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Remedial Investigation Phase 2 Supplemental Work Plan for the Hanford Site 1100-EM-1 Operable Unit

Environmental Engineering Group

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EXECUTIVE SUMMARY

The 1100-EM-1 Phase II remedial investigation work plan details the efforts for final characterization of the 1100-EM-1 Operable Unit that will provide data to be used for the evaluation of remedial operations in the Phase III 1100-EM-1 feasibility study. This work plan conforms with current guidance for remedial investigation and feasibility study activities under the Comprehensive Environmental Response, Compensation, and Liability Act (EPA 1988), and is consistent with the National Oil and Hazardous Substances Pollution Contingency Plan.

The 1100-EM-1 Operable Unit is one of four operable units within the 1100 Area of the Hanford Site, placed on the National Priorities List in July 1989. A Phase I remedial investigation report for the 1100-EM-1 Operable Unit was completed in August 1990, and a Phase I/II feasibility study report was delivered in September 1990.

The Phase I remedial investigation recommended that additional characterization of the 1100-EM-1 Operable Unit should focus on the following:

- 1100-1 (Battery Acid Pit) — The Phase I remedial investigation ground-water sampling results indicated elevated gross-alpha and gross-beta radiation levels in the vicinity of the building (1171 Building) adjacent to the pit.
- 1100-2 (Paint and Solvent Pit) — Tetrachloroethene, although not present in soil samples from the Paint and Solvent Pit, was detected during the Phase I remedial investigation soil gas survey, and also in ground-water samples from a nearby, cross-gradient monitoring well.
- 1100-4 (Antifreeze Tank Site) — The Phase I remedial investigation ground-water sampling results indicated elevated gross-alpha and gross-beta radiation levels in the vicinity of the 1171 Building.
- UN-1100-6 (Discolored Soil Site) — Surface soils at UN-1100-6 are contaminated with bis(2-ethylhexyl)phthalate at levels that may pose a low risk to workers at the operable subunit. The Phase I remedial investigation surface soil sampling also indicated the presence of low concentrations of 1,1,1-trichloroethane.
- Horn Rapids Landfill — Soil sampling during the Phase I remedial investigation detected elevated concentrations of polychlorinated biphenyls at levels of concern. Ground water in the vicinity of the Horn Rapids Landfill also contains elevated levels of nitrate, trichloroethene, and radioactivity that cannot be attributed to the Horn Rapids Landfill with Phase I remedial investigation data.
- Ephemeral Pool — Elevated levels of polychlorinated biphenyls are present in the surface soils of this parking lot runoff basin.

- South Pit — This potential disposal area was identified during the Phase I remedial investigation from historic aerial photographs, and requires characterization for possible Hanford Site related use and contamination.

The Phase II remedial investigation work plan provides a staged process for final characterization of the 1100-EM-1 Operable Unit. This approach is utilized because it is cost effective, and because the Phase I remedial investigation did not indicate the existence of any imminent and substantial endangerment to human health or the environment. A location-specific summary of the level of effort necessary to implement the Phase II remedial investigation, and to provide a draft report to environmental regulatory agencies by July, 1992, is provided below based on the Phase II remedial investigation schedule assumptions. Modification of the scope of work planned may occur as results of characterization efforts become available.

- Operable Unit Wide — An ecological investigation will be conducted focusing on identification of potential ground-water receptors through a well inventory, and further compilation of data regarding land- and water-use plans in the operable unit vicinity.

- 1100-1 (Battery Acid Pit) and 1100-4 (Antifreeze Tank Site) — Archived soil samples from the Phase I remedial investigation will be analyzed for radiation to determine whether these facilities are contributing to ground-water contamination in the vicinity of the 1171 Building.

- 1100-2 (Paint and Solvent Pit) — A single ground-water monitoring well will be installed immediately downgradient from 1100-2 to determine if a plume of tetrachloroethene is migrating from the Paint and Solvent Pit; two additional wells may be needed to delineate any such contamination encountered.

- UN-1100-6 (Discolored Soil Site) — A soil gas survey consisting of approximately nine probe locations, and the installation of one ground-water monitoring well will be used to determine if the ground water at this location is contaminated with 1,1,1-trichloroethane; a soil radiation analysis will be conducted; approximately 15 soil samples will be analyzed to delineate the vertical and areal extent of bis(2-ethylhexyl)phthalate contamination in the soil.

- Horn Rapids Landfill — Soil sampling at approximately eight locations will be conducted to delineate the extent of the polychlorinated biphenyl contamination. Potential ground-water contamination in the landfill vicinity will be characterized through installation of approximately ten ground-water monitoring wells; a single well will be installed for a pump test of the unconfined aquifer; a soil gas survey requiring approximately 75 probe locations will be used to preliminary delineate the ground-water trichloroethene plume; and archived soil samples from the Phase I remedial investigation will be analyzed for radiation. About 35 permanent soil gas probes will be installed to monitor for releases of containerized liquid hazardous wastes potentially buried in the landfill.

- Ephemeral Pool — Up to approximately 24 soil samples will be obtained to delineate the vertical and areal distribution of polychlorinated biphenyls contamination.

- South Pit — The South Pit will be evaluated as a Hanford Site related contaminant source through an information survey, a geophysical survey, and a surface radiation survey. Further soil and ground-water investigation will depend on data obtained from the contaminant source investigation.

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CONTENTS

CONTENTS
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FIGURES

FIGURES
(Continued)

TABLES

ACRONYMS

amsl	above mean sea level
ANF	Advanced Nuclear Fuels Corporation
ARARs	legally applicable, or relevant and appropriate, federal and state environmental standards, requirements, criteria, and limitations
BEHP	bis(2-ethylhexyl)phthalate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CRP	community relations plan
DOE	United States Department of Energy
DOE-RL	United States Department of Energy, Richland Operations Office
DMP	data management plan
DQO	data quality objectives
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FS	feasibility study
FSP	field sampling plan
GAI	Golder Associates Inc.
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NS/EW	north-south/east-west
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PMP	project management plan
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
SVOC	semi-volatile organic compounds
TAL	target analyte list
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TCL	target compound list
TPA	Tri-Party Agreement
TSD	treatment, storage, or disposal
VOA	volatile organic analyses
VOC	volatile organic compound
WHC	Westinghouse Hanford Company

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1.0 INTRODUCTION

The 1100-EM-1 Operable Unit is one of four hazardous substance release project units associated with the 1100 Area of the United States Department of Energy's (DOE's) Hanford Site. In July 1989, the United States Environmental Protection Agency (EPA) placed the 1100 Area, and three other Hanford Site areas, on the National Priorities List (NPL) contained within Appendix B of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR 300). (Note: All regulatory and statutory citations within this work plan refer to the version of the regulation or statute in effect, as amended, on the date of work plan publication.) The EPA took this action pursuant to their authority under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 42 USC 9601 et seq.).

In anticipation of this regulatory action, DOE Richland Operations (DOE-RL) divided the 1100 Area into four operable units and initiated CERCLA response planning for 1100-EM-1—the operable unit assigned the highest priority, within both the 1100 Area and the Hanford Site as a whole, by DOE-RL, EPA, and Washington State Department of Ecology (Ecology).

The DOE-RL, EPA, and Ecology issued the Hanford Federal Facility Agreement and Consent Order, the Tri-Party Agreement (TPA, Ecology et al. 1989a), in May 1989. This agreement, among other things, governs all CERCLA efforts at the Hanford Site. In August 1989, a remedial investigation/feasibility study (RI/FS) work plan for the 1100-EM-1 Operable Unit (DOE-RL 1989) was issued pursuant to the TPA. Upon publication of this work plan, DOE-RL initiated a full-scale effort on the first phase of the 1100-EM-1 RI. The Phase I RI report was submitted to EPA and Ecology for review in August, 1990.

In February 1990, Westinghouse Hanford Company (Westinghouse Hanford or WHC, DOE-RL's Hanford Site operations contractor) issued Task G-90-32, under Westinghouse Hanford Letter Order MDR-SVV-666693, to Golder Associates Inc. (GAI). This task, and subsequent tasks, authorized GAI to develop the Phase II RI supplemental work plan contained herein.

1.1 PURPOSE OF WORK PLAN

The purpose of the 1100-EM-1 Phase II RI is to gather and develop a sufficient amount of the necessary information required to complete the development and analysis of operable unit remedial alternatives during the FS. The remedial alternatives analysis will, in turn, be used by the TPA signatories to make a risk-management-based selection of a remedy for the releases of hazardous substances from the operable unit.

In accordance with the TPA, the 1100-EM-1 RI/FS is being conducted in a concurrent, interactively phased manner. The data collected and evaluated during Phase I RI activities provided information for a preliminary analysis of remedial alternatives in the FS, and the Phase I RI findings and the preliminary FS analyses provided a focus for further RI activities. The goal of the Phase II RI is to further, to the degree necessary to complete the FS, the understanding of the nature and extent of the threat to human health and the environment posed by releases of hazardous substances from the 1100-EM-1 Operable Unit.

The purpose of this work plan is to document the Phase II RI tasks established to achieve this goal.

1.2 ORGANIZATION OF WORK PLAN

The work plan for the 1100-EM-1 Operable Unit Phase II RI conforms with current guidance for RI/FS activities under CERCLA (EPA 1988), and is consistent with the NCP. It has been completed with current knowledge of conditions at the operable unit, but may require modifications as additional information becomes available and a better understanding of operable unit conditions is attained.

In order that it may remain focused on changing project demands, and accommodate the specific decision points built into the investigation, the work plan will be periodically revised and updated through format change control procedures. These procedures are outlined in Section 1.3 of the Quality Assurance Project Plan (QAPP) (see Appendix A).

Five chapters, in addition to this introduction, are included in this work plan. Chapter 2 presents the Phase I RI summary and conclusions. It summarizes the existing data, environmental setting, and contaminant transport and exposure pathways to develop a conceptional model for the 1100-EM-1 Operable Unit. Chapter 3 provides the rationale and objectives for the Phase II RI activities. Chapter 4 presents the tasks necessary to conduct the Phase II RI.

A project schedule is presented in Chapter 5. Modifications to the schedule may need to be made as information is obtained during project implementation. Chapter 6 provides references for literature cited in the work plan. There is one appendix to this work plan, Appendix A - Quality Assurance Project Plan (QAPP).

The elements of a field sampling plan (FSP) are provided throughout the work plan, as such, a separate FSP is not provided. A FSP normally consists of the following six elements: site backgrounds; sampling objectives, sample location and frequency, sample designation, sampling equipment and procedures, and sample handling and analysis. Operable unit background is addressed in Chapter 2 of the work plan. Sampling objectives and sample location and frequency information is provided within field task descriptions in Chapter 4. Sample designation, sampling equipment and procedures, and sample handling and analysis information is discussed in the QAPP. Incorporating the FSP elements in the work plan eliminates redundancy and results in a more compact plan of greater utility.

2.0 PHASE I RI SUMMARY AND CONCLUSIONS

An RI, by its very nature, is a complex, multiple-objective phase of an important regulatory process. It demands the use of a multi-disciplinary investigational approach to define the nature and extent of any threats to human health and the environment posed by releases of contaminants from a site, and any other information needed to support an evaluation of remedial alternatives during the FS phase of the project.

In this section, a summary of the findings of the initial phase of this process for the 1100-EM-1 Operable Unit is presented. This summary is presented below in terms of the physical characteristics (Section 2.1), the nature and extent of contamination (Section 2.2), the environmental fate and transport of operable unit contaminants (Section 2.3), and the risks posed to human health and the environment by the contaminants released from the operable unit (Section 2.4). Detailed discussions on these topics are provided in the Phase I RI report (DOE-RL 1990).

2.1 PHYSICAL CHARACTERISTICS

The 1100 Area, the central warehousing, vehicle maintenance, and transportation operations center for the Hanford Site, was designated an NPL site in July 1989. This NPL site was divided into four operable units, and the first equipment maintenance operable unit, 1100-EM-1, was assigned the highest priority. A detailed presentation of the regional and local aspects of the physical characteristics of the operable unit is in DOE-RL 1990-0X. The following summary focuses on the major issues related to contaminant sources, meteorology, surface hydrology, geology, pedology, hydrogeology, and ecology.

The 1100-EM-1 Phase I RI report (DOE-RL 1990) recommended further investigation at six waste management units assigned or within the operable unit. Given their distinct geographical separation from one another, these facilities, shown in Figure 2-1, are regarded as operable subunits, and are briefly described below:

- 1100-1 (Battery Acid Pit)—an unlined dry sump, or french drain, used for the disposal of waste acid from vehicle batteries
- 1100-2 (Paint and Solvent Pit)—a former sand and gravel pit subsequently used for the disposal of construction debris and, reportedly, waste paints, thinners, and solvents
- 1100-4 (Antifreeze Tank Site)—the site of a former underground storage tank used for the disposal of waste vehicle antifreeze
- UN-1100-6 (Discolored Soil Site)—the location of an apparent disposal event onto the ground surface involving a container of organic waste liquids
- Horn Rapids Landfill—a solid waste facility used primarily for the disposal of office and construction waste and the burning of classified documents; asbestos, sewage sludge, fly ash, and, potentially, drums of unidentified organic liquids were also disposed at this location

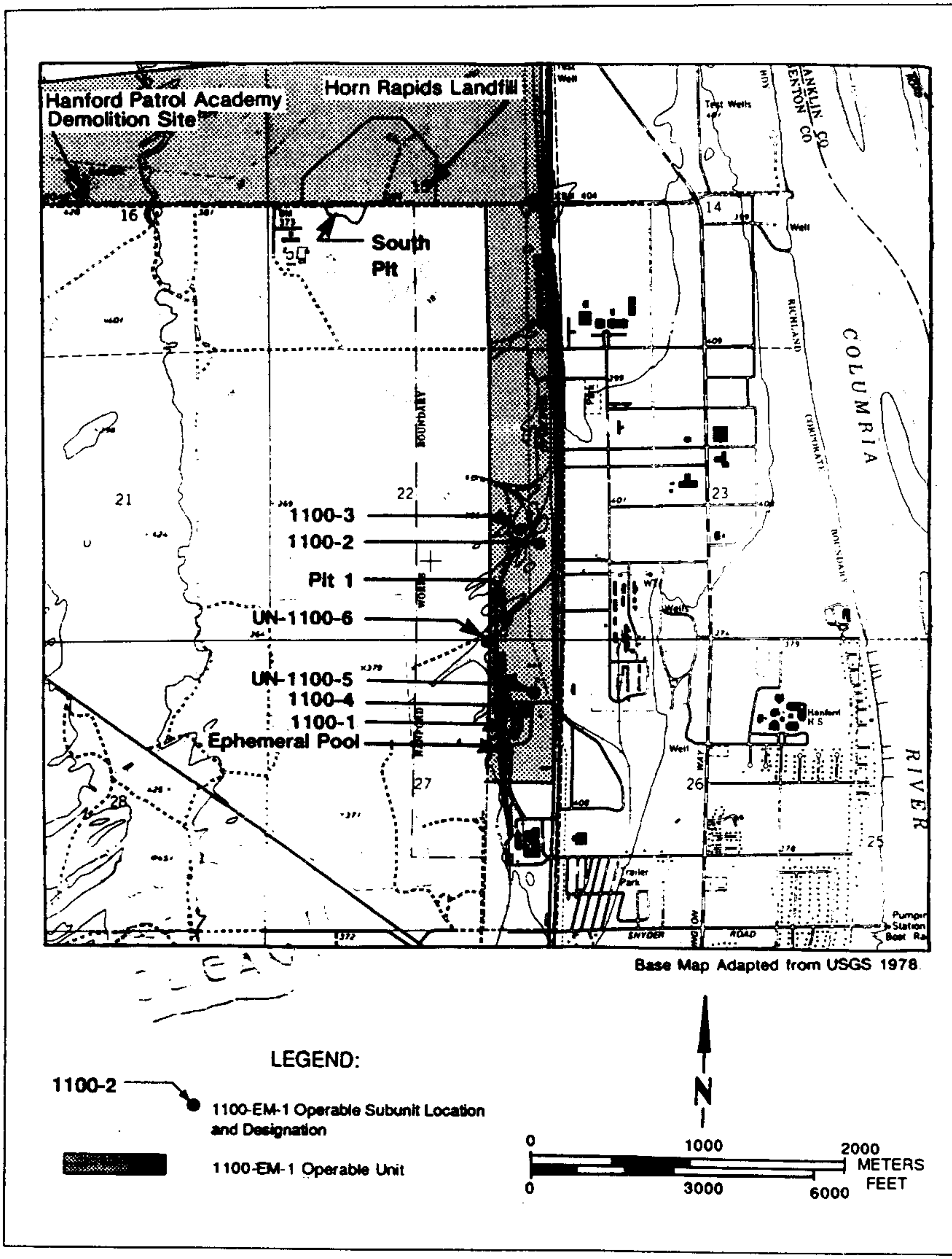

Figure 2-1. 1100-EM-1 Operable Unit.

- Ephemeral Pool—the location of 1100 Area parking lot runoff accumulation during infrequent, high-intensity precipitation events.

Three waste management units and one miscellaneous location are not considered for additional work during the Phase II RI (see Figure 2-1): 1100-3 Antifreeze and Degreaser Pit, UN-1100-5 Radiation Contamination Incident, Hanford Patrol Academy Demolition Site, and Pit 1. The 1100-3 operable subunit was considered to pose no significant contamination problems after evaluation of Phase I data collection activities. The UN-1100-5 operable subunit was considered to pose no significant contamination problem; no radioactivity was found on the 1100 Area parking lot surface, and enough time has elapsed since the release such that the radioisotopes involved are virtually completely decayed. For the purposes of this report, the Hanford Patrol Academy Demolition Site was not regarded as part of the 1100-EM-1 Operable Unit. This waste management unit is a TSD (Treatment, Storage, Disposal) facility that, if necessary, will be addressed separately under Ecology's Resource Conservation and Recovery Act (RCRA) authority. Pit 1 was not considered to pose any significant contamination problem based on the evaluation of the samples collected during the Phase I RI.

There are several other waste management facilities in the vicinity of the 1100-EM-1 Operable Unit. These include two of the remaining three operable units that comprise the 1100 Area NPL Site (the 1100-EM-2 and 1100-EM-3 Operable Units), a potato processing plant, a private nuclear fuel manufacturing facility, the Hanford Site nuclear fuel fabrication and research and development complex (the 300 Area), and the Richland Municipal Landfill. Historical aerial photographs (EPA 1990) indicate surface disturbances south of the Horn Rapids Landfill. This area of disturbance may have been used for waste disposal and is referred to as the South Pit (see Figure 2-1).

The 1100-EM-1 Operable Unit is situated within an area possessing a relatively moderate semiarid climate characterized by low precipitation, high evapotranspiration, and light winds. No significant surface water bodies are located within or immediately adjacent to the operable unit, as the topography is relatively flat and the precipitation, combined with high evapotranspiration potential, provides little water to generate runoff; however, the Columbia River, an important regional surface water resource, is located approximately 1.5 to 1.8 km (0.9 to 1.1 mi) to the east of the operable unit.

The operable unit is underlain by massive basalt flows that form the regional bedrock. The uppermost basalt flow in the area of the 1100-EM-1 Operable Unit is the Ice Harbor Member of the Saddle Mountains Basalt Formation. Overlying the bedrock is the Ringold Formation, an approximately 43- to 52-m (142- to 170-ft) thick deposit of mixed sediments of fluvial and lacustrine origin. The upper portion of this formation consists of sandy gravels, gravelly sands, silty sandy gravels, and silty gravelly sands, with discontinuous sand lenses. These coarse-grained sediments are underlain by finer-grained silts, clays, sandy silts, and sands. Based on published well logs, the lower portion of the Ringold Formation consists of silts, clays, gravels, gravelly sands, sands, and silty sands.

Above the Ringold Formation is the Hanford formation, the dominant facies of which is the Pasco gravels, a variable mixture of boulders, cobbles, pebbles, sands, and silts of glaciofluvial origin. Most of this formation, which is approximately 8- to 17-m (25- to 56-ft) thick at the operable unit, can be classified as unconsolidated basaltic sandy gravels to gravelly sands and silty sandy gravels. Eolian deposits form a thin veneer (< 0.3-m to 6-m

[1- to 20-ft] thick) over the Hanford formation in the area of the operable unit. These deposits consist of moderately-to-well-sorted, very-fine-to-medium-grained sands or silty sands that were originally derived from the Hanford formation.

The soils of the operable unit are primarily classified as regosols, and are largely dominated by the characteristics of the parent materials from which they are derived. The moisture content of these soils ranges from 1 to 7%, and the soils contain only low amounts of organic matter.

An unconfined water-table aquifer, underlain by a silt aquitard, occurs below the operable unit. The aquitard, which was observed throughout the operable unit vicinity, separates the unconfined aquifer from lower confined to semi-confined aquifers. Regionally, the zone of recharge to the unconfined aquifer is located to the west of the operable unit, and the aquifer discharges to the east, in the Columbia River. Local ground-water flow, as measured in early March and late May of 1990, is easterly below most of the operable unit, but northeasterly in the vicinity of the Horn Rapids Landfill. The easterly flow in the southern portion of the operable unit indicates that ground water passing beneath most of the operable subunits could pass through the City of Richland well field, which is located between the operable unit and the Columbia River.

This well field supplements the city's river-derived water supply during times of peak use; however, essentially all water obtained from the field is river water derived from large infiltration ponds around which the withdrawal wells are sited. When in use, large-volume infiltration creates a mound that diverts the regional ground-water flow around the field.

With the exception of the 1100 Area, the entire Hanford Site within Benton County is zoned for restricted uses that are subject to federal government approval. Approximately 45% of the Hanford Site is currently set aside as either wildlife or ecological reserves.

All land encompassing the 1100-EM-1 Operable Unit is currently zoned for either industrial or restricted land use. Adjacent lands are zoned for industrial and commercial use; however, agricultural use is currently being allowed in a heavy-manufacturing-use zone to the west of the operable unit and a medium-industrial-use zone to the east. The nearest agricultural-use zones are about 1.8 km (1.1 mi) to the west of the operable unit, and the closest residential zone is approximately 0.8 km (0.5 mi) to the southeast of the 1100-1 Battery Acid Pit. County and city land-use plans and 1100 Area construction plans indicate that no significant changes in local land use are envisioned.

The Columbia River is the most significant surface-water body in the region. It serves as a source of drinking, industrial process, and irrigation water, and is used for various recreational activities. Ground water in the vicinity of the operable unit is used primarily for environmental monitoring, irrigation, and limited domestic use; all residential areas in the vicinity have access to the city water supply. As mentioned earlier, ground water derived from infiltrated river water is used to supplement the City of Richland water supply during times of peak seasonal demand.

No cultural resources, of either an archeological or historical significance, are located within the 1100-EM-1 Operable Unit.

The operable unit is located in a shrub-steppe vegetational zone characterized by the presence of a sagebrush/bunchgrass plant community in undisturbed areas and a cheatgrass/rabbitbrush/tumbleweed community in areas disturbed by human activities, such as the operable unit. No endangered, threatened, or sensitive plant species or communities are known to inhabit the operable unit vicinity.

The most abundant fauna apparent in the region are the grasshopper, horned lark, western meadowlark, Great Basin pocket mouse, cottontail rabbit, jackrabbit, various raptor species, coyote, and mule deer. The primary animal species of interest that inhabit the operable unit vicinity are the mule deer and two sensitive birds, the Swainson's hawk and the long-billed curlew.

No aquatic ecosystems are located on or adjacent to the operable unit; however, the Columbia River, while not supporting any endangered or threatened aquatic species, does support important populations of game fish, including various species of anadromous salmonids.

2.2 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination at the 1100-EM-1 Operable Unit are summarized below by the environmental media characterized during Phase I RI field activities: contaminant sources, air, soil, and ground water. A detailed presentation of the nature and extent of operable unit contamination is found in the Phase I RI report (DOE-RL 1990).

2.2.1 Contaminant Sources

The six operable subunits of interest were evaluated in detail with respect to their potential as primary or secondary sources of significant environmental contamination at the 1100-EM-1 Operable Unit. These subunits are: the 1100-1 Battery Acid Pit, the 1100-2 Paint and Solvent Pit, the 1100-4 Antifreeze Tank Site, the UN-1100-6 Discolored Soil Site, the Horn Rapids Landfill, and the Ephemeral Pool. Each subunit is briefly described in Section 2.1, above. Three other waste management units and a miscellaneous location, 1100-3, UN-1100-5, Hanford Patrol Academy Demolition Site, and Pit 1, are not given further detailed consideration in the Phase II RI for reasons specified in Section 2.1.

The original waste streams associated with each of the six operable subunits considered in this plan are no longer in existence. Therefore, the soils of these subunits are regarded as existing secondary sources of contamination. Soil contamination is summarized in Section 2.2.3 below.

Surface radiation surveys were conducted at each of the operable subunits, with the exception of UN-1100-6, and the Ephemeral Pool; the results of all such surveys were negative—no measurable radioactivity was encountered. Soil gas surveys were conducted at the 1100-1, 1100-2, and Horn Rapids Landfill operable subunits. Tetrachloroethene (PCE) was encountered within the soil gas of 1100-2 and the Horn Rapids Landfill, and trichloroethene (TCE) and 1,1,1-trichloroethane (TCA) were also found at the landfill.

Of the other nearby waste management facilities mentioned in Section 2.1, one—the Advanced Nuclear Fuels Corporation (ANF) complex—is known to have contributed significant levels of contamination to operable unit ground waters in the vicinity of the Horn Rapids Landfill. Contaminants known to have emanated from this facility are nitrate, fluoride, sulfate, ammonia, and gross-alpha and gross-beta radiation.

2.2.2 Air Contamination

One round of ambient air monitoring data was available for operable unit characterization; a second round of monitoring was conducted to assess potential occupational impacts during RI activities. The quantity and quality of these data are such that their utility is questionable; however, no indications of substantial deterioration of ambient air quality in the vicinity of the operable unit were found under the moderate wind conditions present at the time the monitoring was conducted.

2.2.3 Soil Contamination

Soils were sampled at each operable subunit, and analyzed for Target Analyte List (TAL) and Target Compound List (TCL) parameters. In addition, samples obtained from the 1100-4 subunit were analyzed for ethylene glycol, and certain samples from the Horn Rapids Landfill were analyzed for asbestos fibers. Results were compared to operable-unit-specific background concentrations to determine the contaminants present, and preliminary conservative toxicity screening was performed to determine contaminants of potential concern. Surface soils are conservatively considered to be those lying within 0.6 m (2 ft) of the ground surface. The findings for each subunit are summarized below:

- 1100-1 (Battery Acid Pit)—arsenic is the only contaminant of potential concern, encountered in the subsurface stratum in one sample at a concentration barely exceeding background levels

- 1100-2 (Paint and Solvent Pit)—chromium is the only soil column contaminant of potential concern, encountered in a single surface sample at a concentration not greatly in excess of background. In fact, the mean surface chromium concentration at 1100-2 is lower than the mean background concentration; PCE was encountered during the soil gas survey conducted under the source investigation (see Section 2.2.1)

- 1100-4 (Antifreeze Tank Site)—the surface stratum of the soil column was not sampled at this subunit, but a concrete floor prevents direct contact with surface soils at this location; arsenic was found at elevated levels of potential concern, but only in a single sample obtained from below the water table

- UN-1100-6 (Discolored Soil Site)—only surface soils were sampled and analyzed at this subunit; the two contaminants of potential concern identified are bis(2-ethylhexyl)phthalate (BEHP) and chlordane; BEHP is present in percentage concentrations, and the distribution of the chlordane contamination is spatially correlated with the BEHP contamination

- Horn Rapids Landfill—both surface and subsurface soils were sampled and analyzed, but the subsurface sampling intentionally avoided areas of known and suspected waste deposition; the soil column contaminants of potential concern are polychlorinated biphenyls (PCB), chromium, and arsenic. PCB was detected at levels of potential concern at three surface and one subsurface location; arsenic was encountered at levels of potential concern at one surface and two subsurface locations; chromium is more widely distributed, being found in 11 surface and eight subsurface locations at levels of potential concern; and TCE, PCE, and TCA were encountered in the gaseous phase of the landfill soils during the soil gas survey conducted for this subunit

- Ephemeral pool—two surface soil samples were obtained at this location; two contaminants of potential concern, PCB and chlordane, are identified—chlordane was found in both samples, and PCB in only one.

2.2.4 Ground-Water Contamination

Twenty-nine monitoring wells throughout the 1100-EM-1 Operable Unit vicinity, and two distribution lines from the nearby City of Richland well field, were sampled during the Phase I RI field activities. Twenty-one wells were sampled in the first round of monitoring, and 29 in the second round. The well field distribution lines were sampled in both monitoring rounds.

The samples obtained were analyzed for conventional, TAL, and TCL parameters. Results were compared to operable-unit- or Horn Rapids Landfill-specific background concentrations, as appropriate, to determine the contaminants present. The determination of landfill-specific background was necessary due to the presence of the reported, upgradient ANF plume. Preliminary conservative toxicity screening was performed to determine contaminants of potential concern.

The only operable unit ground-water contaminant of potential concern identified, PCE, is present in a single well near the 1100-2 Paint and Solvent Pit; however, available data are currently insufficient to understand the magnitude and extent of this contamination.

Although existing data do not suggest operable unit sources, two other areas of ground-water contamination are present within the vicinity of the 1100-EM-1 Operable Unit. One is an area of generally deteriorated ground-water quality in the vicinity of the 1171 Building that contains elevated concentrations of several contaminant parameters, including gross-alpha radiation at levels that may be of interest.

The other ground-water contaminants appear to form a plume that originated upgradient from, and is passing beneath, the Horn Rapids Landfill. This plume is characterized primarily by the presence of high concentrations of TCE and nitrate, which, along with the operable unit contaminants of concern, are regarded as contaminants of interest.

2.3 CONTAMINANT FATE AND TRANSPORT

The contaminant fate characteristics of nine contaminants of interest—arsenic, BEHP, chlordane, chromium, nitrate, PCB, PCE, TCA, and TCE—are discussed in the Phase I RI report (DOE-RL 1990). These contaminants include the operable unit contaminants of potential concern and TCE and nitrate, the two ground-water contaminants that characterize what appears to be a plume of upgradient origin with respect to the Horn Rapids Landfill. Potentially operative contaminant transport pathways for the operable unit are qualitatively identified and quantitatively evaluated, where feasible, in the Phase I RI report (DOE-RL 1990).

The relevant, potentially operative contaminant transport pathways for the 1100-EM-1 Operable Unit evaluated in the Phase I RI report were:

- Volatile emissions and atmospheric dispersion—PCE from 1100-2; TCE, PCE, and TCA from the Horn Rapids Landfill

- Fugitive dust emissions and atmospheric dispersion—BEHP from UN-1100-6; arsenic, chromium, and PCB from the Horn Rapids Landfill

- Direct contact of surface contamination—arsenic and chromium at 1100-3; BEHP and chlordane at UN-1100-6; arsenic, chromium, and PCB at the Horn Rapids Landfill; PCB and chlordane at the ephemeral pool

- Vadose-zone transport—considered to be insignificant

- Ground-water transport—TCE and nitrate in the vicinity of the Horn Rapids Landfill; available data are currently insufficient to evaluate PCE contamination associated with 1100-2

- Surface-water transport—PCE, TCE, and nitrate in the Columbia River from contaminated ground-water discharge

- Terrestrial biological transport—arsenic, chromium, and PCB to humans through mule deer, and to Swainson's hawks and long-billed curlews, at the Horn Rapids Landfill

- Aquatic biological transport—PCE, TCE, and nitrate uptake by fish in the Columbia River.

2.4 RISKS TO HUMAN HEALTH AND THE ENVIRONMENT

Section 6 of the Phase I RI (DOE-RL 1990) provides a detailed assessment of the baseline risks, under current land- and water-use conditions, posed to human health and the environment by contaminant releases from and near the 1100-EM-1 Operable Unit. Brief summaries of the human and environmental portions of this assessment are respectively provided in Sections 2.4.1 and 2.4.2 below.

2.4.1 Human Health Risks

Of the nine contaminants of interest at and near the 1100-EM-1 Operable Unit, none alone, on the basis of an assessment of a hypothetically most exposed individual, were shown to pose a significant threat to human health under current land- and water-use conditions. The overall risk associated with systemic toxicity is negligible and the overall risk associated with carcinogenicity is approximately 2E-06. These cumulative risks include not only all identified operable unit contaminants of potential concern, but also TCE and nitrate associated with an apparent ground-water plume of upgradient origin with respect to the Horn Rapids Landfill.

Approximately 90% of the overall cancer risk to the most exposed individual were attributed to two operable unit contaminants of concern, BEHP and PCB. The risk assessment indicated that the human population at risk for adverse effects of these two contaminants consists of workers having direct access to and job duties on the UN-1100-6 Discolored Soil Site, the Horn Rapids Landfill, and the Ephemeral Pool.

The BEHP poses a problem at the UN-1100-6 operable subunit, where it is present in surface soils in percentage concentrations. Ingestion and inhalation of these soils may increase cancer risks by about E-06. The Ephemeral Pool and the Horn Rapids Landfill have surficial PCB soil contamination. The ingestion and inhalation of contaminated soils at both facilities and the consumption of venison potentially contaminated by the landfill may also increase cancer risks by about E-06.

Exposure to contaminated ground water downgradient of the 1100-2 operable subunit, or in the vicinities of the 1171 Building and the Horn Rapids Landfill, although dismissed as an operative pathway under existing land- and water-use conditions, could pose a human health hazard. Depending upon where a withdrawal well might be sited and how it may be used, a significantly increased cancer risk could be associated with PCE and TCE ingestion and inhalation, and a systemic toxic hazard could be posed by the ingestion of nitrate-contaminated ground water. Insufficient data exist to determine whether ingestion of gross-alpha radiation could pose a significant risk.

The PCE is associated with the 1100-2 Paint and Solvent Pit, and the TCE and nitrate are associated with a plume in the vicinity of the Horn Rapids Landfill; however, existing ground-water data are not sufficient to prove the landfill, and thus the operable unit, to be the source of the latter two contaminants. The gross-alpha radiation appears to be associated with the 1171 Building. Existing data are also insufficient to prove an operable unit source of this contamination.

2.4.2 Environmental Risks

Two sensitive bird species known to inhabit the Horn Rapids Landfill vicinity, the Swainson's hawk and the long-billed curlew, were selected as indicator species for the terrestrial environmental evaluation. Arsenic, chromium, and PCB, due to their presence in landfill surface soils, were the contaminants of potential concern for these species.

There is no evidence to support a conclusion of adverse contaminant impacts to the Swainson's hawks known to inhabit the landfill vicinity. A potential for such impacts, especially due to chromium, to the long-billed curlews that nest within and adjacent to the landfill can not be ruled out; however, the evaluation presented for this sensitive terrestrial community was simplistic and far from certain. The annual reoccurrence of both migratory species suggests that they are successfully reproducing. Putting the operable unit contamination problems into perspective, normal human activities (e.g., clearing, construction, facility operations, pesticide application, and off-road vehicle use) probably pose the greater threat to both species and most other terrestrial organisms.

An environmental evaluation was also performed for the aquatic community of the Columbia River. Tetrachloroethene, derived from the discharge of 1100-2 vicinity ground waters to the river, was the contaminant of potential concern for this community. TCE and nitrate, derived from the discharge of Horn Rapids Landfill vicinity ground waters to the river, are additional contaminants of interest.

As nitrate is a readily assimilated essential nutrient for aquatic plants, and the levels that could be contributed to the river are insignificant, it should pose no risk to aquatic life. The comparison of a conservatively biased prediction of TCE concentrations in the Columbia River indicated, with a fair degree of certainty, that no adverse impacts to aquatic communities will occur. Operable unit characterization data are currently insufficient to allow for a quantitative evaluation of potential PCE impacts, but by analogy, it is unlikely that any adverse impact to aquatic life will occur.

3.0 WORK PLAN RATIONALE

The Phase I RI report (DOE-RL 1990) provides a focused conceptual understanding of the 1100-EM-1 Operable Unit. Based on such an understanding, the report concludes with recommendations for further RI activities. These recommendations have been refined to develop the work scope for the Phase II RI.

In accordance with the TPA, the Phase II RI work scope was developed consistent with EPA's data quality objectives (DQO) process (EPA 1987a and 1987b), as modified for the Hanford Site (McCain and Johnson 1990). This process is briefly described in Section 3.1, and the approach to conducting the Phase II RI for the 1100-EM-1 Operable Unit is outlined in a series of logic diagrams in Section 3.2.

3.1 DATA QUALITY OBJECTIVES PROCESS

The work scope for the 1100-EM-1 Operable Unit Phase II RI was developed consistent with EPA's DQO development process (EPA 1987a), as modified for Hanford Site applications by McCain and Johnson (1990). The EPA (1987b) explicitly states that they do not require specific DQO deliverables during the remedial response process. The manner in which the three-stage DQO process was used is briefly outlined below to provide an understanding of the logic behind the development of this work plan. The three stages are decision types identification (Section 3.1.1), data uses and needs identification (Section 3.1.2), and data collection program design (Section 3.1.3).

3.1.1 Stage 1—Identification of Decision Types

The first stage of the DQO process is the identification of decision types. There are four steps within this stage: (1) the identification and involvement of data users; (2) the evaluation of available data; (3) the development of an operable unit conceptual model; and (4) the specification of project objectives and decisions.

Identification and involvement of data users has been arranged on a programmatic basis for all Hanford Site environmental restoration activities through the TPA and associated program plans. On the project level, primary data users maintain close involvement in the DQO process through the opportunity to review and comment on project plans and reports.

The Phase I RI report for 1100-EM-1 provides a thorough interim evaluation of available data and presents these data in such a manner as to provide for a conceptual understanding of the operable unit. The final activity of the Stage 1 DQO process, the specification of project objectives and decisions for the Phase II RI, is documented by means of logic diagrams and brief objectives statements in Section 3.2 (Work Plan Approach); further details are provided in Chapter 4.0 (Phase II RI Tasks) and the accompanying QAPP (see Appendix A).

3.1.2 Stage 2—Identification of Data Uses and Needs

The second stage of the DQO process consists of the identification of data uses and needs. This stage can be viewed as occurring in six steps: (1) the identification of data uses; (2) the identification of data types; (3) the identification of data quality needs; (4) the identification of data quantity needs; (5) the evaluation of sampling and analysis options; and (6) the review of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters.

Each Phase II RI task and its component activities were developed to provide data for a specific project use. Concise objectives statements are provided within this work plan to document the justification for each task and activity. Objectives statements in Section 3.2 are general in nature, while those presented on a task- or activity-specific basis in Chapter 4.0 are more focused. Objectives statements are also provided in the accompanying QAPP (Appendix A).

The identification of data types required in the Phase II RI evolved from the identification of project-specific data gaps upon review of the Phase I RI report (DOE-RL 1990). The scope of work presented in this plan was specifically developed to eliminate, to the extent practicable, such identified data gaps to a degree sufficient to allow the completion of the ongoing FS.

Data quality needs were identified upon consideration of integrated factors such as prioritized data uses, appropriate analytical levels, contaminants of concern (and those of potential concern or interest), contaminant levels of concern, analytical detection limits, and critical sample locations. The Phase II RI approach laid out in Section 3.2, and the required tasks presented and described in Chapter 4.0 and scheduled in Chapter 5.0, are organized such that data will be collected in an efficient and cost-effective manner that will provide information for high priority overall project needs. Analytical methods and investigational techniques were selected within appropriate analytical levels (e.g., screening methodologies versus standard methodologies), in accordance with McCain and Johnson (1990), to help maximize the efficiency and cost effectiveness of the Phase II RI. The second phase of the operable unit investigation was designed to focus on those contaminants of either concern, potential concern, or interest that were identified in the Phase I RI report (DOE-RL 1990). On the basis of the baseline risk assessment and the contaminant levels of concern presented in the Phase I RI report, analytical methodologies were selected, to the extent technically feasible, to provide detection limits low enough to allow for useful refinement of risk evaluations. Finally, Chapter 4.0 sets forth means to provide for the characterization of critical locations and operable unit conditions (e.g., to define the extent of significant environmental contamination attributable to 1100-EM-1, and to better define background conditions).

Due to uncertainties in regard to the extent of contamination in various environmental media, it is impossible to identify data quantity needs exactly. This problem is addressed by means of a staged approach to the Phase II RI. Data will be collected, analyzed, and evaluated in stages so that all involved parties can participate in deciding when the extent of contamination is well enough defined to allow FS completion.

Sampling and analysis options were evaluated in accordance with McCain and Johnson (1990). Selections were made on the basis of the data quality needs outlined above, and the applicability of relevant PARCC parameters, which are documented in the QAPP (see Appendix A).

3.1.3 Stage 3—Design of Data Collection Program

The third and final stage of the DQO process consists of the design of a data collection program. Chapter 4.0 of this work plan presents such a data collection program in detail. The associated QAPP in Appendix A, and other Hanford Site program and 1100-EM-1 project plans incorporated into this plan by reference, provide the mechanism by which the data collection program for the second phase of the 1100-EM-1 RI will be implemented, controlled, and documented.

3.2 WORK PLAN APPROACH

The Phase II RI will include the following integrated, subcomponent data collection tasks:

- Contaminant source investigation
- Pedological investigation
- Hydrogeological investigation
- Ecological investigation
- Geodetic control.

All or some of these tasks, as appropriate, will be conducted at each location in the operable unit. Figure 3-1 shows the investigational tasks as planned for seven separate locations and operable-unit-wide tasks. Question marks are used in Figure 3-1 to show where decision points occur. Tasks in locations with question marks may not be necessary, pending results from preceeding tasks. Each location is briefly discussed in the following subsections.

3.2.1 Operable-Unit-Wide Tasks

The two tasks that are operable-unit-wide in nature are shown in a logic diagram in Figure 3-2. The tasks include an ecological investigation and geodetic control. Activities to be performed during the ecological investigation are:

- A land- and water-use assessment to compile and refine projections for 1100-EM-1 Operable Unit vicinity

- A well inventory to refine the information gathered during the Phase I RI.

Geodetic control will be performed at all sampling points established for the Phase II RI to document locational data.

Location

Phase II RI Investigation Tasks	Operable-Unit-Wide	1100-1	1100-2	1100-4	UN-1100-6	Horn Rapids Landfill	Ephemeral Pool	South Pit
Contaminant Source Investigation								
Source data compilation								●
Geophysical survey								●
Soil gas survey					●	●		●
Surface radiation survey					●			●
Radiation analysis		●		●	●	●		
Pedological investigation					●	●	●	?
Hydrogeological Investigation								
Soil gas survey					?	?		?
Monitoring well installation		?	●	?	?	?		?
Sampling and analysis		?	●	?	?	?		?
Aquifer testing						?		
Ecological Investigation								
Land- and water-use assessment	●							
Well inventory	●							
Geodetic Control	●							

LEGEND:

● Planned task

? Contingent on results of preceeding tasks

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Figure 3-1. Phase II RI Investigation Tasks.

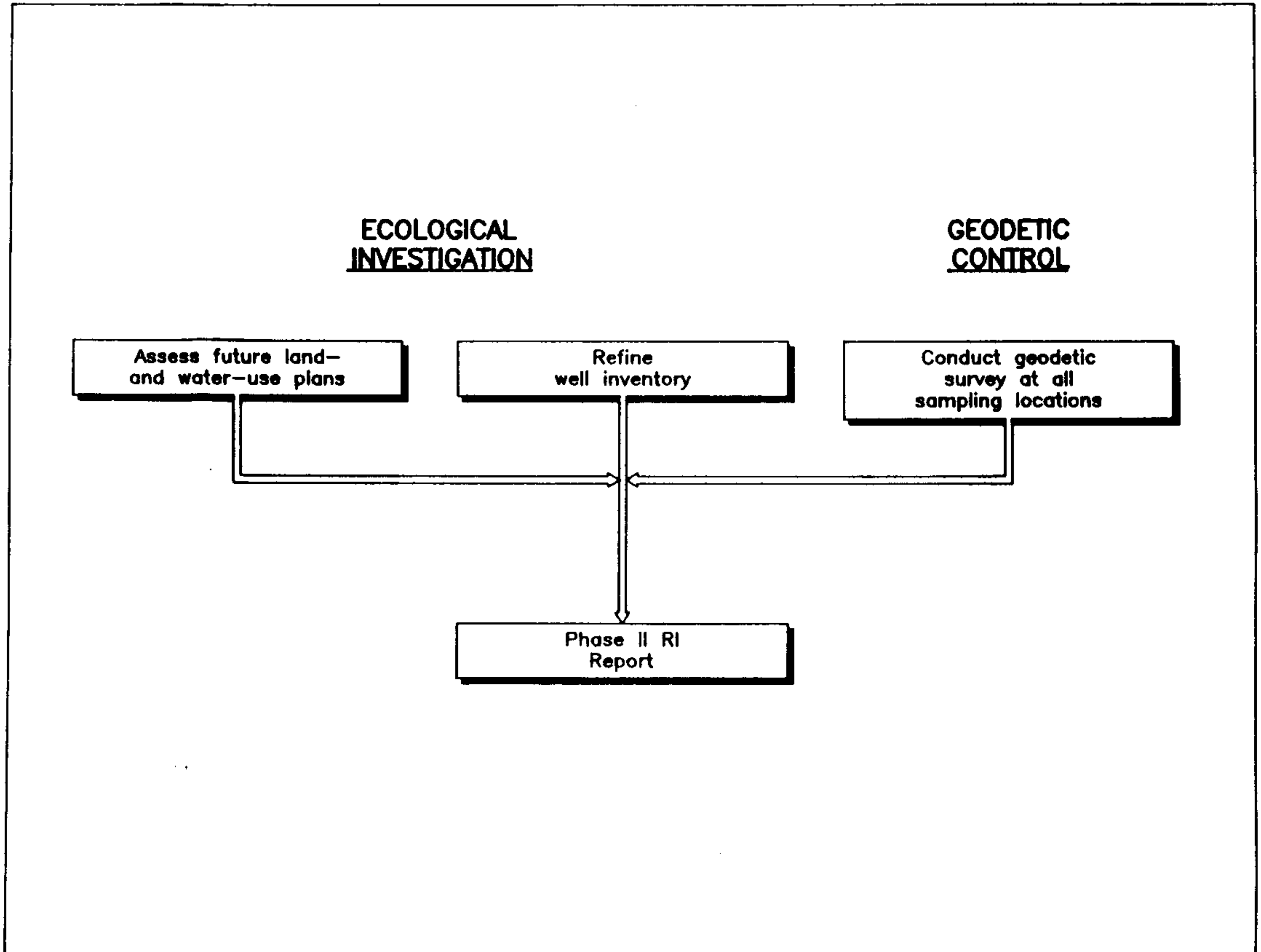

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Figure 3-2. Operable-Unit-Wide Ecological Investigation and Geodetic Control.

3.2.2 1100-1 and 1100-4 Tasks

Figure 3-3 is a logic diagram for further investigation of the 1100-1 Battery Acid Pit and the 1100-4 Antifreeze Tank Site. The tasks planned for 1100-1 and 1100-4 are a contaminant source investigation and a hydrogeological investigation. The activity planned under source investigation is a radiation analysis of archived soils samples to determine if 1100-1 or 1100-4 are sources of the ground water contamination around the 1171 Building.

If the results of the contaminant source investigation indicate 1100-1 or 1100-4 to be potential sources of the contaminated ground water in the 1171 Building vicinity, the activities planned for the subsequent hydrogeological investigation consist of a staged monitoring well installation, sampling, and analysis to delineate the ground-water contamination attributable to the operable unit source(s).

If neither the 1100-1 nor the 1100-4 operable subunits are found to be sources of low-level radioactivity in the 1171 Building vicinity ground waters, the characterization of this potential problem will be deferred to the 1100-EM-2 Operable Unit RI. This operable unit consists primarily of waste management units located within or near the 1171 Building (DOE-RL 1990).

3.2.3 1100-2 Tasks

The one task planned for the 1100-2 Paint and Solvent Pit is shown in a logic diagram in Figure 3-4. The activities planned for this task are a staged monitoring well installation, sampling, and analysis to delineate the ground-water contamination attributable to the 1100-2 operable subunit.

3.2.4 UN-1100-6 Tasks

Three tasks, shown in a logic diagram in Figure 3-5, are planned for the UN-1100-6 Discolored Soil Site: a contaminant source, a pedological, and a hydrogeologic investigation. The activities planned for the contaminant source investigation are:

- A soil gas survey to determine if a source of volatile organic compounds (VOCs) (e.g., TCA) is present at the subunit

- A surface radiation survey to determine if the subunit is contributing to the low-level radiation contamination in the 1171 Building vicinity.

The activities planned for the pedological investigation are:

- Lateral and vertical soil sampling to delineate the BEHP contamination

- Radiation analysis of soil samples obtained at depth during the BEHP delineation to supplement the surface radiation survey

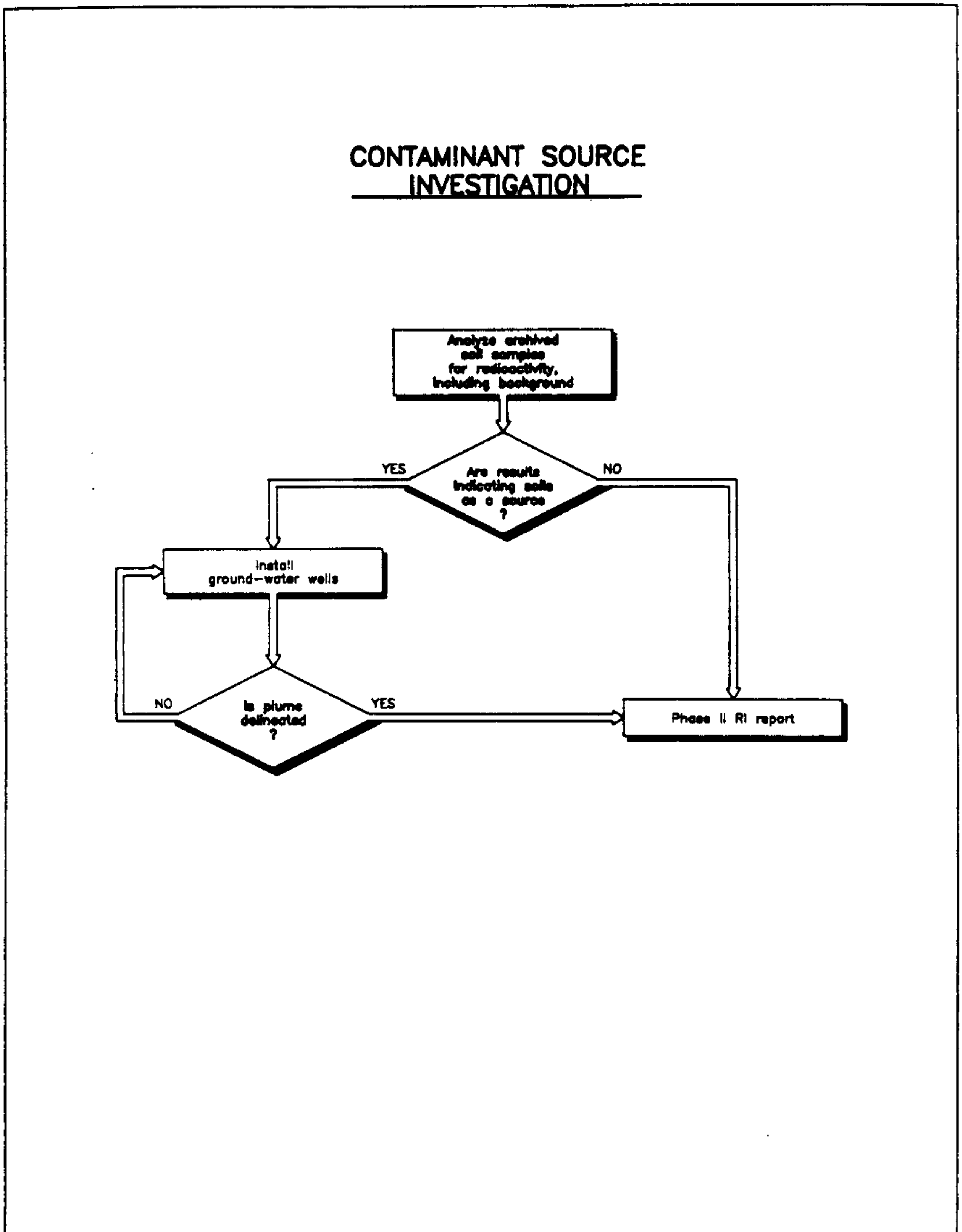

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Figure 3-3. 1100-1 and 1100-4 Operable Subunits Contaminant Source Investigation.

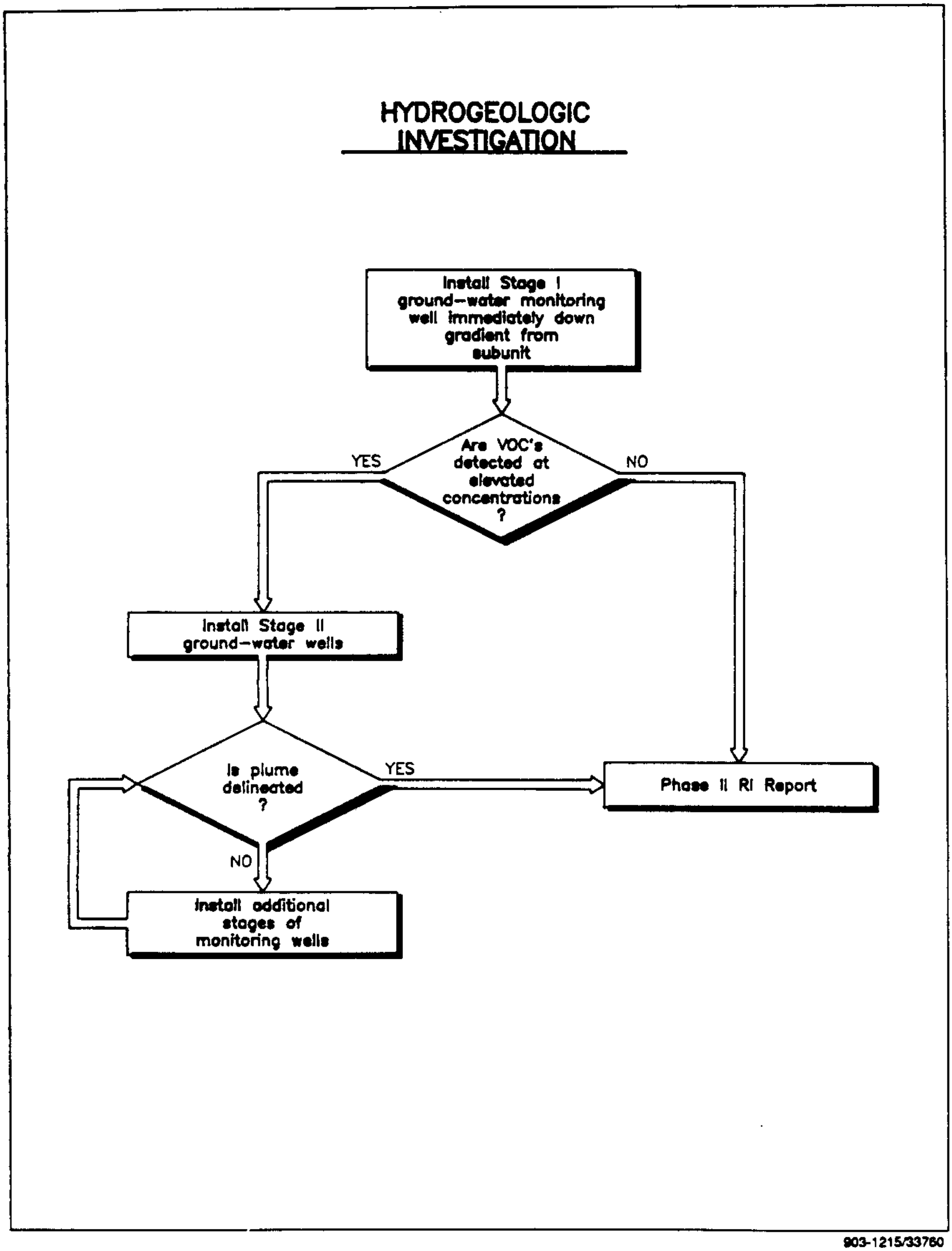

Figure 3-4. 1100-2 Operable Subunit Hydrogeologic Investigation.

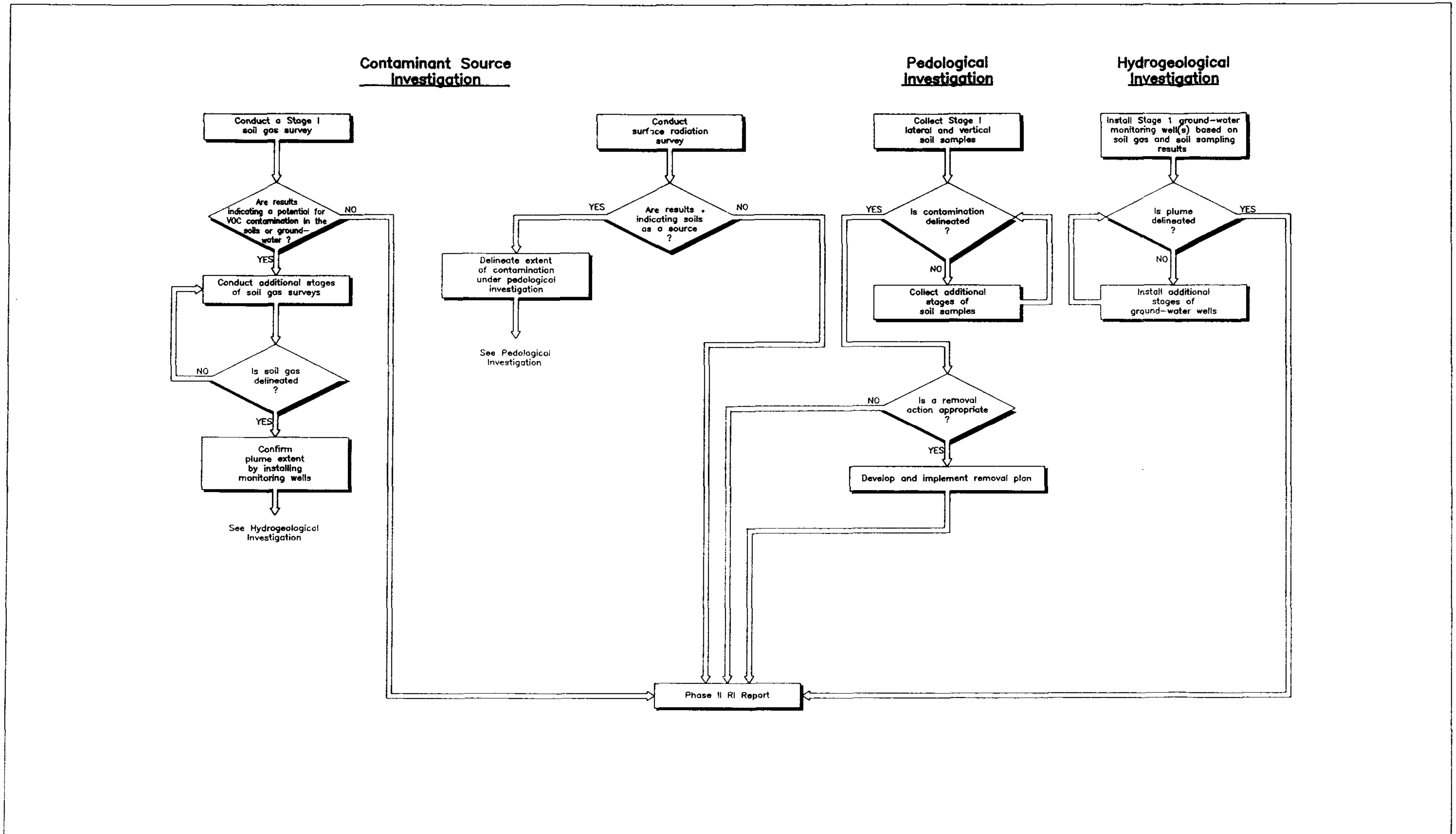

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Figure 3-5. UN-1100-6 Operable Subunit Contaminant Source, Pedological, and Hydrogeological Investigation.

- Lateral and vertical soil sampling for radiation delineation, if necessary, pending the results from the surface radiation survey and the radiation analysis.

The activities planned for the hydrogeological investigation are contingent on the results of the source and pedological investigations. The activities are a staged monitoring well installation, sampling, and analysis to delineate the ground-water contamination attributable to the operable subunit.

3.2.5 Horn Rapids Landfill Tasks

The tasks planned for the Horn Rapids Landfill are contaminant source, pedological, and hydrogeological investigations. A logic diagram for the further investigation of the Horn Rapids Landfill is shown in Figure 3-6. The activities planned for the contaminant source investigation are:

- Installation of a permanent soil gas monitoring network to monitor for the release of volatile organics from suspected buried drums of solvent
- Radiation analysis of archived soil samples to determine if the soils are contributing to the ground-water contamination in the vicinity of the operable subunit.

Activities planned for the pedological investigation are:

- Lateral and vertical soil sampling to determine the extent of PCB contamination
- Soil sampling to determine the oxidation state of chromium in contaminated surface soils.

The activities planned for the hydrogeological investigation are to:

- Evaluate existing upgradient monitoring wells to determine if the installation of additional upgradient monitoring wells are necessary
- Install, sample, and analyze additional upgradient monitoring wells, if necessary, to monitor upgradient ground water
- Evaluate upgradient ground water and determine if the Horn Rapids Landfill is contributing to ground water contamination
- Conduct a soil gas test to determine the feasibility of using soil gas to detect volatiles in ground water
- Perform a soil gas survey to preliminarily delineate the extent of VOCs (e.g., TCE) in ground water

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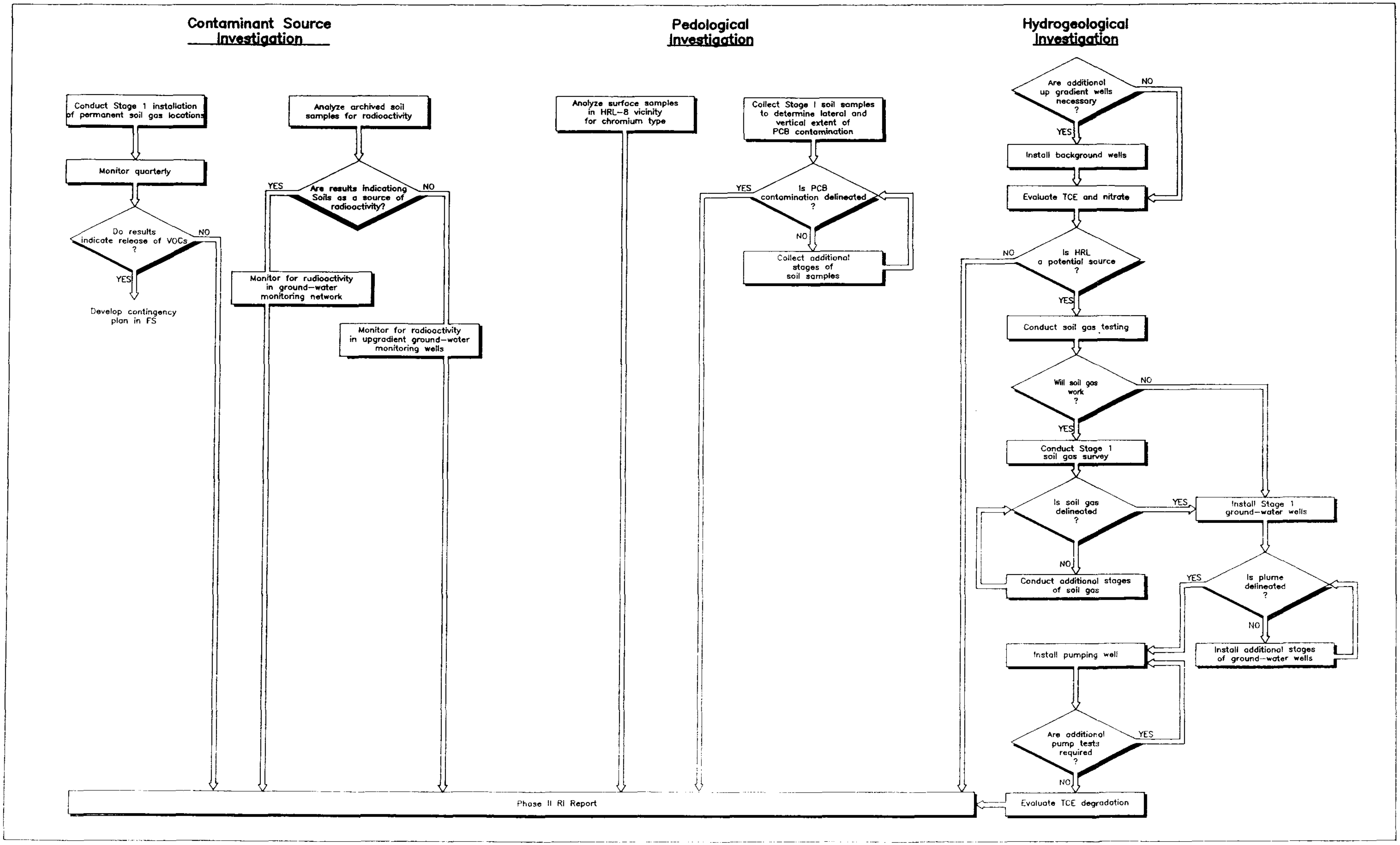

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Figure 3-6. UN-1100-6 Horn Rapids Contaminant Source, Pedological, and Hydrogeological Investigations.

- Install, sample, and analyze monitoring wells in stages to confirm the extent of ground-water contamination, preliminarily delineated by the soil gas survey
- Install a pumping well and conduct a pump test to refine the hydraulic information obtained during first phase of the RI
- Evaluate TCE degradation in ground water to refine ground-water modeling efforts.

3.2.6 Ephemeral Pool Tasks

Figure 3-7 provides a logic diagram of the pedological task planned for the Ephemeral Pool. The activity planned for the pedological investigation is lateral and vertical soil sampling to determine the extent of PCB contamination.

3.2.7 South Pit Tasks

The tasks planned for the South Pit include contaminant source, pedological, and hydrogeological investigations. A logic diagram for the South Pit investigation tasks is provided in Figure 3-8. The activities planned for contaminant source investigation are:

- Compilation of any existing information to determine past operations
- If the South Pit is determined to be a DOE responsibility, perform geophysical, surface radiation, and soil gas surveys to determine the boundaries and potentially contaminated areas.

Activities planned for the pedological investigational task include:

- Sample and analyze surface and subsurface soils to determine if soils are contaminated.

The need for the implementation of the hydrogeologic task is contingent on the contaminant source and pedological investigations. If further hydrogeological investigation is required, the Horn Rapids Landfill hydrogeological investigation task will be expanded to include the South Pit because of its close proximity.

3.3 DATA EVALUATION METHODOLOGIES

During the Phase II RI, data will be evaluated as soon as they are validated and available. This will allow the data to be used in rescoping and focusing the Phase II RI, as appropriate. The data evaluation tasks will provide summaries and interpretations of the collected information that will be used to verify contaminant- and location-specific legally applicable or relevant and appropriate environmental standards, requirements, criteria, and limitations (ARARs) to refine the baseline risk assessment, to continue and focus the FS, and to complete the Phase II RI report.

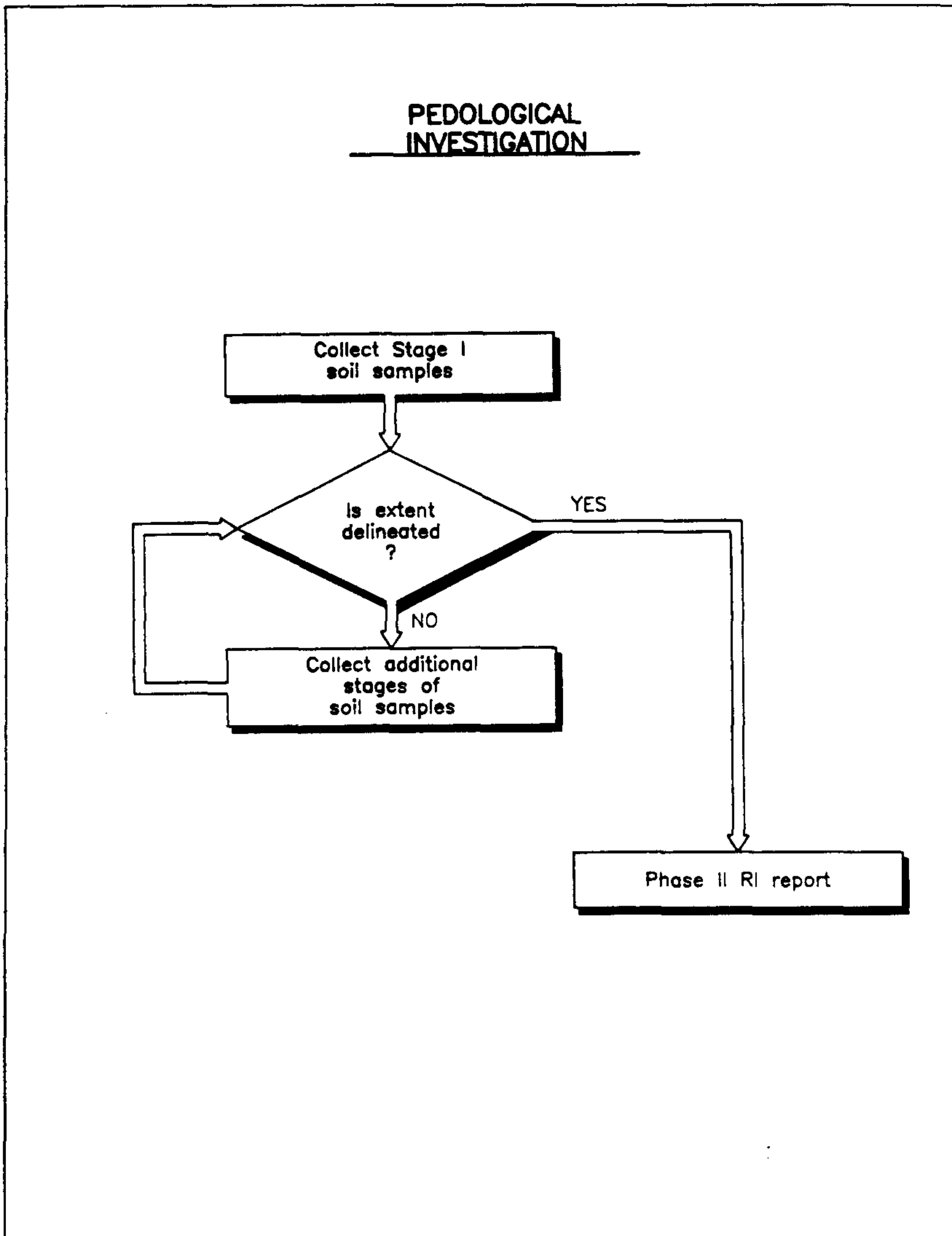

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Figure 3-7. Ephemeral Pool Pedological Investigation.

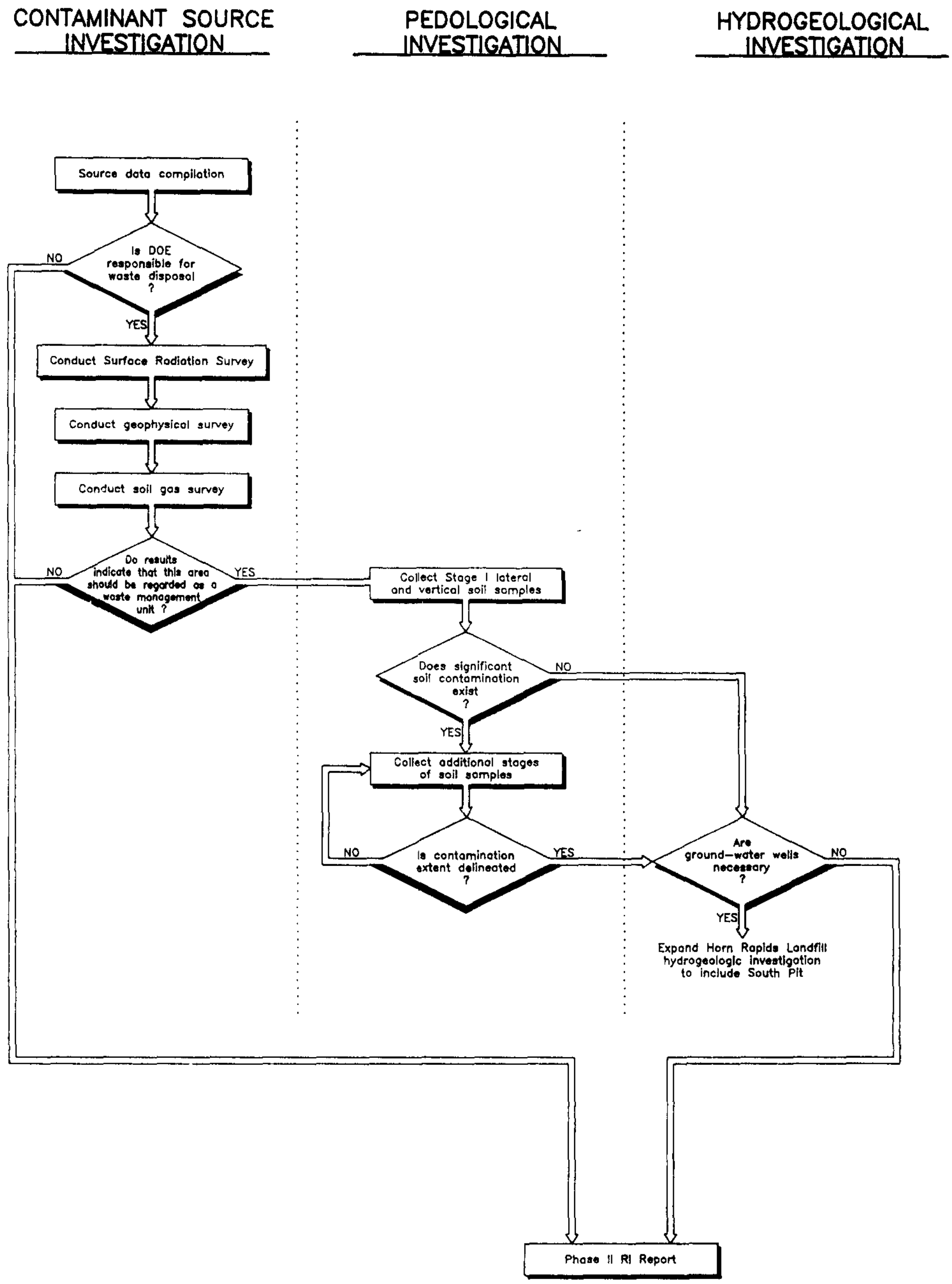

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Figure 3-8. South Pit Contaminant Source, Pedological, and Hydrogeological Investigation.

Contaminant data for each environmental medium will be plotted to facilitate the understanding of the extent of contamination. Statistical comparisons with background conditions will be performed to determine which contaminants attributable to the operable unit are present in elevated concentrations. Although empirical observation will provide the basis for estimating contaminant transport through the environmental media, the computer model PORFLO-3 (Runchal and Sager 1989) is available at the Hanford Site for the analysis of ground-water transport and environmental exposures.

Once the list of contaminants of concern for the operable unit is confirmed or refined, the task to refine the baseline risk assessment will be conducted. This task includes the activities of refining contaminant identification, exposure assessment, toxicity assessment, and risk characterization.

The ongoing development, screening, and analysis of remedial alternatives in the FS will be performed using RI data in conjunction with standard costing and technical procedures, knowledge of prior technical applications, and engineering judgement.

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4.0 PHASE II REMEDIAL INVESTIGATION TASKS

The purpose of this chapter is to set forth the various tasks to be implemented during the course of the additional operable unit characterization phase of the 1100-EM-1 RI/FS project. If treatability studies are necessary, a separate treatability investigation work plan will be developed.

The additional operable unit characterization tasks specified below are designed to provide information to satisfy the work plan approach outlined in Chapter 3. Detailed FSP information on task and activity objectives and sample locations and frequencies is provided with the task descriptions. Further FSP information on sample designations, sampling equipment and procedures, and sample handling and analysis procedures is specified of the QAPP (see Appendix A).

This document is intended to be the final characterization plan for the 1100-EM-1 Operable Unit. It will therefore be necessary to modify the plan during the course of the Phase II RI through established change control procedures (see Appendix A, Section 1.3). Depending on the results of certain tasks, others may need to be created, supplemented, or deleted. Necessary modifications will be agreed upon by DOE-RL, EPA, and Ecology at the monthly unit managers' meetings, and documented in meeting minutes; minutes will be distributed to affected project personnel.

This chapter is divided into the following sections:

- Section 4.1 Project Management Tasks
- Section 4.2 Operable-Unit-Wide Tasks
- Section 4.3 1100-1 and 1100-4 Tasks
- Section 4.4 1100-2 Tasks
- Section 4.5 UN-1100-6 Tasks
- Section 4.6 Horn Rapids Landfill Tasks
- Section 4.7 Ephemeral Pool Tasks
- Section 4.8 South Pit Tasks
- Section 4.9 Data Evaluation Tasks
- Section 4.10 Baseline Risk Assessment Refinement Tasks
- Section 4.11 Phase II Remedial Investigation Report Task.

4.1 PROJECT MANAGEMENT TASKS

Project management is needed throughout the course of the Phase II RI to direct and document project activities and to secure the data and evaluations generated. The administrative and institutional tasks necessary to support overall project activities can be found in the project management plan (PMP) provided in the RI/FS work plan for the 1100-EM-1 Operable Unit (DOE-RL 1989). Specific project management tasks needed to implement the additional operable unit characterization in the Phase II RI are:

- Task 1—General Management
- Task 2—Meetings
- Task 3—Cost Control

- Task 4—Schedule Control
- Task 5—Data Management
- Task 6—Quality Assurance
- Task 7—Health and Safety
- Task 8—Community Relations
- Task 9—Progress Reports

Each of these tasks is described in further detail below.

4.1.1 Task 1—General Management

The day-to-day supervision of, and communication with, project staff and subcontractors is the object of this task. Throughout the project, daily communications between office and field personnel are required, along with periodic communications with subcontractors, to assess progress and exchange information. This task is not meant to duplicate existing general management activities for the 1100-EM-1 RI/FS as a whole, but is included here for completeness.

4.1.2 Task 2—Meetings

Meetings for the 1100-EM-1 RI/FS are held, as necessary, with members of the project staff, subcontractors, regulatory agencies, and other appropriate entities to communicate information, assess project status, and resolve problems. A kickoff meeting will be held at the onset of the Phase II RI, and a unit managers' meeting will continue to be held monthly. The frequency of other meetings will be determined based upon need.

4.1.3 Task 3—Cost Control

The 1100-EM-1 RI/FS project costs are regularly tracked. This task is currently being implemented for the entire RI/FS, and will be continued for the Phase II RI.

4.1.4 Task 4—Schedule Control

Scheduled project milestones are tracked weekly and presented monthly at the unit managers' meetings. This task, already being conducted for the entire RI/FS, will be continued for the Phase II RI.

4.1.5 Task 5—Data Management

This task is established to ensure that the data management procedures, as documented in the data management plan (DMP) contained in the 1100-EM-1 RI/FS work plan (DOE-RL 1989), are carried out appropriately. The project records will be organized, secured, and maintained accessible to appropriate project and regulatory personnel. All field reports, field logs, health and safety documents, quality assurance/quality control

(QA/QC) documents, laboratory data, memoranda, correspondence, and reports will be entered into the records upon completion, receipt, or transmittal.

4.1.6 Task 6—Quality Assurance

This task is established to ensure that the provisions of the QAPP and its implementing procedures are carried out appropriately, using the monitoring methods defined. The QAPP for this phase of the RI/FS is included as Appendix A, and specifically applies to Phase II RI field activities and laboratory analyses.

4.1.7 Task 7—Health and Safety

This task is included to ensure that Westinghouse Hanford health and safety procedures, specified in WHC (1990) and Brown (1988), are carried out. A pre-job safety plan, a form for which is provided in WHC (1990), will be completed prior to each Phase II RI task. Adherence to such established procedures will ensure compliance with all federal and state occupational safety and health regulations.

4.1.8 Task 8—Community Relations

Community relations activities will be conducted in accordance with the community relations plan (CRP) for the Hanford Site (Ecology et al. 1989b). All community relations activities associated with the 1100-EM-1 Operable Unit will be conducted under this overall Hanford Site CRP.

4.1.9 Task 9—Progress Reports

Monthly progress reports will be prepared, distributed to the appropriate personnel and entities (project and unit managers, coordinators, contractors, subcontractors, etc.), and entered into the project file. These reports will summarize the work completed, present data generated, and provide evaluations of the data as they become available. Progress, anticipated problems and recommended solutions, upcoming activities, key personnel changes, status of deliverables, and budget and schedule information will be included.

4.2 OPERABLE-UNIT-WIDE TASKS

The Phase II RI is intended to complete the characterization of the 1100-EM-1 Operable Unit. Each operable subunit has further unique characterization requirements. Sections 4.3 through 4.8 present the tasks for further work at operable subunits assigned to 1100-EM-1; however, some tasks are not specific to an individual operable subunit. This section presents the tasks that will be conducted on an operable-unit-wide basis. The operable-unit-wide additional characterization is divided into two tasks:

- Task 1 — Ecological Investigation for the 1100-EM-1 Operable Unit
- Task 2 — Geodetic Control for the 1100-EM-1 Operable Unit.

Descriptions of these tasks are provided below.

4.2.1 Task 1—Ecological Investigation for the 1100-EM-1 Operable Unit

The Phase I RI risk assessment for the 1100-EM-1 Operable Unit assumed that future land and water use in the 1100 Area and vicinity will be the same as they are now. The ground-water well inventory for the Phase I RI was conducted by searching Ecology and Hanford Site records; a field check was not conducted. This task consists of two operable-unit-wide activities to gather additional information on land and water use.

4.2.1.1 Activity 1a—Land- and Water-Use Assessment for the 1100-EM-1 Operable Unit.

Activity Objective: The purpose of this activity is to compile any future land- and water-use projections for the Hanford Site in general, and the 1100 Area and vicinity in particular.

Activity Description: Land- and water-use projections will be compiled from federal, state, and local governments having jurisdiction over the 1100 Area and vicinity. Project staff will obtain current drafts of documents compiled during the Phase I RI, and obtain any newly drafted materials on projected land and water use.

All information gathered under this activity will be handled and filed in project files in compliance with the applicable procedures specified in Table 2 of the QAPP (see Appendix A).

Sample Locations, Frequencies, and Analysis: No sampling is required for this task.

4.2.1.2 Activity 1b—Well Inventory Refinement for the 1100-EM-1 Operable Unit.

Activity Objective: The purpose of this activity is to refine the information gathered during Phase I activities on ground-water withdrawal points within the potentially contaminated downgradient direction to determine if additional existing wells should be included in the Phase II RI ground-water investigation.

Activity Description: The survey will be conducted by a door-to-door search collecting information on location, current owner, current use, well condition, and well log availability. Wells will be photographed to document the current condition. Wells will also be sounded to determine the total depth and water level.

All information collected during the survey will be documented and handled in compliance with the procedures specified in Table 2 of the QAPP (see Appendix A).

Sampling Locations, Frequencies, and Analysis: No sampling is required under this task. A one time survey will be conducted in Township 10 N, Range 28 E, sections 9, 10, 11, 14, 15, 16, 21, 22, 23, 26, 27, 28, and the northern half of sections 33, 34, and 35. All well locations not currently identified with north-south/east-west (NS/EW) coordinates and elevations will be surveyed (see Section 4.2.2.1).

4.2.2 Task 2—Geodetic Control for the 1100-EM-1 Operable Unit

The single activity planned for this task is geodetic surveying within the established geodetic coordinate system to determine Phase II RI sampling locations.

4.2.2.1 Activity 2a—Geodetic Survey for the 1100-EM-1 Operable Unit.

Activity Objective: The objective of this activity is to document all Phase II RI sampling point locational data on an operable-unit-wide basis.

Activity Description: Locational data includes NS/EW Hanford Site coordinates and elevations in feet (ft) above mean sea level (amsl). Table 4-1 identifies the locational data needed for specific sampling methods.

Table 4-1. Survey Data Types for Sampling Locations at the 1100-EM-1 Operable Unit

Sampling Location	Survey Data Type
Soil Gas Probes	NS/EW Coordinates
Surface Samples	NS/EW Coordinates
Soil Borings	NS/EW Coordinates and Elevations
Monitoring or Existing Wells	NS/EW Coordinates and Elevations
Geophysical Transects	NS/EW Coordinates
Surface Radiation Transects	NS/EW Coordinates

Applicable procedural controls for geodetic surveying and equipment, and field data documentation are specified in Table 2 of the QAPP (see Appendix A).

Sample Locations, Frequencies and Analysis: No sampling will be conducted by this activity.

4.3 1100-1 AND 1100-4 TASKS

Further characterization of the 1100-1 and 1100-4 operable subunits may be required due to the presence of elevated gross-alpha and gross-beta radiation in the first round of ground-water sampling in the 1171 Building vicinity. The additional characterization of these two subunits is divided into two tasks:

- Task 1 — Contaminant Source Investigation for 1100-1 and 1100-4
- Task 2 — Hydrogeological Investigation for 1100-1 and 1100-4.

Descriptions of these tasks are provided below.

4.3.1 Task 1—Contaminant Source Investigation for 1100-1 and 1100-4

The sole activity planned for this task is a radiation analysis of archived soil samples.

4.3.1.1 Activity 1a—Radiation Analysis for 1100-1 and 1100-4.

Activity Objective: The purpose of this activity is to determine whether the soils of the 1100-1 or the 1100-4 operable subunits are contributing to the low-level radiation contamination in the ground water near the 1171 Building, as noted from the single round of monitoring data currently available (DOE-RL 1990).

Activity Description: Archived soil samples obtained during the Phase I RI will have complete laboratory analyses for gross-alpha, -beta, and -gamma radiation. Archived background soil samples will also be analyzed to allow for comparisons to local background conditions.

Sample Locations, Frequencies and Analysis: No new sampling will be conducted for this activity; archived soil samples from borings BAP-1, ATS-1, and MW-3 will be used. The locations of these borings are shown in Figure 4-1. Archived samples from borings BAP-2, DP-7, and HRL-1 will be used to characterize background soil radiation levels. The locations of these background borings are shown in Figure 4-2.

All samples will have complete laboratory analysis for gross alpha-, beta-, and gamma-radiation. If radiation is present in amounts significantly above background levels, further analyses will be conducted to determine the specific radionuclides of potential concern. If analyses for specific radionuclides are necessary, the list of radionuclides will be determined at that time.

The analytical methods for conducting the gross-alpha, -beta, and -gamma radiation analyses are specified in Table 1 of the QAPP (see Appendix A). If further analyses are required to determine the presence of specific radionuclides, the QAPP will be amended to include the methods for such analyses.

4.3.2 Task 2—Hydrogeological Investigation for 1100-1 and 1100-4

The need for the implementation of this task is contingent on the results of the radiation analysis described in Task 1 above, and verification of ground-water radiation contamination by subsequent rounds of monitoring planned for the RI (DOE-RL 1990). If neither the 1100-1 nor 1100-4 operable subunits are found to be sources of the low-level radiation contamination in the 1171 Building vicinity ground waters, the characterization of this potential problem will be deferred to the 1100-EM-2 Operable Unit RI, as this operable unit consists primarily of waste management units located within or near the 1171 Building (DOE-RL 1990). This task consists of two activities: monitoring well installation, and ground-water sampling and analysis.

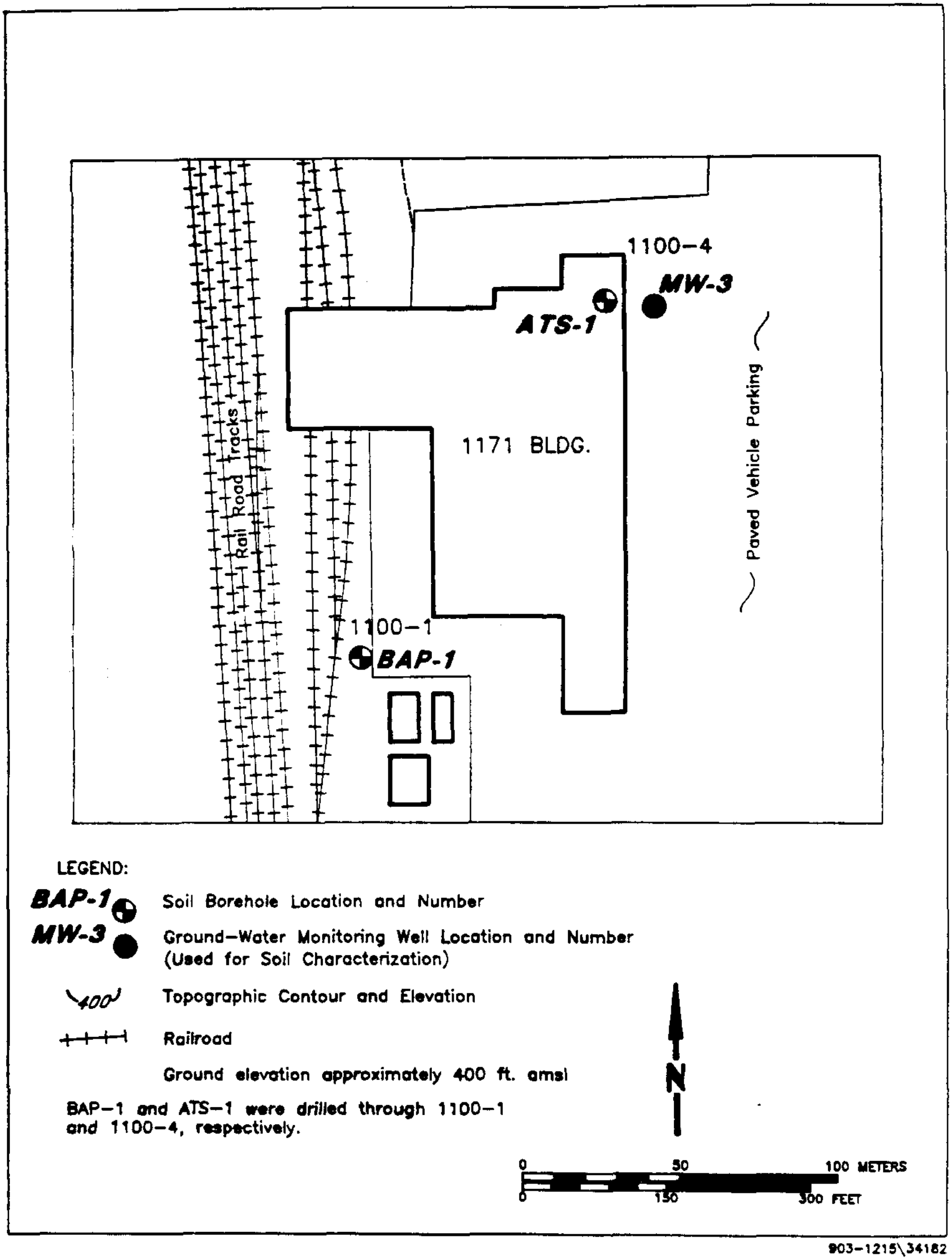

Figure 4-1. Phase I RI Soil Sampling Locations for the 1100-1 and 1100-4 Operable Subunits.

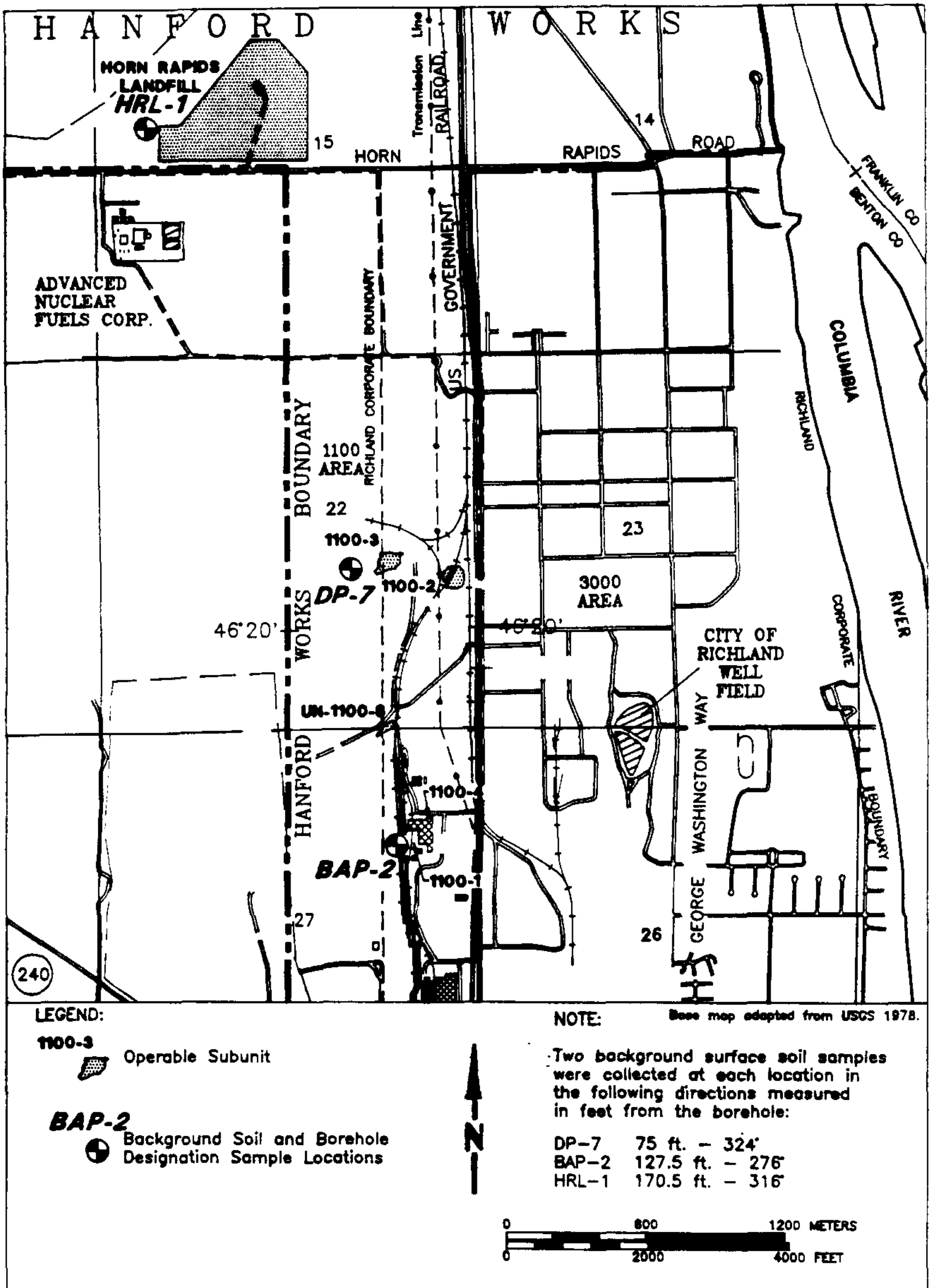

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Figure 4-2. Background Soil Sampling Locations for the 1100-E M-1 Operable Unit.

4.3.2.1 Activity 2a—Monitoring Well Installation for 1100-1 and 1100-4.

Activity Objective: The objective of this activity, should it be necessary, is to delineate the extent of any significant radiation contamination in ground water that is attributable to the 1100-1 or 1100-4 operable subunits.

Activity Description: If Task 1 results indicate a need for a hydrogeological investigation at either 1100-1 or 1100-4, this task will consist of installing additional ground-water monitoring wells in stages to delineate the extent of the contamination.

Procedures for installing ground-water monitoring wells are presented in Table 2 of the QAPP (see Appendix A).

Sample Locations, Frequency and Analysis: Should this task become necessary, wells would be installed immediately downgradient from the operable subunit identified as the potential source of radiation contamination. The effects of ground-water mounding, due to City of Richland well field operations to the east, would need to be considered in locating wells, and a sufficient number of wells would be installed in stages to delineate the extent of contamination. No new background wells would need to be constructed.

If any monitoring wells are installed under this activity, soil samples will be obtained every 1.5 m (5 ft) and at changes of lithology. Samples will be obtained by drive tube, sealed, and analyzed, according to procedures specified in Table 2 of the QAPP (see Appendix A), for in-situ moisture.

If additional monitoring well locations are necessary to delineate the extent of contamination, their locations will be determined from the results of sampling the wells immediately downgradient from the operable subunits (see Section 4.3.2.2 below). Existing background well locations that are known to be unimpacted by releases from the ANF complex, and are thus appropriate for comparisons, are shown in Figure 4-3. All wells installed under this activity will be geodetically surveyed (see Section 4.2.2.1).

4.3.2.2 Activity 2b—Ground-Water Sampling and Analysis for 1100-1 and 1100-4.

Activity Objective: The purpose of this activity is to sample and analyze ground water from monitoring wells installed during Activity 2a (Section 4.3.2.1), and from the east- and west-supply lines of the Richland well field.

Activity Description: Ground-water samples will be obtained from the stage 1 monitoring wells and the Richland well field supply lines, and analyzed. Results from stage 1 analyses will be used to determine if additional stages of monitoring well installation are required to delineate operable subunit contamination.

Monitoring well sampling, sample designation, and sample handling procedures are provided in Table 2 of the QAPP (see Appendix A).

Sample Locations, Frequency and Analysis: Ground water will be sampled from the monitoring wells installed in Activity 2a within one week after well completion, then quarterly for two periods, and finally included, as necessary, in the regular monitoring for the operable unit. Ground water will also be sampled quarterly from the Richland well

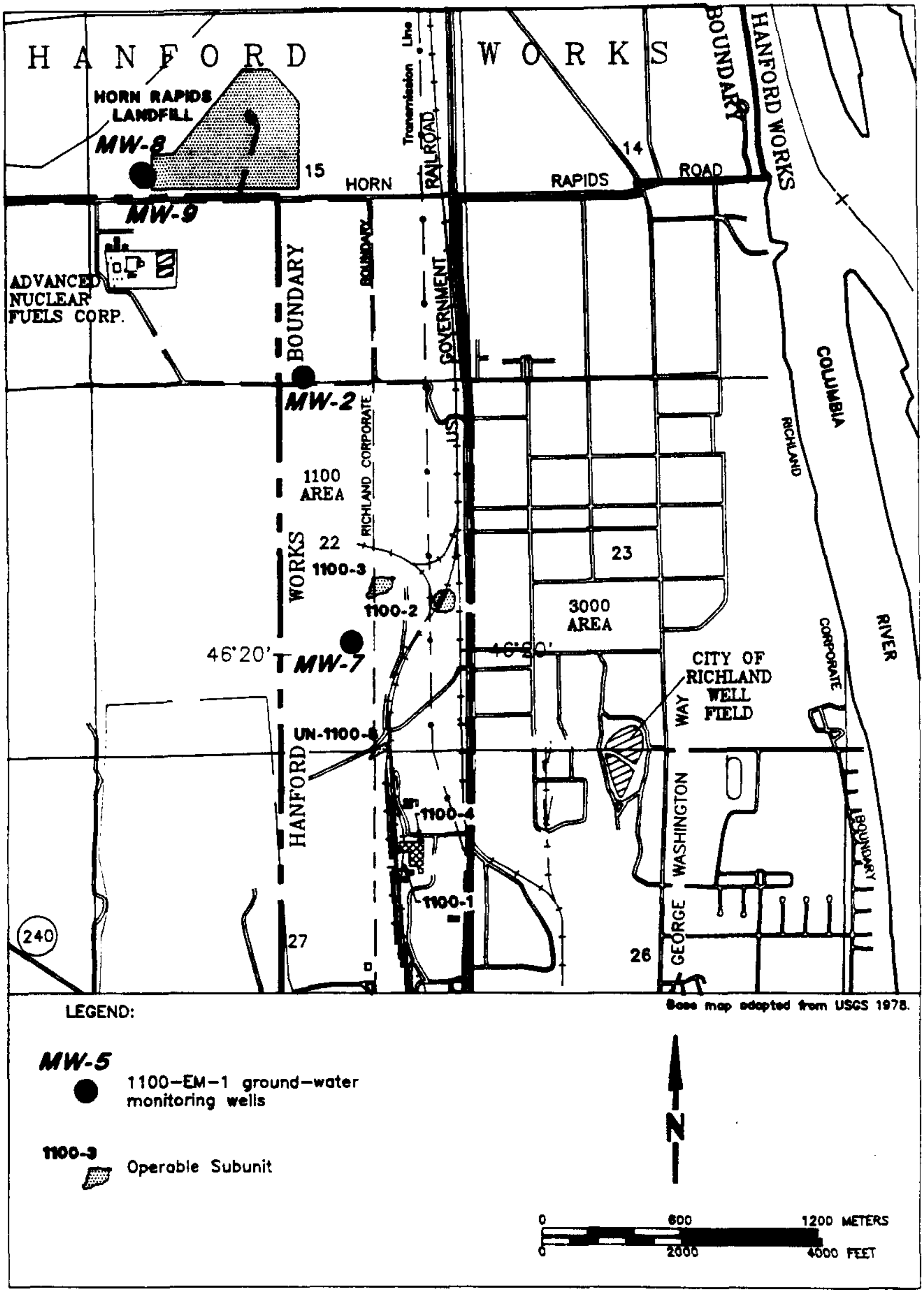

Figure 4-3. Operable-Unit-Specific-Upgradient Ground-Water Monitoring Well Locations.

field supply lines. All samples will have complete laboratory analysis for gross-alpha, -beta, and -gamma radiation. Samples will also be analyzed for specific radionuclides of potential concern, as determined in Task 1 above. The QAPP will be amended under Task 1 to include the analytical methods for specific radionuclides if such analyses are required.

4.4 1100-2 TASKS

Elevated PCE concentrations were found within a small area of the 1100-2 operable subunit during the Phase I RI soil gas survey. Surface and subsurface soil investigations in the area of elevated soil gas concentrations did not locate a source. No monitoring wells are located immediately downgradient from this operable subunit. Further investigation is required to determine if operable subunit ground water is contaminated. One task is planned to provide additional characterization:

- Task 1—Hydrogeological Investigation for 1100-2.

4.4.1 Task 1—Hydrogeological Investigation for 1100-2

The activities planned for this task include monitoring well installation, and ground-water sampling and analysis.

4.4.1.1 Activity 1a—Monitoring Well Installation for 1100-2.

Activity Objective: This activity will be conducted in stages. The objective of Stage 1 is to install a downgradient monitoring well to monitor 1100-2 subunit ground water. The objective of Stage 2 is to delineate the extent of any significant contamination in ground water that is attributable to the 1100-2 operable subunit.

Activity Description: One monitoring well will be installed within the unconfined aquifer immediately downgradient from 1100-2 operable subunit. If any contamination is present in the ground water at significant levels and it is determined that 1100-2 is the source of the contamination, additional wells will be installed to delineate the plume.

Monitoring wells will be installed according to the procedures specified in Table 2 of the QAPP (see Appendix A).

Sample Location, Frequency and Analysis: Monitoring well(s) installed by this activity will be sampled by Activity 1b. The location of the Stage 1, downgradient monitoring well, is shown in Figure 4-4. Should additional wells become necessary, wells would be installed downgradient from the operable subunit. The effects of ground-water mounding due to the City of Richland well field operations to the east would need to be considered in locating wells, and a sufficient number of wells would need to be installed in stages to delineate the extent of the contaminant plume.

Soil samples will be obtained every 1.5 m (5 ft) and at changes of lithology from monitoring wells installed under this activity. Samples will be obtained by drive tube, sealed, and analyzed, according to procedures specified in Table 2 of the QAPP (see Appendix A), for in-situ moisture. No new background wells would need to be constructed.

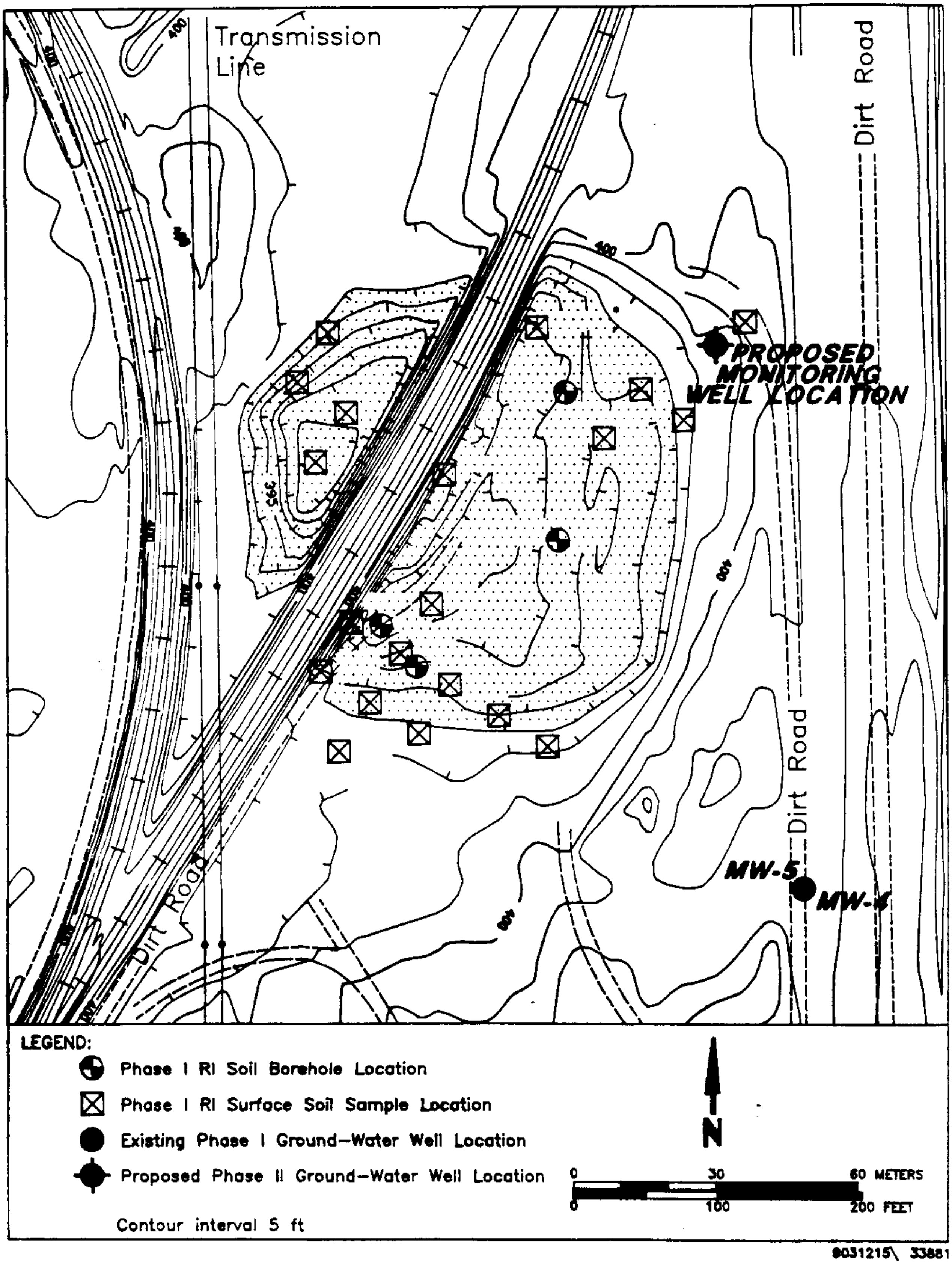

Figure 4-4. Proposed Location for the Stage 1 Phase II RI Monitoring Well for the 1100-2 Operable Subunit.

All monitoring wells installed under this activity will be geodetically surveyed (see Section 4.2.2.1).

4.4.1.2 Activity 1b—Ground-Water Sampling and Analysis for 1100-2.

Activity Objective: The objective of this task is to sample and analyze ground-water monitoring well(s) installed during Activity 1a.

Activity Description: Ground-water samples will be obtained from the stage 1 downgradient monitoring well, and analyzed to characterize the operable subunit ground water. Analytical results will also be used to determine if additional stages of monitoring well installation are required to delineate operable subunit ground-water contamination.

Sampling Equipment, sample designation, and handling procedures are specified in Chapters 4 and 5 and Tables 2 and 3 of the QAPP (see Appendix A).

Sample Location, Frequency and Analysis: Ground water will be sampled from the Stage 1 downgradient well, installed under Activity 1a, within one week after well completion, then quarterly for two periods, and finally included, as necessary, in the regular monitoring for the operable unit. The Stage 1 initial two rounds of sampling (the second round is required for verification of the results from the first round) will be analyzed for TCL, TAL, and conventional water quality parameters according to the analytical procedures specified in Table 1 of the QAPP (see Appendix A).

Additional rounds of sampling will be analyzed for contaminants of interest. Such parameters will be determined from the results of the Data Evaluation and Baseline Risk Assessment Refinement Tasks (see Sections 4.9.3 and 4.11, respectively). The list of contaminants of interest will be developed from the results of the two initial rounds of sampling. If Stage 2 monitoring wells are installed, samples will be taken within one week of well completion, then quarterly for two periods, and finally included in the regular monitoring for the operable unit. Stage 2 samples will be analyzed for the contaminants of interest determined after the first two rounds of sampling in the Stage 1 well.

4.5 UN-1100-6 TASKS

Only surface soils were sampled and analyzed during Phase I RI activities. Further characterization of the UN-1100-6 operable subunit is required due to the elevated BEHP contamination and the low levels of VOCs in the surface soils. The BEHP concentrations in the surface soils of this subunit pose potentially significant risks to human health under current land- and water-use conditions. Additional characterization of this subunit is described in the following tasks:

- Task 1—Contaminant Source Investigation for UN-1100-6
- Task 2—Pedological Investigation for UN-1100-6
- Task 3—Hydrogeologic Investigation for UN-1100-6.

4.5.1 Task 1—Contaminant Source Investigation for UN-1100-6

A soil gas survey and a surface radiation survey are the two activities under this task.

4.5.1.1 Activity 1a—Soil Gas Survey for UN-1100-6.

Activity Objective: The purpose of this activity is to determine if a source of the low levels of VOCs found in the surface soils is present in the vadose zone or ground water at the UN-1100-6 operable subunit.

Activity Description: A soil gas survey will be conducted to determine if a source of VOC contamination exists in the vadose zone at the UN-1100-6 operable subunit. If additional stages of soil gas surveys are required to delineate any significant VOC contamination, an activity will be created under Task 3, Hydrogeologic Investigation.

Soil gas probe installation, sampling, sample handling, and sample designation procedures are specified in Table 2 of the QAPP (see Appendix A).

Sample Location, Frequency and Analysis: Nine temporary soil gas probes will be installed to a depth of 1.2 m (4 ft) at locations shown in Figure 4-5. Once probes are installed, soil gas will be sampled and analyzed one time. Soil gas will be analyzed for the VOCs specified in Table 1 of the QAPP (see Appendix A) by the methods which are specified therein. Soil gas probe locations will be staked to allow for geodetic surveying (see Section 4.2.2.1).

4.5.1.2 Activity 1b—Surface Radiation Survey for UN-1100-6.

Activity Objective: The purpose of this activity is to determine whether the surface soils of the UN-1100-6 operable subunit are contributing to low-level radioactivity in the ground water near the 1171 Building. Subsurface soils will be investigated by Task 2.

Activity Description: An operable unit-specific background plot will first be established by conducting the survey on land surfaces where operable unit background soils were obtained. The surface of the operable subunit will be surveyed for alpha-, beta-, and gamma-radiation. Any surface areas identified with elevated radiation above background will be characterized in Task 2, Pedological Investigation.

Procedures for conducting the surface radiation survey are specified in Table 2 of the QAPP (see Appendix A).

Sample Locations, Frequency and Analysis: The background plot established for the operable unit will be used for determining background surface radiation levels at the UN-1100-6 operable subunit. This background radiation survey will be conducted in in the areas of the three background soil sampling locations established during the Phase I RI (see Figure 4-2) to the west of the operable unit. The three background plots will be approximately 23 m (75 ft) by 23 m (75 ft). Sampling at the background plots will be conducted at intersecting points on approximately an 8-m (25-ft) grid to obtain discrete readings at each point. This grid spacing may be modified if it is determined that a closer spacing is required. Approximately 48 total points will be sampled using this grid spacing.

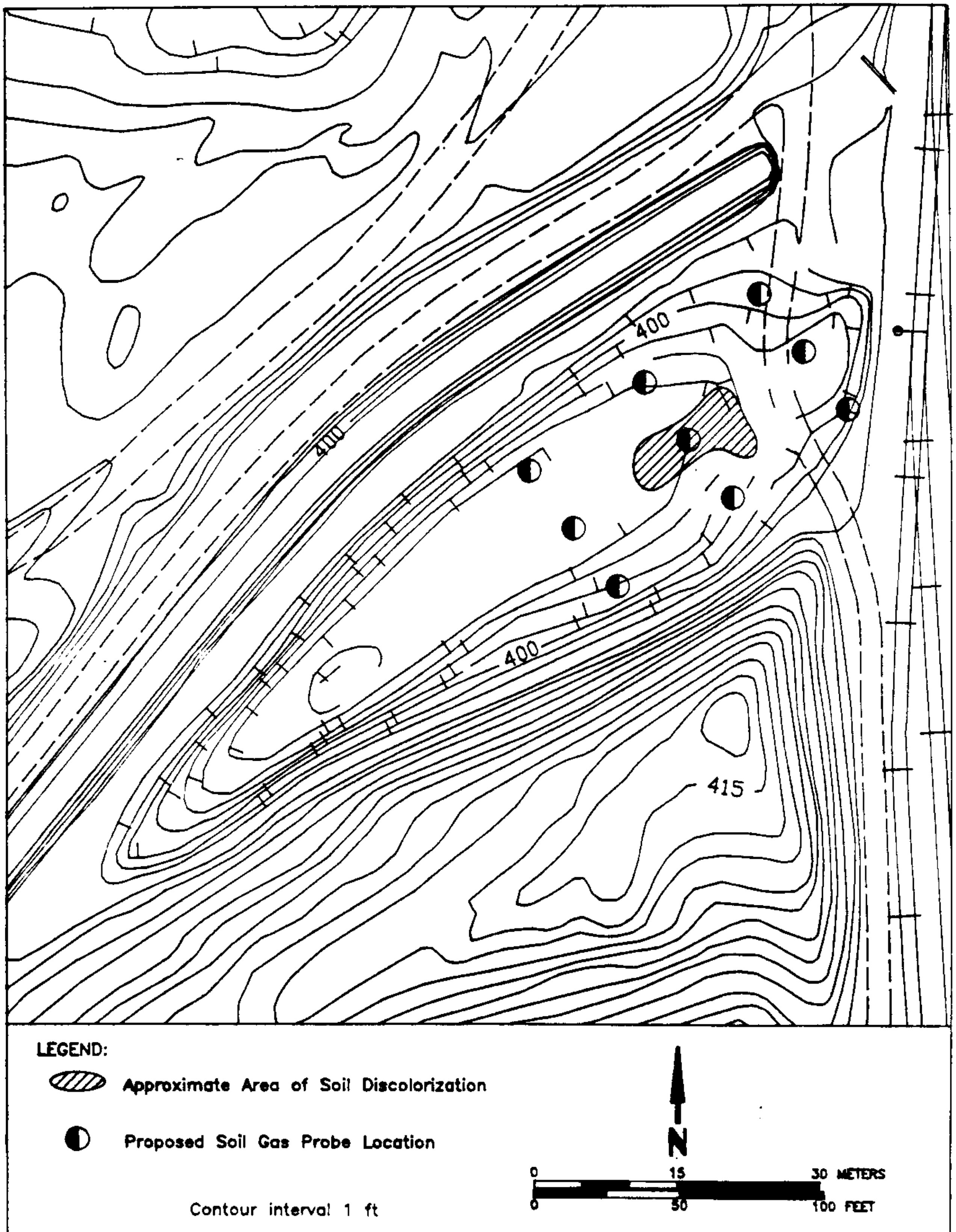

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Figure 4-5. Proposed Location for the Phase II RI Gas Probes for the UN-1100-6 Operable Subunit.

Such background measurements will be obtained after the operable subunit itself is surveyed, and only if detectable levels of radiation are encountered.

Sampling within the UN-1100-6 operable subunit will be conducted along transects within the area shown in Figure 4-6 at approximately 8-m (25-ft) intervals to determine the location and the extent of elevated radiation. This grid spacing may be modified if it is determined that a closer spacing is required. Where an elevated level of radiation (statistically greater than background) is encountered along a transect, the survey will depart from the transect to locate and quantify the source of the reading. Areas with elevated radiation will be staked and flagged for subsequent geodetic surveying (see Section 4.2.2.1).

The surface radiation survey will be conducted for alpha-, beta-, and gamma-radiation using a hand-held, laboratory-quality, alpha detector and a sodium-iodide, beta/gamma detector that reads in counts per minute. The survey will be done in dry weather conditions to avoid the potential for water shielding of alpha and lower energy beta sources.

Continuous recording equipment will be used to generate data along the grid lines during the surface radiation survey. Records of all calibrations and procedure applications will be maintained in a field notebook in accordance with procedures specified in Table 2 of the QAPP (see Appendix A).

4.5.2 Task 2—Pedological Investigation for UN-1100-6

The three activities planned for this task are BEHP delineation, radiation analysis, and radiation delineation.

4.5.2.1 Activity 2a—BEHP Delineation at UN-1100-6.

Activity Objective: The purpose of this activity is to delineate the lateral and vertical extent of BEHP contamination within the UN-1100-6 operable subunit soils.

Activity Description: Additional soil samples will be collected in stages to accurately delineate the lateral and vertical extent of BEHP contamination. If a removal action is determined to be appropriate, a new planning and implementation task will be created.

Procedures for collecting surface samples, subsurface soil boring samples, sample designation, and handling procedures are specified in Chapters 4 and 5 and Tables 2 and 3 of the QAPP (see Appendix A).

Sample Locations, Frequency and Analysis: The locations of Stage 1 surface samples and soil borings are shown in Figure 4-7. Six surface samples will be collected adjacent to the discolored soil. Three hand-augered soil borings will be completed to a depth of 1.2 m (4 ft) and sampled at depths of 0.3, 0.6, and 1.2 m (1, 2, and 4 ft) below the surface. If additional stages of sampling are required to delineate the extent of contamination, locations will be determined based upon the results of Stage 1 sampling and analysis.

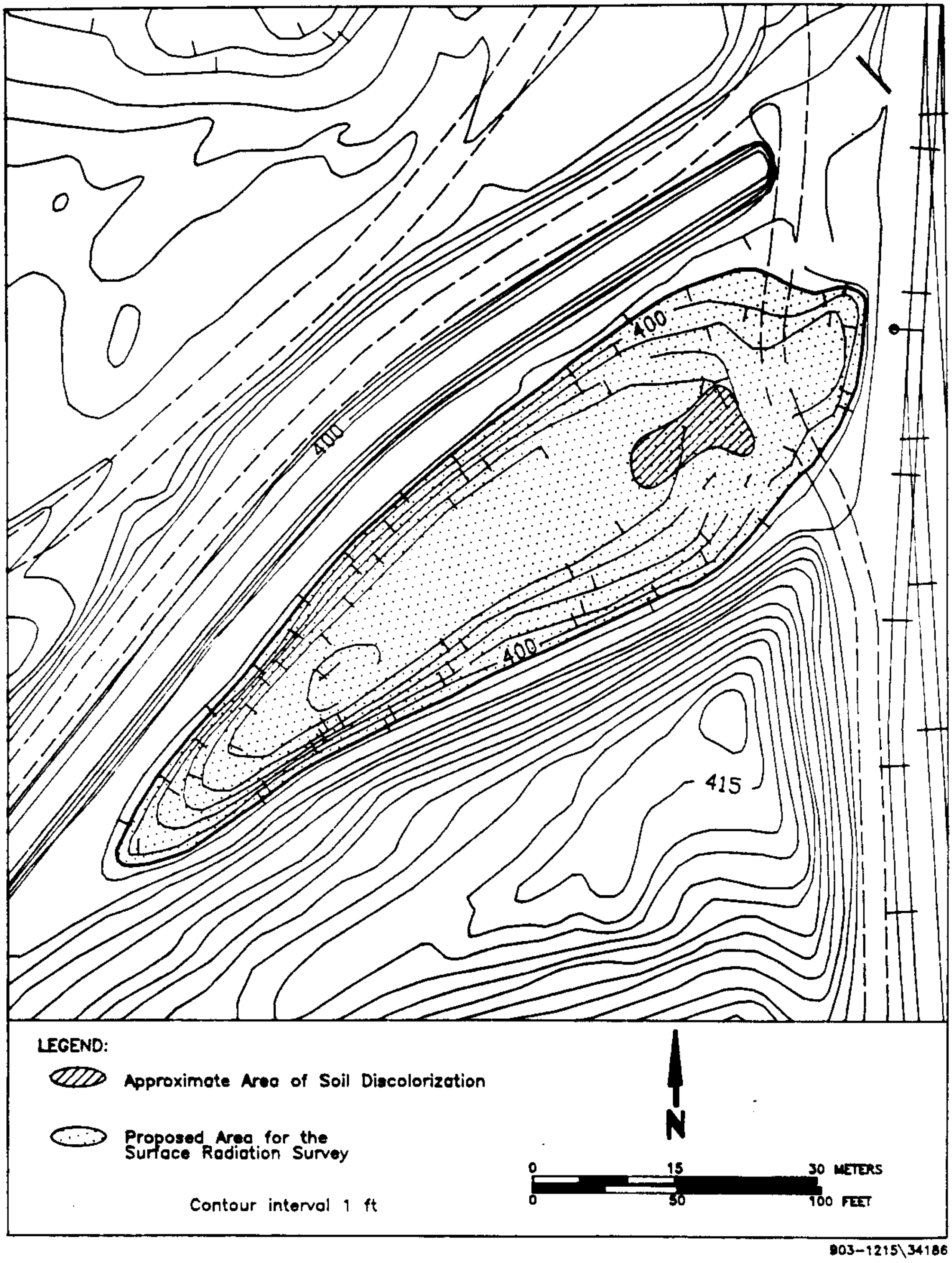

Figure 4-6. Proposed Area to Conduct the Surface Radiation Survey at UN-1100-6 Operable Subunit.

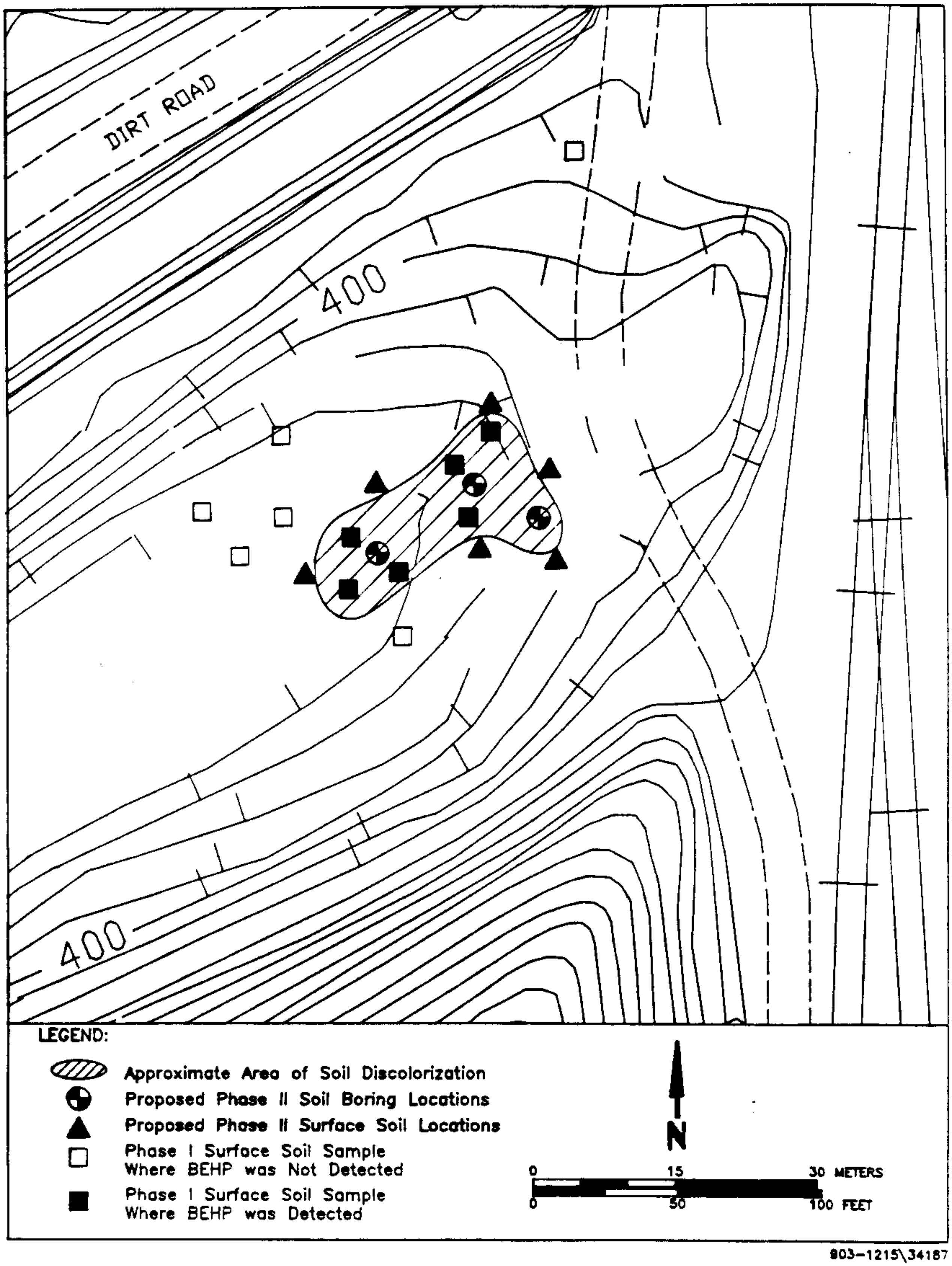

Figure 4-7. Proposed Stage 1 Soil Sampling Locations for BEHP Delineation at the UN-1100-6 Operable Subunit.

All soil samples will be analyzed for semi-volatile organic compounds (SVOCs) according to the analytical procedures specified in Table 1 of the QAPP (see Appendix A). Samples obtained from 1.2 m (4 ft) below the surface will have additional analysis conducted under Activity 2b (see Section 4.5.2.2). All sample locations will be geodetically surveyed (see Section 4.2.2.1).

4.5.2.2 Activity 2b—Radiation Analysis for UN-1100-6.

Activity Objective: The purpose of this activity is to determine whether the subsurface soils at UN-1100-6 operable subunit are contributing to the low-level radiocativity in the ground water near the 1171 Building.

Activity Description: Soil samples obtained from 1.2 m (4 ft) below the surface during Activity 2a (Section 4.5.2.1) will, in addition to Activity 2a SVOC analysis, have complete laboratory analysis for gross-alpha, -beta, and -gamma radiation. Archived background soil samples will also be analyzed to allow for comparisons to local background conditions.

Sample Locations, Frequencies and Analysis: No new sampling will be conducted for this activity; subsurface soil samples from Activity 2a borings will be used. The locations of these borings are shown in Figure 4-7. Archived samples from borings BAP-2, DP-7, and HRL-1 will be used to characterize background soil radiation levels. The locations of these background borings are shown in Figure 4-2. All samples will have complete laboratory analysis for gross-alpha, -beta, and -gamma radiation. If radiation is present in amounts significantly above background levels, further analysis will be conducted to determine the presence of any specific radionuclides of concern. If analysis for specific radionuclides of potential concern is necessary, the list of radionuclides will be determined at that time. The analytical methods for conducting the gross-alpha, -beta, and -gamma radiation analysis are specified in Table 1 of the QAPP (see Appendix A). If further analysis is required to determine the presence of specific radionuclides, the QAPP will be amended to include the methods required for such analyses.

4.5.2.3 Activity 2c—Radiation Delineation for UN-1100-6.

Activity Objective: The purpose of this activity is to delineate any significant radiation determined to exist under Task 1, Activity 1b (see Section 4.5.1.2) and Task 2, Activity 2b (see Section 4.5.2.2).

Activity Description: The need for the implementation of this activity is contingent on the results of the surface radiation survey (Task 1, Activity 1b [see Section 4.5.1.2]); and radiation analysis on subsurface soils (Task 2, Activity 2b [see Section 4.5.2.2]). If radiation is present in amounts significantly above background levels, additional samples will be obtained to determine the lateral and vertical extent of contamination.

Additional surface and subsurface soil samples will be collected in stages to accurately delineate the lateral and vertical contamination. The results will be used to determine if additional soil samples are required to delineate the extent of contamination.

Procedures for collecting surface and subsurface samples, sample designation, and handling procedures are specified in Table 2 of the QAPP (see Appendix A).

Sample Locations, Frequencies and Analysis: The locations for additional soil samples are contingent on the results of Task 1 and Task 2. All samples will have complete laboratory analysis for gross-alpha, -beta, and -gamma radiation. If radiation is present in amounts significantly above background levels, analyses will be conducted to determine the presence of any specific radionuclides of concern. If analysis for specific radionuclides of concern is necessary, the list of radionuclides will be determined at that time. If further analyses are required to determine the presence of specific radionuclides, the QAPP will be amended to specify the analytical methods required.

4.5.3 Task 3—Hydrogeological Investigation for UN-1100-6

The need for the implementation of this task is contingent on the results of the soil gas survey (see Section 4.5.1.1) and the surface radiation survey (see Section 4.5.1.2) conducted under Task 1, and the vertical extent of BEHP contamination (see Section 4.5.2.1) conducted under Task 2. If the UN-1100-6 operable subunit is not found to be the source of the low-level ground-water radiation levels in the 1171 Building vicinity, or is not found to be a source of potential VOC ground-water contamination, or the BEHP contamination is limited to surface soils, no further hydrogeological characterization will be conducted.

This task is further divided into two activities: monitoring well installation and ground-water sampling and analysis.

4.5.3.1 Activity 3a—Monitoring Well Installation at UN-1100-6.

Activity Objective: The objective of this activity is to delineate the extent of any significant VOC, SVOC, or radiation in ground water that is attributed to the UN-1100-6 operable subunit.

Activity Description: Monitoring wells will be installed in stages. Stage 1 monitoring well installation will consist of installing one monitoring well immediately downgradient from the UN-1100-6 operable subunit. If the ground water is contaminated, additional stages of monitoring wells will be installed to delineate the plume.

Monitoring well installation procedures are specified in Table 2 of the QAPP (see Appendix A).

Sample Location, Frequency and Analysis: Should this task become necessary, the Stage 1 monitoring well will be installed immediately downgradient from the operable subunit as shown in Figure 4-8. If required, a sufficient number of wells would need to be installed in stages to delineate the extent of the contamination. If any monitoring wells are installed by this activity, soil samples will be obtained every 1.5 m (5 ft) and at changes of lithology. Samples will be obtained by drive tube, sealed, and analyzed according to procedures, specified in Table 2 of the QAPP (see Appendix A), for in-situ moisture. The effects of ground-water mounding due to City of Richland well field operations to the east would need to be considered in locating wells. No new background wells would need to be constructed. All wells installed by this task will be geodetically surveyed (see Section 4.2.2.1).

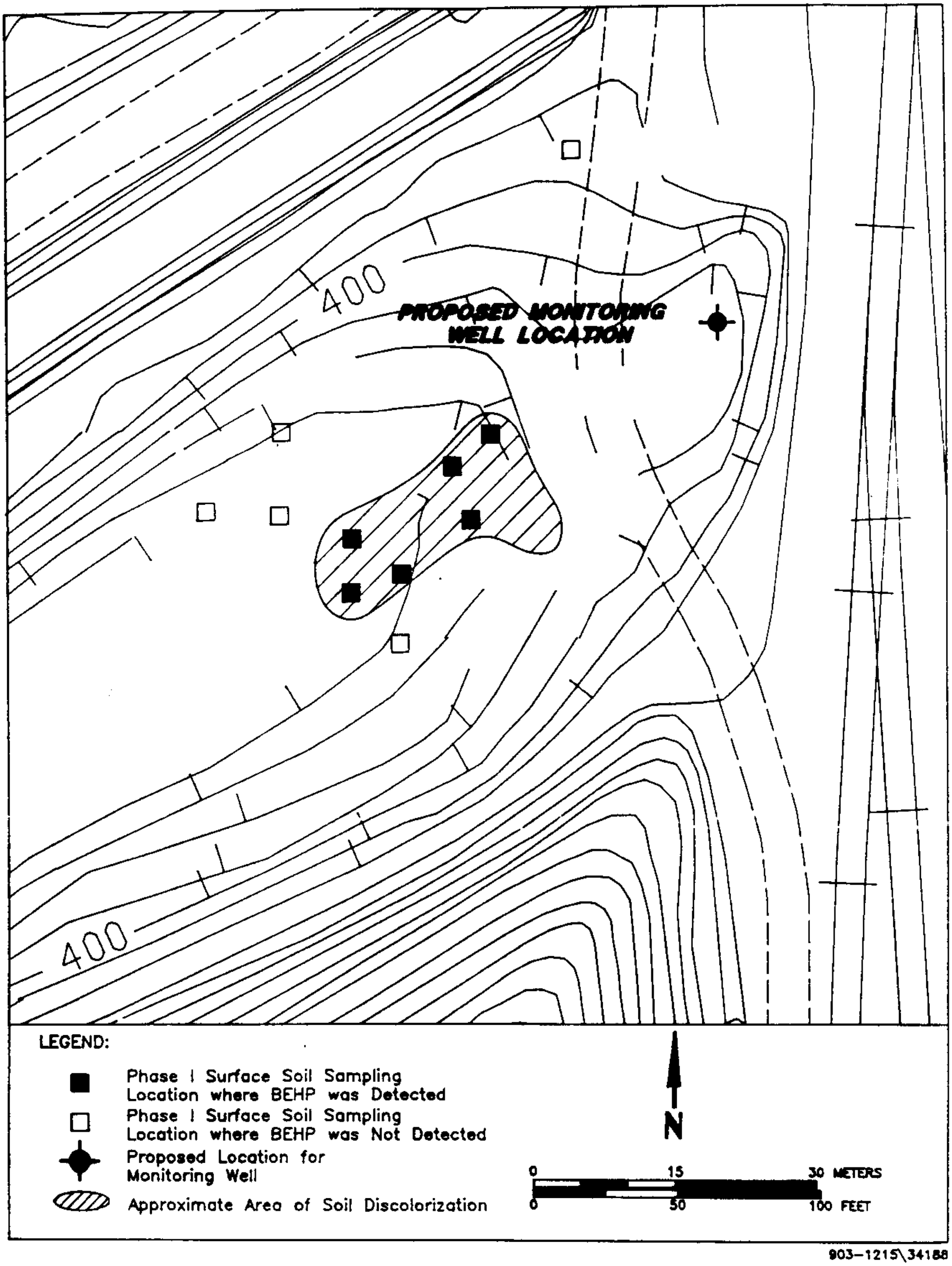

Figure 4-8. Proposed Location of the Contingent Stage 2 Ground-Water Monitoring Well at the UN-1100-6 Operable Subunit.

4.5.3.2 Activity 3b—Ground-Water Sampling and Analysis at UN-1100-6.

Activity Objective: The purpose of this activity is to sample and analyze the ground-water monitoring wells installed during Activity 3a (see Section 4.5.3.1).

Activity Description: Ground-water samples will be obtained from the Stage 1 downgradient well, and analyzed to characterize operable unit ground water. Analytical results will be used to determine if additional stages of monitoring wells are required to delineate operable subunit ground-water contamination.

Sampling equipment, sample designation, and handling procedures are specified in Chapters 4 and 5 and Tables 2 and 3 of the QAPP (see Appendix A).

Sample Location, Frequency and Analysis: Ground water will be sampled from the Stage 1 downgradient well, installed in Activity 3a (see Section 4.5.3.1), within one week after well completion, then quarterly for two periods, and then included, as necessary, in the regular monitoring for the operable unit. The Stage 1 initial two rounds of sampling (the second round is required for verification of the results from the first round) will be analyzed for TCL, TAL, and conventional water quality parameters.

Additional rounds of sampling will be analyzed for contaminants of interest. Such parameters will be determined from the results of the Data Evaluation and Baseline Risk Assessment Refinement Tasks (see Sections 4.9.3 and 4.11, respectively). If Stage 2 monitoring wells are installed, samples will be taken within one week of well completion, then quarterly for two periods, and then included, as necessary, in the regular monitoring for the operable subunit. Stage 2 samples will be analyzed for contaminants of interest. Analytical methods are specified in Table 1 of the QAPP (see Appendix A).

4.6 HORN RAPIDS LANDFILL TASKS

Horn Rapids Landfill operable subunit requires further investigation due to the elevated concentrations of TCE and nitrate in ground water, and PCB and chromium in soils. This investigation is divided into the following tasks:

- Task 1—Contaminant Source Investigation for Horn Rapids Landfill
- Task 2—Pedological Investigation for Horn Rapids Landfill
- Task 3—Hydrogeological Investigation for Horn Rapids Landfill.

Descriptions of these tasks are provided below.

4.6.1 Task 1—Contaminant Source Investigation for Horn Rapids Landfill

Soil gas monitoring network installation and sampling, and radiochemical analysis, are the two activities planned for this task.

4.6.1.1 Activity 1a—Soil Gas Monitoring Network Installation and Sampling at Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to install a system to detect any changes in concentrations of VOCs in soil gas being generated within the landfill that would indicate a sudden release of buried liquid solvents.

Activity Description: A permanent soil gas monitoring network will be installed to monitor for the release of vapors from the rupture of suspected buried drums of volatile liquids. Additional temporary soil gas survey locations may be required under Task 3, Hydrogeological Investigation, if the source of TCE in the local ground water is attributed to the landfill.

Soil gas probe installation, soil gas sampling, sample handling, and sample designation procedures are specified in Chapters 4 and 5 and Tables 2 and 3 of the QAPP (see Appendix A).

Sampling Location and Frequency: Thirty-five permanent soil gas probes will be installed on a 76-m (250-ft) grid as shown in Figure 4-9. Soil gas probes will be sampled within one week of completion, and then sampled every quarter. Soil gas will be analyzed for VOCs according to the procedures specified in Table 1 of the QAPP (see Appendix A). Soil gas probe locations will be surveyed (see Section 4.2.2.1).

4.6.1.2 Activity 1b—Radioactivity Analysis for Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to determine whether the soils of the Horn Rapids Landfill operable subunit are contributing to the low-level radiation contamination found in the ground water in the vicinity of the landfill.

Activity Description: Archived subsurface soil samples obtained during the Phase I RI will have complete laboratory analysis for gross-alpha, -beta, and -gamma radiation. Archived background soil samples will also be analyzed to allow for comparisons to local background conditions.

Sample Locations, Frequencies and Analysis: No new sampling will be conducted for this activity; archived soil samples from borings HRL-2 through HRL-10 will be used. The locations of these borings are shown in Figure 4-10. Archived samples from borings BAP-2, DP-7, and HRL-1 will be used to characterize background soil radiation levels. The locations of these background borings are shown in Figure 4-2. All samples will have complete laboratory analysis for gross-alpha, -beta, and -gamma radiation. If radiation is present in amounts significantly above background levels, further analysis will be conducted to determine the presence of any specific radionuclides of potential concern. The analytical methods for conducting the gross-alpha, -beta, and -gamma radiation analysis are specified in Table 1 of the QAPP (see Appendix A). If further analysis is required to determine the presence of specific radionuclides, the QAPP will be amended to specify the analytical methods required.

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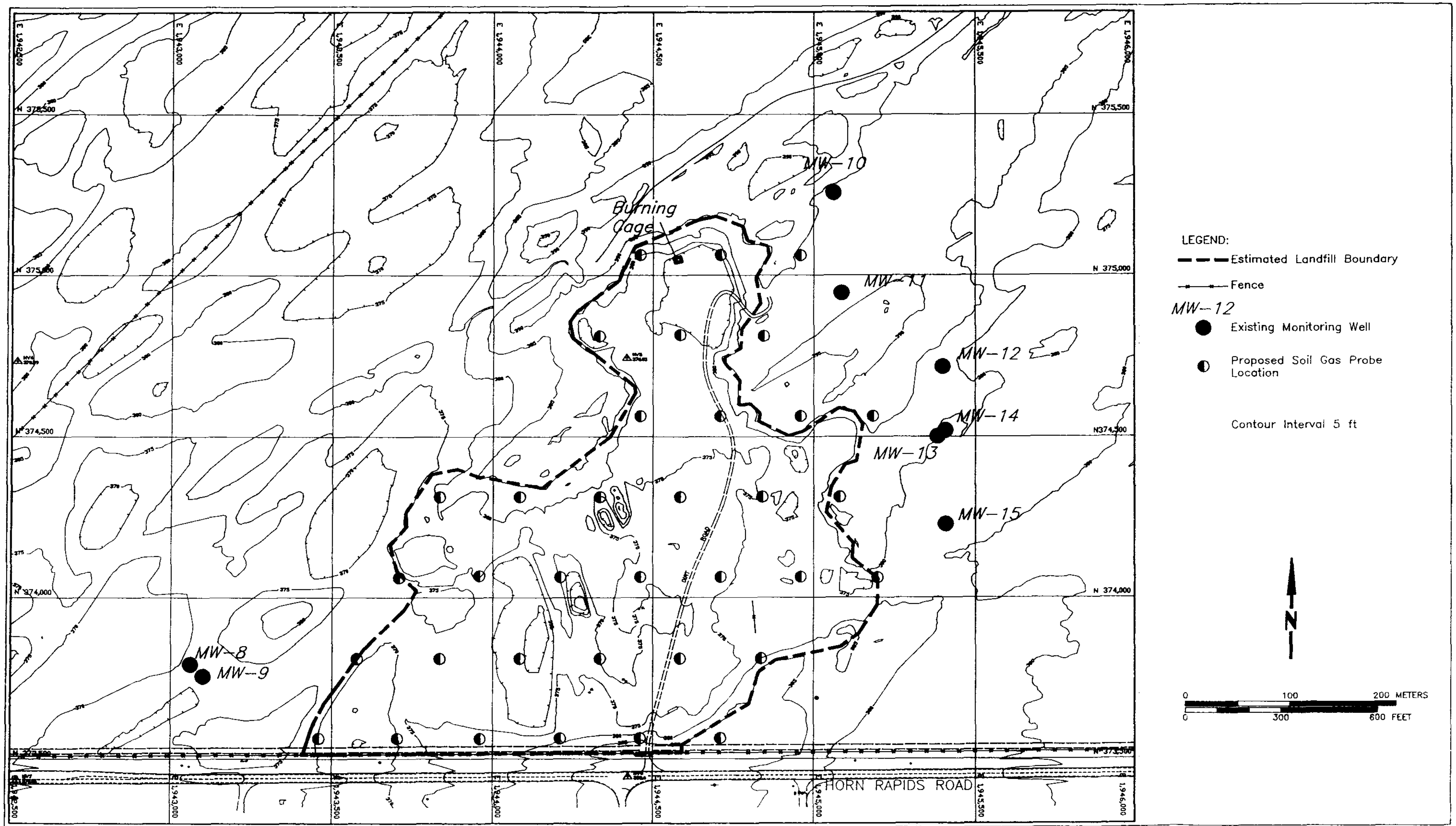

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Figure 4-9. Proposed Location for 35 Permanent Soil Gas Probes for the Horn Rapids Landfill Operable Subunit.

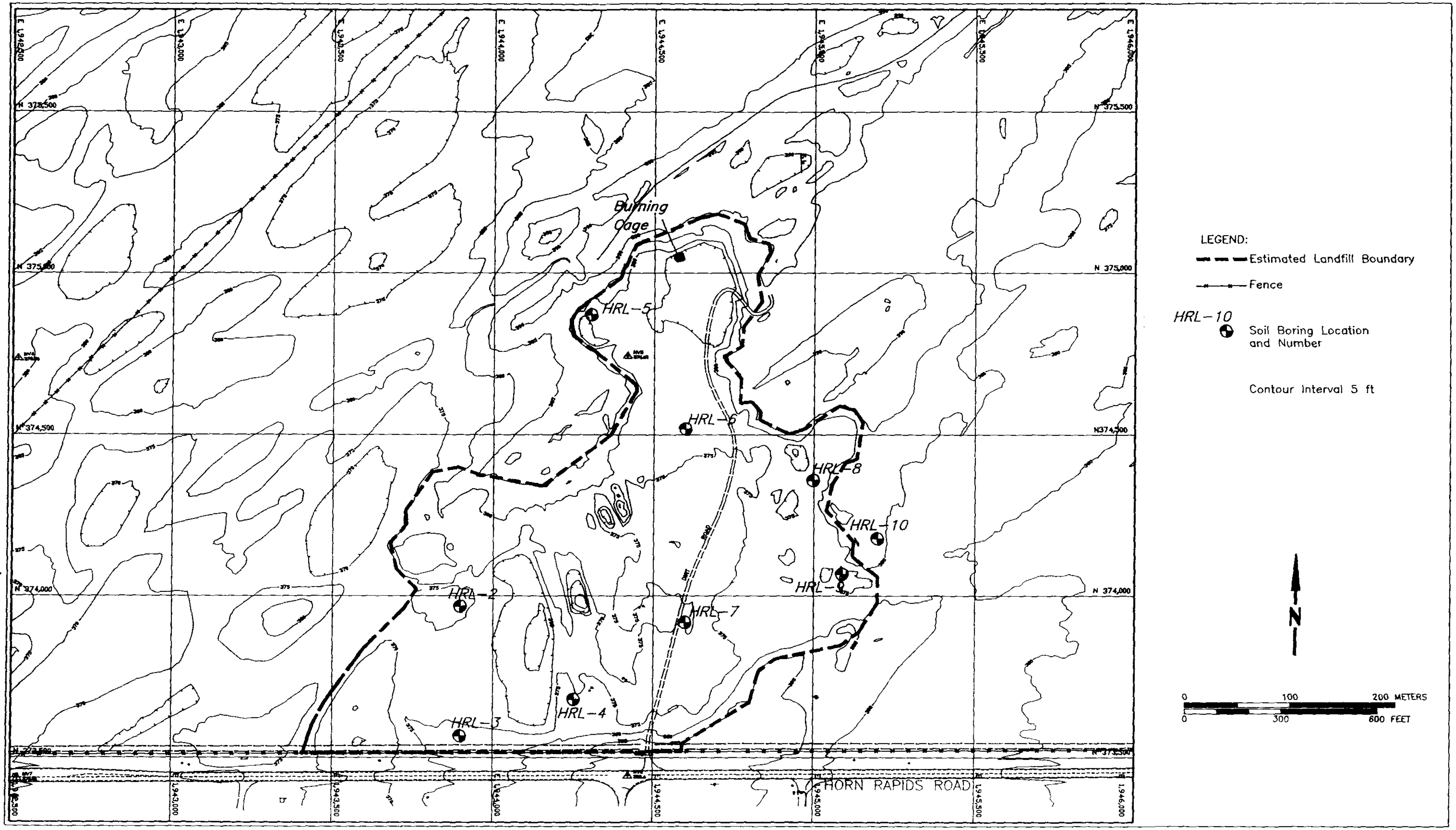

Figure 4-10. Phase I RI Soil Boring Locations at the Horn Rapids Landfill Operable Subunit.

4.6.2 Task 2—Pedological Investigation for Horn Rapids Landfill

Two activities are planned for this task: PCB delineation and chromium oxidation state analysis.

4.6.2.1 Activity 2a—PCB Delineation at Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to delineate the lateral and vertical extent of PCB contamination in soils at Horn Rapids Landfill operable subunit.

Activity Description: Additional soil samples will be collected in stages to accurately define the lateral and vertical extent of PCB contamination.

Surface sampling, soil boring installation, sampling equipment, sample handling, and sample designation procedures are specified in Chapters 4 and 5 and Tables 2 and 3 of the QAPP (see Appendix A).

Sampling Location and Frequency: The locations of Stage 1 surface and subsurface samples are shown in Figure 4-11. If additional stages of soil sampling are required to delineate the extent of contamination, locations will be determined upon the results of Stage 1 sampling and analysis. Subsurface hand-augered borings will be completed to a depth of 1.2 m (4 ft). Samples will be collected at 0.3, 0.6, and 1.2 m (1, 2, and 4 ft) below the surface.

All soil samples collected for this activity will be analyzed for PCBs according to the analytical procedures specified in Table 1 of the QAPP (see Appendix A).

4.6.2.2 Activity 2b—Sample and Analyze for Chromium Oxidation State at Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to determine the oxidation state of the chromium that is elevated in the surface soils at Horn Rapids Landfill operable subunit. The risk assessment prepared during Phase I RI assumed the presence of hexavalent chromium, the most toxic state.

Activity Description: Additional surface soil samples will be collected and analyzed for chromium oxidation state from locations identified as having elevated concentrations of chromium.

Surface sampling procedures are specified in Table 2 of the QAPP (see Appendix A).

Sampling Location and Frequency: Surface soil samples will be obtained one time in the immediate vicinity of borehole HRL-8, and Phase I RI surface sample locations AH181 and AH184. Figure 4-12 shows the location of the samples. Samples will be analyzed for total chromium and hexavalent chromium. Analytical procedures are specified in Table 1 of the QAPP (see Appendix A). Sample locations will be surveyed (see Section 4.2.2.1).

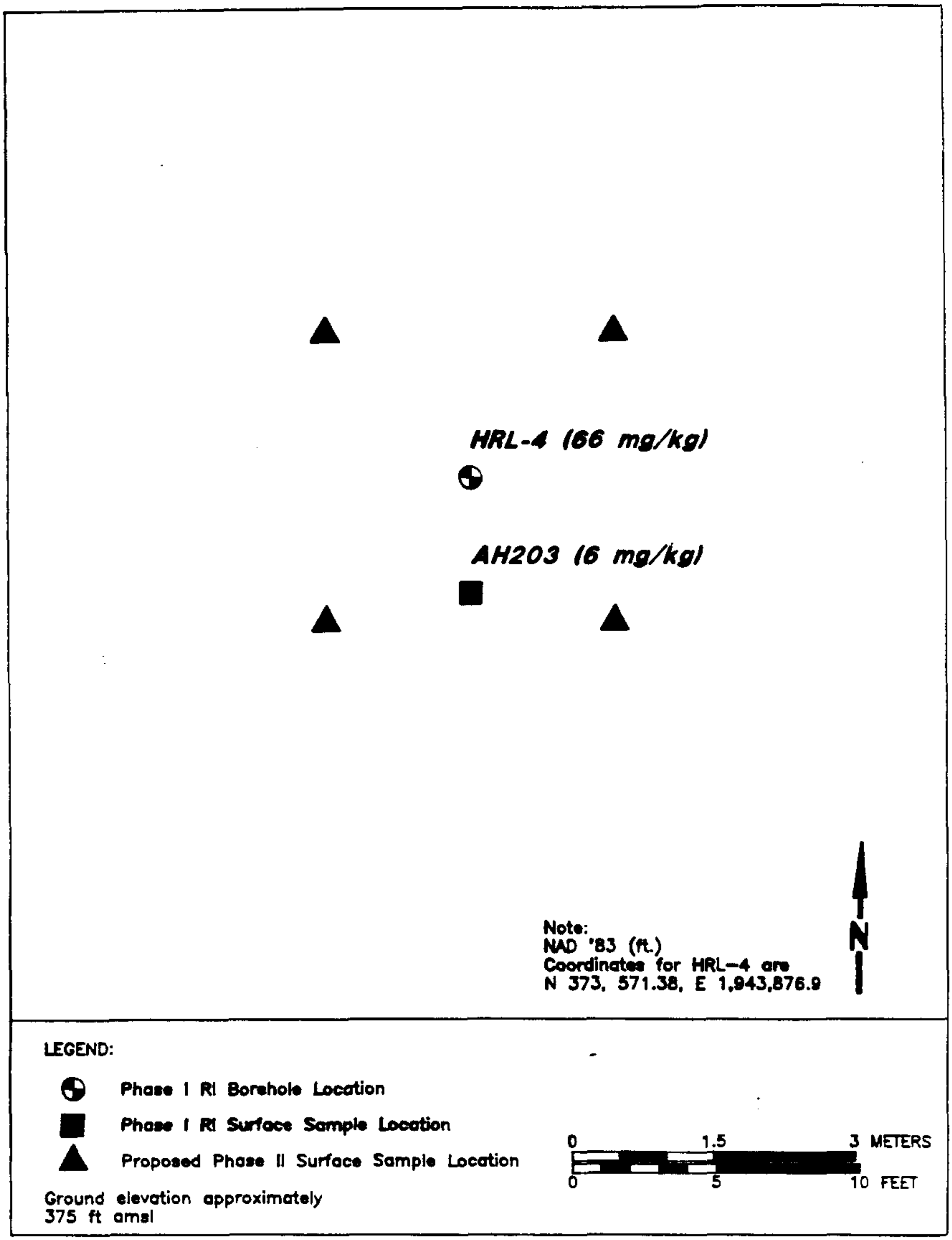

Figure 4-11. Proposed Stage 1 Soil Sampling for PCB Delineation at the Horn Rapids Landfill Operable Subunit.

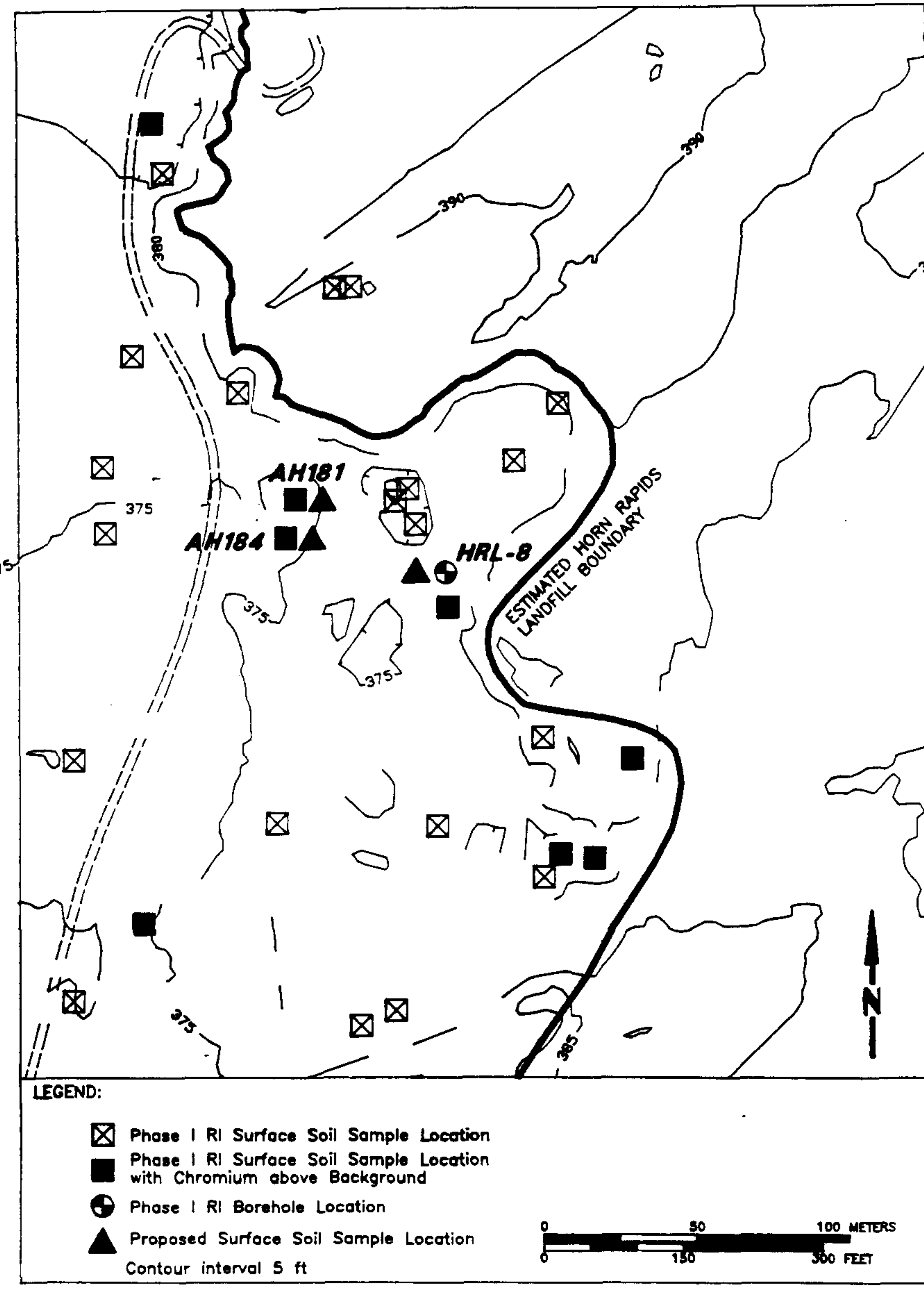

Figure 4-12. Proposed Locations of Surface Soil Sampling for Chromium at the Horn Rapids Landfill Operable Subunit.

4.6.3 Task 3—Hydrogeological Investigation for Horn Rapids Landfill

Further characterization of Horn Rapids Landfill operable subunit ground water is required due to the elevated nitrate and TCE. The source(s) of the elevated nitrate and TCE was not definitively determined during Phase I RI activities. This task consists of the following potential set of activities:

- Evaluate existing upgradient monitoring well locations
- Install upgradient monitoring well installation
- Sample and analyze upgradient ground-water monitoring wells
- Evaluate TCE and nitrate sources
- Conduct a soil gas test for ground-water plume delineation
- Delineate ground-water plume by soil gas
- Install additional monitoring wells
- Sample and analyze ground water from additional monitoring wells
- Plan, install, and conduct a pumping test
- Evaluate TCE degradation.

4.6.3.1 Activity 3a—Evaluate Existing Upgradient Monitoring Wells at Horn Rapids Landfill.

Activity Objective: Due to the contaminant plume known to have emanated from the ANF complex, the placement of Horn Rapids Landfill upgradient monitoring wells is crucial to the characterization of Horn Rapids Landfill operable subunit potential contribution to ground-water contamination. The purpose of this activity is to evaluate the locations of existing upgradient monitoring wells installed during the Phase I RI, and to evaluate existing ANF monitoring wells to determine if additional upgradient wells are necessary.

Activity Description: Ground-water gradient maps prepared in the Phase I RI will be used to determine if existing wells are in optimum locations for upgradient characterization. Well construction and bore logs for ANF will be obtained and reviewed to determine the usability of monitoring well data for Horn Rapids Landfill characterization. This activity will determine if additional upgradient wells are necessary.

All information collected by this activity will be documented and filed in the project file according to the applicable procedures specified in Table 2 of the QAPP (see Appendix A).

Sample Location, Frequency, and Analysis: No sampling is required by this activity.

4.6.3.2 Activity 3b—Installation of Additional Upgradient Monitoring Wells at Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to install additional upgradient monitoring wells between the Horn Rapids Landfill and potential upgradient ground-water contamination sources.

Activity Description: The need for the implementation for this task is contingent on the evaluation of existing upgradient wells conducted in Activity 3a. If additional wells are required, this task will consist of installing additional upgradient wells to characterize ground water entering or flowing beneath the Horn Rapids Landfill.

The procedures for installing ground-water wells are specified in Table 2 of the QAPP (see Appendix A).

Sample Location, Frequency, and Analysis: No sampling is required by this task. Should this task become necessary, wells would be installed upgradient from the operable subunit. Areas proposed for additional upgradient monitoring wells, denoted as A and B, are shown in Figure 4-13. Whether any new upgradient wells are installed, and whether they are installed in Area A or Area B, is dependent on the evaluation of existing upgradient wells on ANF property and the potential for ground-water contamination attributable to the South Pit.

If any monitoring wells are installed by this activity, soil samples will be obtained every 1.5 m (5 ft) and at changes of lithology. Samples will be obtained by drive tube, sealed, and analyzed, according to procedures specified in Table 2 of the QAPP (see Appendix A), for in-situ moisture. All wells installed by this activity will be geodetically surveyed (see Section 4.2.2.1).

4.6.3.3 Activity 3c—Upgradient Ground-Water Sampling and Analysis at Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to sample and analyze upgradient monitoring wells installed in Activity 3b (Section 4.6.3.2).

Activity Description: Upgradient monitoring wells installed in Activity 3b (Section 4.6.3.2) will be sampled and analyzed to determine the upgradient water quality for Horn Rapids Landfill operable subunit.

Chapters 4 and 5 and Tables 2 and 3 of the QAPP (see Appendix A) specify sampling, sampling equipment, and sample designation and handling procedures.

Sample Location, Frequency, and Analysis: Ground water will be sampled within one week of well completion, then quarterly for two periods, and then included, as necessary, in the regular monitoring schedule for the operable unit. The initial two rounds (the second round is required for verification of the results from the first round) of sampling will be analyzed for TCL, TAL, and conventional water quality parameters. Additional rounds of sampling will be analyzed for contaminants of interest. Such parameters will be determined from the results of the Data Evaluation and Baseline Risk Assessment Refinement Tasks (see Sections 4.9.3 and 4.11, respectively). Analytical procedures are specified in Table 1 of the QAPP (see Appendix A).

4.6.3.4 Activity 3d—Evaluate TCE and Nitrate at Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to evaluate TCE and nitrate as compared to upgradient water quality to determine if Horn Rapids Landfill is a potential source.

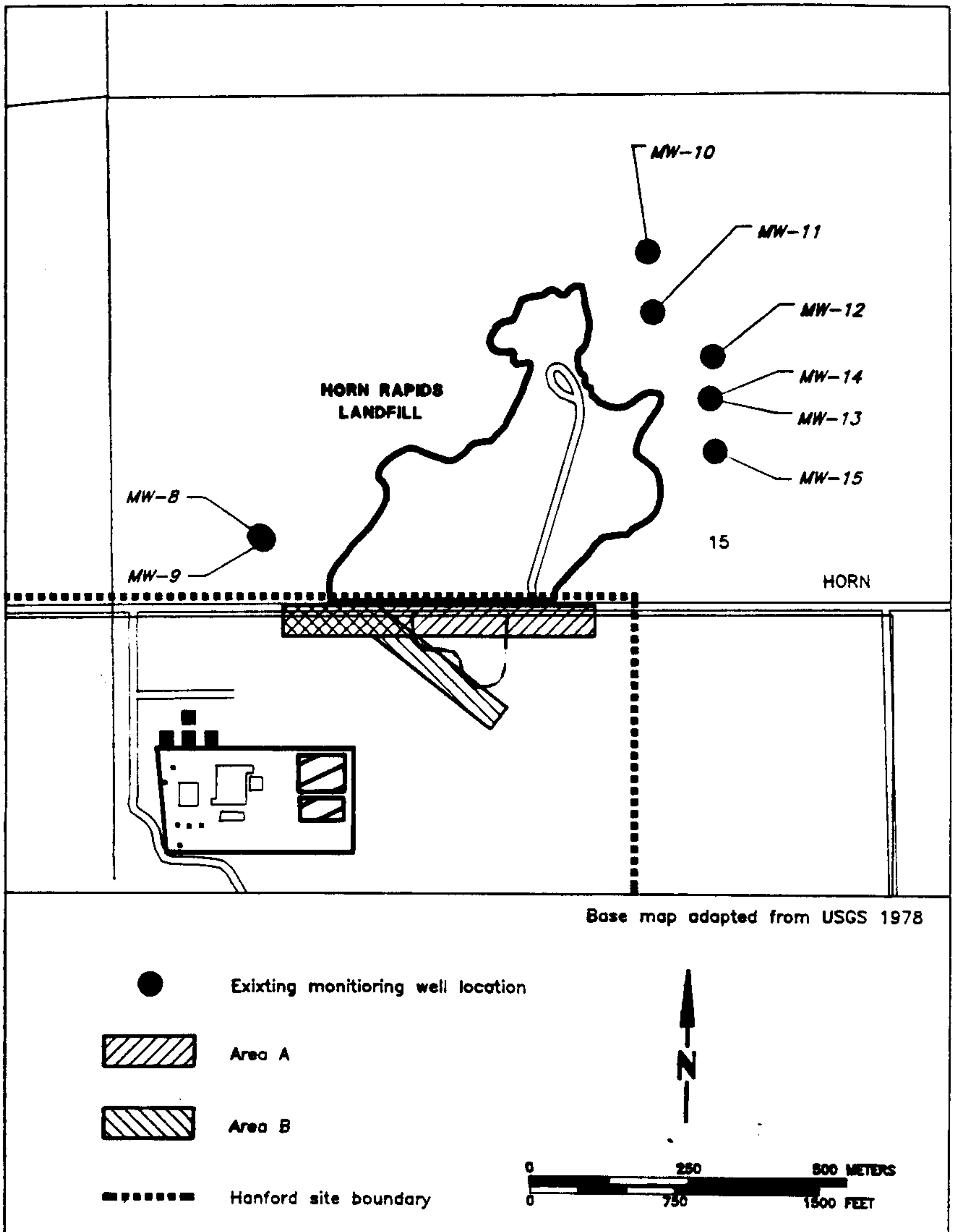

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Figure 4-13. Proposed Areas for Potential Upgragient Monitoring Well Locations at the Horn Rapids Landfill Operable Subunit.

Activity Description: Water quality results for TCE and nitrate, available from all upgradient wells, will be compared to operable subunit downgradient monitoring well data to determine if Horn Rapids Landfill is contributing to the ground-water contamination. If the TCE and nitrate are not attributed to Horn Rapids Landfill, no further hydrogeologic characterization will be conducted.

The evaluations conducted by this task will be documented and handled according to procedures specified in Table 2 of the QAPP (see Appendix A).

Sample Location, Frequency, and Analysis: No sampling is required by this task.

4.6.3.5 Activity 3e—Soil Gas Testing for Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to determine if soil gas is an effective method for delineating TCE ground-water contamination in the vicinity of the Horn Rapids Landfill.

Activity Description: The need for implementation for this task is contingent on the results of TCE and nitrate evaluation conducted in Activity 3d. Soil gas will be sampled at four depths in the vicinity of downgradient monitoring wells. Soil gas results will be analyzed for spacial, depth, and purging variability, and surface infiltration effects. The analysis will be used to determine if soil gas is an effective method to delineate TCE ground-water contamination by soil gas, and, if so, to refine specific methodology.

Soil gas probe installation, sample designation, and handling procedures are specified in Table 2 of the QAPP (see Appendix A).

If soil gas is not determined to be an effective method for delineating the TCE ground-water plume, a new activity will be created to delineate the plume by installing monitoring wells in stages.

Sample Location, Frequency, and Analysis: If this activity is conducted, temporary soil gas probes will be installed in a triangular pattern around existing monitoring wells MW-12, MW-15, and 699-S29-E12. Figure 4-14 shows the locations of these wells. Soil gas probes will be installed to a depth of 3 m (10 ft), and samples will be obtained at depths of 0.6, 1.2, 1.8, and 3 m (2, 4, 6, and 10 ft). Samples will be analyzed for the VOCs according to the analytical procedures specified in Table 1 of the QAPP (see Appendix A). The results will be analyzed for spacial, depth, and purging variability, and surface infiltration effects. Soil gas probe locations will be geodetically surveyed (see Section 4.2.2.1).

4.6.3.6 Activity 3f—Plume Delineation by Soil Gas at Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to preliminarily delineate VOC ground-water contamination with soil gas.

Activity Description: This activity is contingent on the results of Activity 3e in Section 4.6.3.5. Soil gas probes will be installed in stages to delineate the extent of the VOC ground-water contamination in the area of the Horn Rapids Landfill.

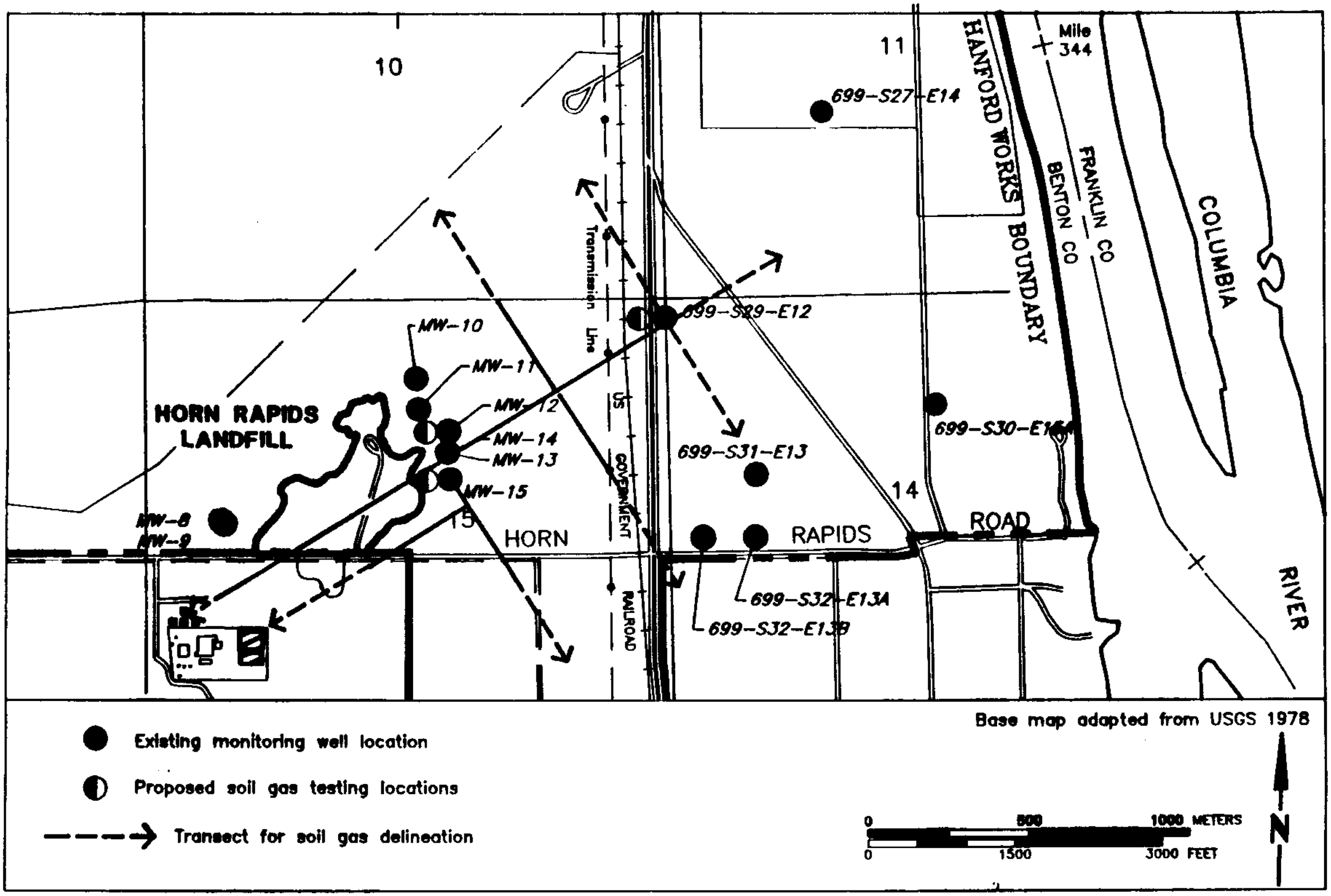

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Figure 4-14. Proposed Transects for Preliminary Ground-Water Plume Delineation by Soil Gas Survey and Proposed Soil Gas Testing Locations at the Horn Rapids Landfill Operable Subunit.

Soil gas probe installation, sample designation, and handling procedures are specified in Chapters 4 and 5 and Tables 2 and 3 of the QAPP (see Appendix A).

Sample Location, Frequency, and Analysis: Temporary soil gas probes will be installed in stages along transects shown in Figure 4-14 at 76-m (250-ft) intervals. Soil gas samples will be analyzed for the VOCs according to the analytical procedures specified in Table 1 of the QAPP (see Appendix A). Installation of additional stages of soil gas will be determined upon the results Stage 1 soil gas. Soil gas probe locations will be staked and locations geodetically surveyed (see Section 4.2.2.1).

4.6.3.7 Activity 3g—Additional Monitoring Well Installation at Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to install additional monitoring wells to confirm the TCE plume extent delineated by Activity 3f (see Section 4.6.3.6).

Activity Description: The need for the implementation of this activity is contingent on the results of TCE and nitrate evaluation in Activity 3d (see Section 4.6.3.4). Monitoring wells will be installed in stages to monitor operable unit ground-water contamination and confirm the extent of the plume.

Monitoring well installation procedures are specified in Table 2 of the QAPP (see Appendix A).

Sample Location, Frequency, and Analysis: Should this activity become necessary, additional monitoring wells will be installed in stages downgradient from the operable subunit. The results of the soil gas survey conducted in Activity 3e (Section 4.6.3.6) will be used to locate additional monitoring wells. If any monitoring wells are installed by this activity, soil samples will be obtained every 1.5 m (5 ft) and at changes of lithology. Samples will be obtained by drive tube, sealed, and analyzed according to procedures specified in Table 2 of the QAPP (see Appendix A) for in-situ moisture. Wells installed by this activity will be sampled and analyzed by Activity 3h. All wells installed by this activity will be geodetically surveyed (see Section 4.2.2.1).

4.6.3.8 Activity 3h—Ground Water Sampling and Analysis at Horn Rapids Landfill.

Activity Objective: The purpose of this activity is to sample and analyze monitoring wells installed under Activity 3g (see Section 4.6.3.7).

Activity Description: Should this activity become necessary, ground-water samples will be obtained from Stage 1 monitoring wells and analyzed to confirm the extent of the plume. Analytical results will also be used to determine if additional stages of monitoring wells are required to delineate operable subunit ground-water contamination.

Sampling equipment, sample designation, and handling procedures are specified in Chapters 4 and 5 and Tables 2 and 3 of the QAPP (see Appendix A).

Sample Location, Frequency and Analysis: Ground water will be sampled from monitoring wells installed in Activity 3g (see Section 4.6.3.7), within one week after well completion, then quarterly for two periods, and then included in the regular monitoring for the operable subunit. Samples will be analyzed for contaminants of interest. Such parameters will be determined from the results of the Data Evaluation and Baseline Risk Assessment Refinement Tasks (see Sections 4.9.3 and 4.11, respectively). Contaminants of interest will be determined by the results from upgradient ground-water results. Analytical methods are provided in Table 1 of the QAPP (see Appendix A).

4.6.3.9 Activity 3i—Hydraulic Pump Test Planning.

Activity Objective: The purpose of this activity is conduct, if necessary, planning to perform pump testing.

Activity Description: Once the nature and extent of ground-water contamination attributable to the landfill, if any, is well understood, a hydraulic pump test plan, in the form of a technical memorandum, will be prepared to determine the number of pump tests necessary, the location of the pump test and pumping well, and the use of existing wells for observation.

Sample Location, Frequency, and Analysis: No sampling is required by this activity.

4.6.3.10 Activity 3j—Pumping Well Installation.

Activity Objective: If a pump test is determined to be necessary, a high capacity pumping well will need to be installed. The currently installed monitoring wells are not capable of pumping flow rates (up to 2,500 l/min) large enough to adequately stress the aquifer.

Activity Description: The hydraulic pump test plan (see Activity 3i) will establish the most effective location(s) for the pump test(s) and pumping well(s). The pumping well must be designed to accommodate and sustain large flow rates (up to 2,500 l/min) with high water transmission efficiency. Figure 4-15 illustrates the proposed construction details of the aquifer hydraulic testing/pumping well.

Details as the pumping well installation procedures are specified of the QAPP (see Appendix A).

Sample Location, Frequency, and Analysis: Soil samples will be obtained every 1.5 m (5 ft) and at change in stratigraphy. Samples will be obtained by drive tube in accordance with procedures listed in Table 2 in the QAPP (see Appendix A). The soil samples will be for hydrogeologic assessments and will not be chemically analyzed. All pumping wells installed by this activity will be surveyed (see Section 4.2.2.1).

4.6.4.11 Activity 3k—Pump Test.

Activity Objective: The purpose of conducting hydraulic pump tests, if they become necessary, is to obtain information on the hydraulic properties of the unconfined aquifer in the vicinity of Horn Rapids Landfill. The information obtained from the pump test will be used for operable unit characterization, baseline risk assessment, and evaluation of remedial alternatives.

Activity Description: Before performing drawdown/recovery tests, the wells will be tested for well efficiency and antecedent trends in water levels. Well efficiency will be

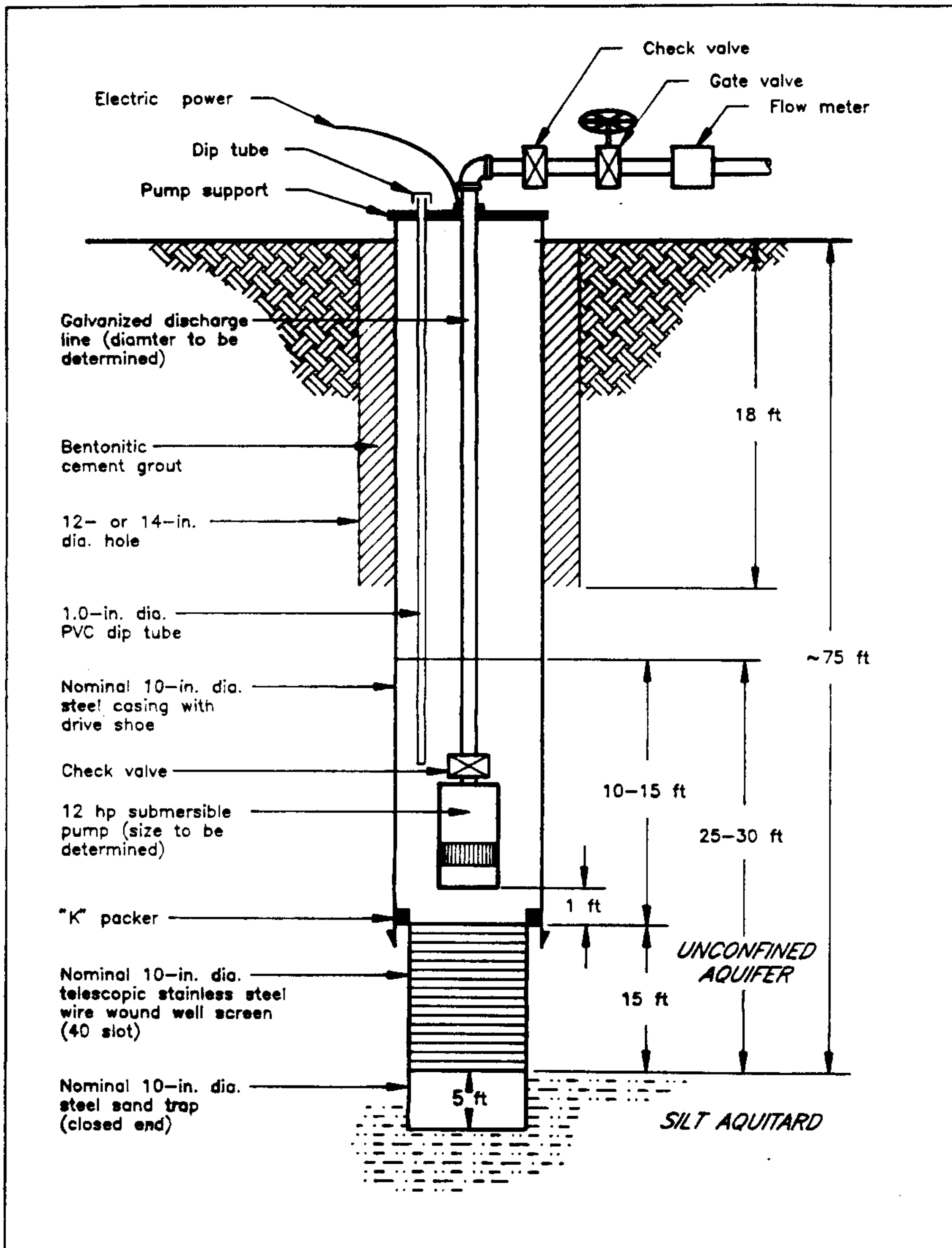

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Figure 4-15. Diagram of Extraction Well/Pump Construction at the Horn Rapids Landfill Aquifer Pump Test.

evaluated by using the step drawdown technique which will be conducted at three discharge rates. Estimates of well efficiency and transmissivity will be made and the optimal constant pumping rate for longer term drawdown/recovery test will be determined. For evaluation of antecedent trends, water levels will be monitored and recorded for a period of about 25% of the anticipated pumping time.

During the drawdown/recovery test, the well will be pumped at a constant rate for a minimum of one day. The total length of the test will be determined by a hydrogeologist and will depend on the results of the step drawdown tests. Drawdown and pump discharge rate will be monitored and recorded with time. The pump discharge rate will be monitored and regulated if the discharge rate changes. After the pump is turned off, the recovery of water levels in the well will be monitored and recorded with time. Other wells in the near vicinity, < 100 m (< 328 ft) from the pumping well, will be monitored for water levels during the entire test.

Details on the testing methodologies, equipment, calibration requirements, and data monitoring and recording frequencies are specified in the applicable procedures included in Table 2 of the QAPP (see Appendix A). Procedures for handling and disposing of purgewater at the Hanford Site are provided in DOE-RL, Ecology, and EPA (1990).

<u>Sample Location, Frequency, and Analysis:</u> The location of the test and number of tests will be determined under Activity 3i (see Section 4.6.3.9).

4.6.4.12 Activity 3l—Contaminant Degradation Evaluation.

<u>Activity Objective:</u> The purpose of this activity is to evaluate the degradation of TCE in the ground water in the vicinity of Horn Rapids Landfill.

<u>Activity Description:</u> Hydraulic degradation of TCE will be evaluated by collecting samples of ground water from monitoring wells known to have detectable TCE in low, medium, and high concentrations. The ground-water samples will be analyzed for TCE and TCE degradation products at various time intervals.

<u>Sample Location, Frequency, and Analysis:</u> Samples of ground water will be obtained from MW-11, MW-12, and MW-15 and placed in volatile organic analyses (VOA) bottles. Samples will be stored in an area void of light at the average ground-water temperature for the Horn Rapids Landfill vicinity. Samples will be extracted from the individual bottles at 1, 2, 4, 8, and 12 months and analyzed for TCE and TCE degradation byproducts: dichloroethene and vinyl chloride. Analytical methods are specified in Table 1 of the QAPP (see Appendix A).

4.7 EPHEMERAL POOL TASKS

Random surface grab samples obtained from the Ephemeral Pool during Phase I RI sampling activities found elevated PCB concentrations. Further characterization of the soils is planned in the following task:

- Pedological Investigation for Ephemeral Pool.

4.7.1 Task 1—Pedological Investigation for Ephemeral Pool

The pedological investigation at the Ephemeral Pool consists of one activity to delineate the PCB contamination.

4.7.1.1 Activity 1a—PCB delineation at the Ephemeral Pool.

Activity Objective: The purpose of this activity is to delineate the lateral and vertical extent of PCB contamination within the Ephemeral Pool.

Activity Description: Additional soil samples will be collected in stages to accurately delineate the lateral and vertical extent of PCB contamination.

Surface and subsurface sampling, sampling equipment, sample handling, and sample designation procedures are specified in Chapters 4 and 5, and Tables 2 and 3 of the QAPP (see Appendix A).

If a previously defined removal action is determined to be appropriate, a new task will be created to develop and implement a removal plan.

Sample Locations, Frequency and Analysis: The locations of six Stage 1 surface soil samples are shown in Figure 4-16. If additional stages of sampling are required to delineate the lateral extent of contamination, locations will be determined upon the results of Stage 1 sampling and analysis. In Stage 2, soil borings will be completed by hand augering to a depth of 1.2 m (4 ft) to determine the vertical extent. Samples will be collected at depths of 0.3, 0.6, and 1.2 m (1, 2 and 4 ft) below the surface. All sampling locations will be geodetically surveyed (see Section 4.2.2.1).

All soil samples will be analyzed for PCBs according to the analytical procedures specified in Table 1 of the QAPP (see Appendix A).

4.8 SOUTH PIT TASKS

The South Pit was identified from an aerial photographic study conducted by EPA (1990) during the Phase I RI. No field investigations were conducted at this potential operable subunit during the Phase I RI. Due to the evidence provided by the aerial photograph, further investigation is required. The characterization of this potential operable subunit is divided into three tasks:

- Task 1—Contaminant Source Investigation for the South Pit
- Task 2—Pedological Investigation for the South Pit
- Task 3—Hydrogeological Investigation for the South Pit.

Descriptions of these tasks are provided below.

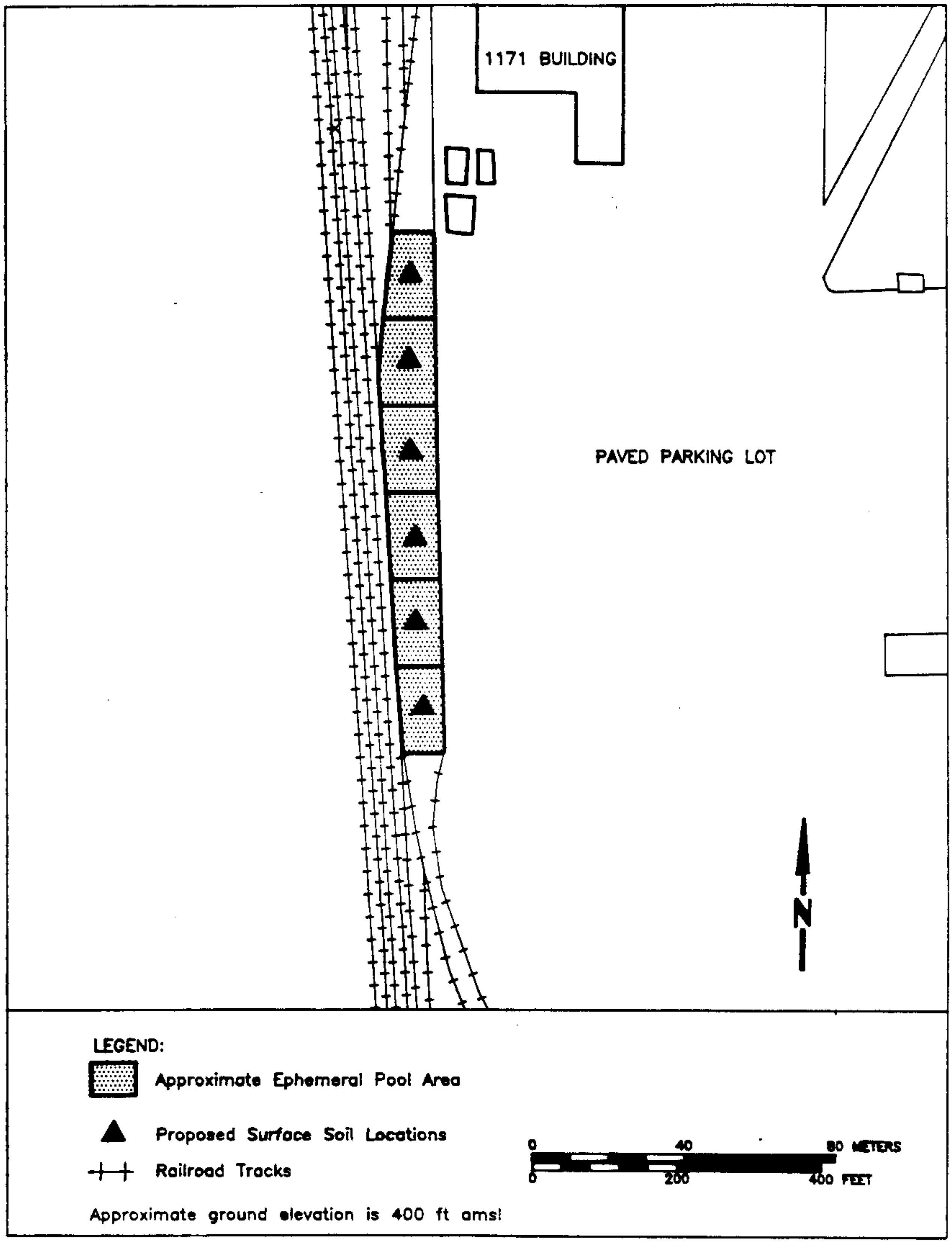

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Figure 4-16. Proposed Soil Sampling Locations at the Ephemeral Pool.

4.8.1 Task 1—Contaminant Source Investigation for the South Pit

Four activities are planned for this task: source data compilation, a surface radiation survey, a geophysical survey, and a soil gas survey.

4.8.1.1 Activity 1a—Source Data Compilation for the South Pit.

Activity Objective: The purpose of this activity is to determine if any existing information is available on the history of the South Pit that will determine if waste was disposed in the pit, and if any such disposal was related to the Hanford Site.

Activity Description: An attempt will be made to locate any existing engineering plans or environmental reports with information on the South Pit. Site visits and meetings with former and current employees and local officials will be conducted. Evidence of the facility being unrelated to the Hanford Site would result in the remainder of the Task 1 activities, and Tasks 2 and 3, not being implemented.

Information collected and interviews conducted will be documented; all records so produced shall be controlled in compliance with applicable procedures specified in Table 2 of the QAPP (see Appendix A).

Sampling Location and Frequency: No sampling will be required by this activity.

4.8.1.2 Activity 1b—Surface Radiation Survey for the South Pit.

Activity Objective: The purpose of this activity is to locate any areas of radiation in the surface soils within the South Pit.

Activity Description: An operable unit-specific background plot will first be established by conducting the survey on land surfaces where operable unit background soils were obtained. The surface of the operable subunit will be surveyed for alpha-, beta-, and gamma-radiation. A new activity will be created in Task 2 (Pedological Investigation) to characterize any surface areas identified with elevated radiation above background.

Procedures for conducting the surface radiation survey are specified in Table 2 of the QAPP (see Appendix A).

Sample Locations, Frequency and Analysis: The background plot established for the operable unit will be used for determining background surface radiation levels at the South Pit. This background radiation survey will be conducted in areas of the three background soil sampling locations that were established during the Phase I RI (see Figure 4-2) to the west of the operable unit. The three background plots will be approximately 23 m (75 ft) by 23 m (75 ft). Sampling at the background plots will be conducted at intersecting points on approximately an 8-m (25-ft) grid to obtain discrete readings at each point. This grid spacing may be modified if it is determined that a closer spacing is required. Approximately 48 total points will be sampled using this grid spacing. Such background measurements will be obtained after the pit itself is surveyed, and only if detectable levels of radiation are encountered.

Sampling within the South Pit will be conducted along transects within the area shown in Figure 4-17 at approximately 8-m (25-ft) intervals to determine the location and the extent of elevated radiation. This grid spacing may be modified if it is determined that a closer spacing is required. Where an elevated level of radiation (statistically greater than background) is encountered along a transect, the survey will depart from the transect to locate and quantify the source of the reading. Areas with elevated radiation will be staked and flagged for subsequent geodetic surveying (see Section 4.2.2.1).

The surface radiation survey will be conducted for alpha-, beta-, and gamma-radiation using a portable (vehicle-mounted or hand-held) laboratory-quality alpha detector and a sodium-iodide, beta/gamma detector that read in counts per minute. The survey will be done in dry weather conditions to avoid the potential for water shielding alpha and lower energy beta sources.

Continuous recording equipment will be used to generate data along the grid lines during the surface radiation survey. Records of all calibrations and procedure applications will be maintained in a field notebook in accordance with procedures specified in Table 2 of the QAPP (see Appendix A).

4.8.1.3 Activity 1c—Geophysical Surveys for the South Pit.

Activity Objective: The objective of this activity is to determine the depth of fill, boundary of burial areas, and location of buried objects at the South Pit.

Activity Description: The need for the implementation of this activity is contingent on the results of the source data compilation in Activity 1a (see Section 4.8.1.1). If waste disposal is determined to have occurred at the South Pit, ground penetrating radar, magnetometry, and electromagnetic surveys will be conducted to determine the depth of fill, boundary of burial areas, and locations of buried objects.

Procedures for ground penetrating radar and electromagnetic surveys are specified in Table 2 of the QAPP (see Appendix A).

Sampling Location and Frequency: A grid will be established on 15-m (50-ft) intervals and surveyed (see Section 4.2.2.1). Figure 4-18 shows the area to be included in the geophysical surveys. The ground penetrating radar and the electromagnetic survey will be conducted along transects established by the grid. Areas identified as having potential for being contaminated will be clearly marked and surveyed (see Section 4.2.2.1).

4.8.1.4 Activity 1d—Soil Gas Survey for the South Pit.

Activity Objective: The purpose of this activity is to determine if a source of contamination exists in the form of volatile emissions from the South Pit.

Activity Description: The need for the implementation of this activity is contingent on the results of the source data compilation. A soil gas survey will be conducted to determine if a source of VOC contamination exists within the South Pit soil gases. Additional stages of soil gas surveying may be required under Task 3, Hydrogeologic Investigation, if VOCs are present at significant levels in the soil gas sampled from this activity.

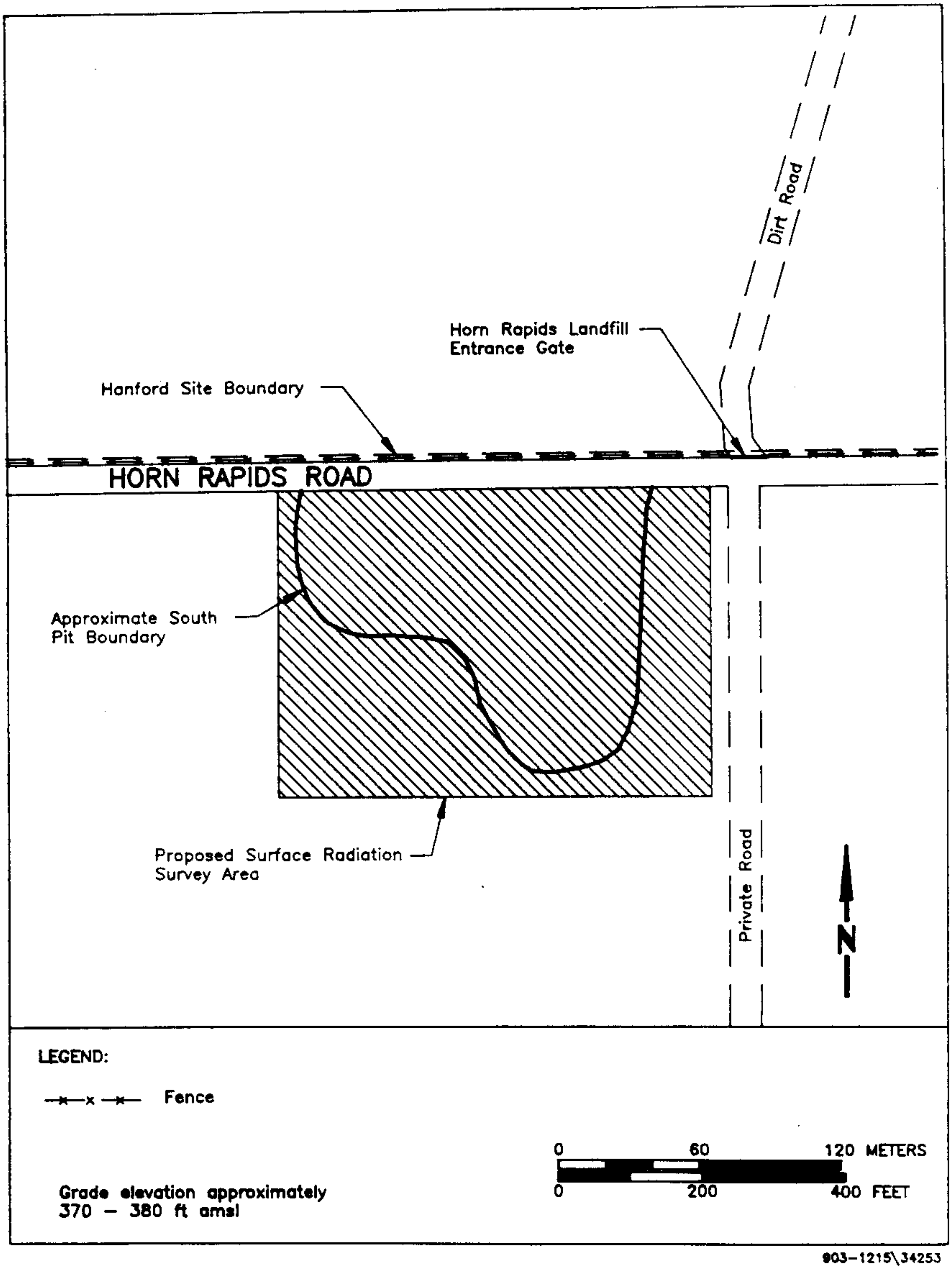

Figure 4-17. Proposed Area to Conduct the Surface Radiation Survey for the South Pit.

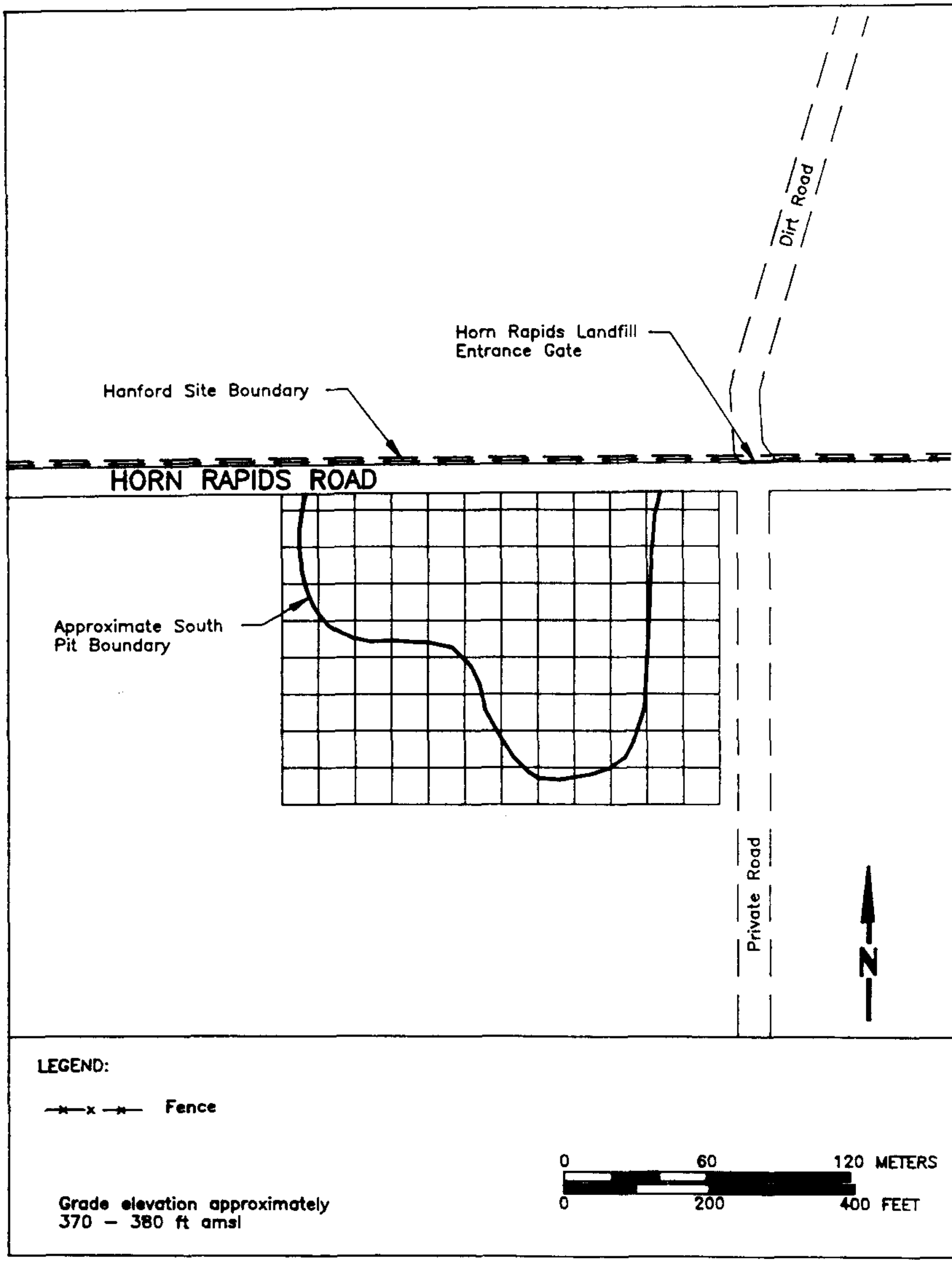

Figure 4-18. Proposed Transects for Geophysical Surveys in the South Pit.

Soil gas probe installation, sample handling, and sample designation procedures are specified in Chapters 4 and 5 and Tables 2 and 3 of the QAPP (see Appendix A).

Sample Location and Frequency: Approximately 25 soil gas probes will be installed to a depth of 1.2 m (4 ft) at locations shown in Figure 4-19. Once probes are installed, soil gas will be sampled and analyzed one time. Soil gas probe locations will be staked for surveying (see Section 4.2.2.1).

4.8.2 Task 2—Pedological Investigation for the South Pit

The need for the implementation of this task is contingent or the results of Task 1 (Section 4.8.1). If the results of the source investigation indicate a potential for soils to be contaminated, one activity, soil sampling and analysis, will be conducted.

4.8.2.1 Activity 2a—Soil Sampling and Analysis at the South Pit.

Activity Objective: The purpose of this activity is to determine if any contamination is present in South Pit soils and if required, delineate the lateral and vertical extent.

Activity Description: This activity will be conducted in stages. During Stage 1, surface and subsurface soil sample will be collected and analyzed to characterize contamination in soils at the South Pit. During Stage 2, surface and subsurface soils will be collected to determine the extent of contamination if required by Stage 1 sampling and analysis.

Surface and subsurface sampling, sampling equipment, sample handling, and sample designation procedures are specified in Chapters 4 and 5 and Tables 2 and 3 of the QAPP (see Appendix A).

Sample Location, Frequency, and Analysis: The Stage 1 soil sample locations will be determined by the results of the activities in Task 1 (Section 4.8.1). Stage 1 soil samples will be analyzed for TAL and TCL parameters. Stage 2 sampling locations will be determined upon results of Stage 1 sampling and analysis. Stage 2 samples will be analyzed for contaminants of interest. Such parameters will be determined from the results of the Data Evaluation and Baseline Risk Assessment Refinement Tasks (see Sections 4.9.2 and 4.11, respectively). Analytical procedures are specified in Table 1 of the QAPP (see Appendix A).

4.8.3 Task 3—Hydrogeological Investigation for the South Pit

The need for the implementation of this task is contingent on the results of Task 1 and Task 2. If further hydrogeological investigation is required, the Horn Rapids Landfill hydrogeological investigation will be expanded to include the South Pit due to its close proximity.

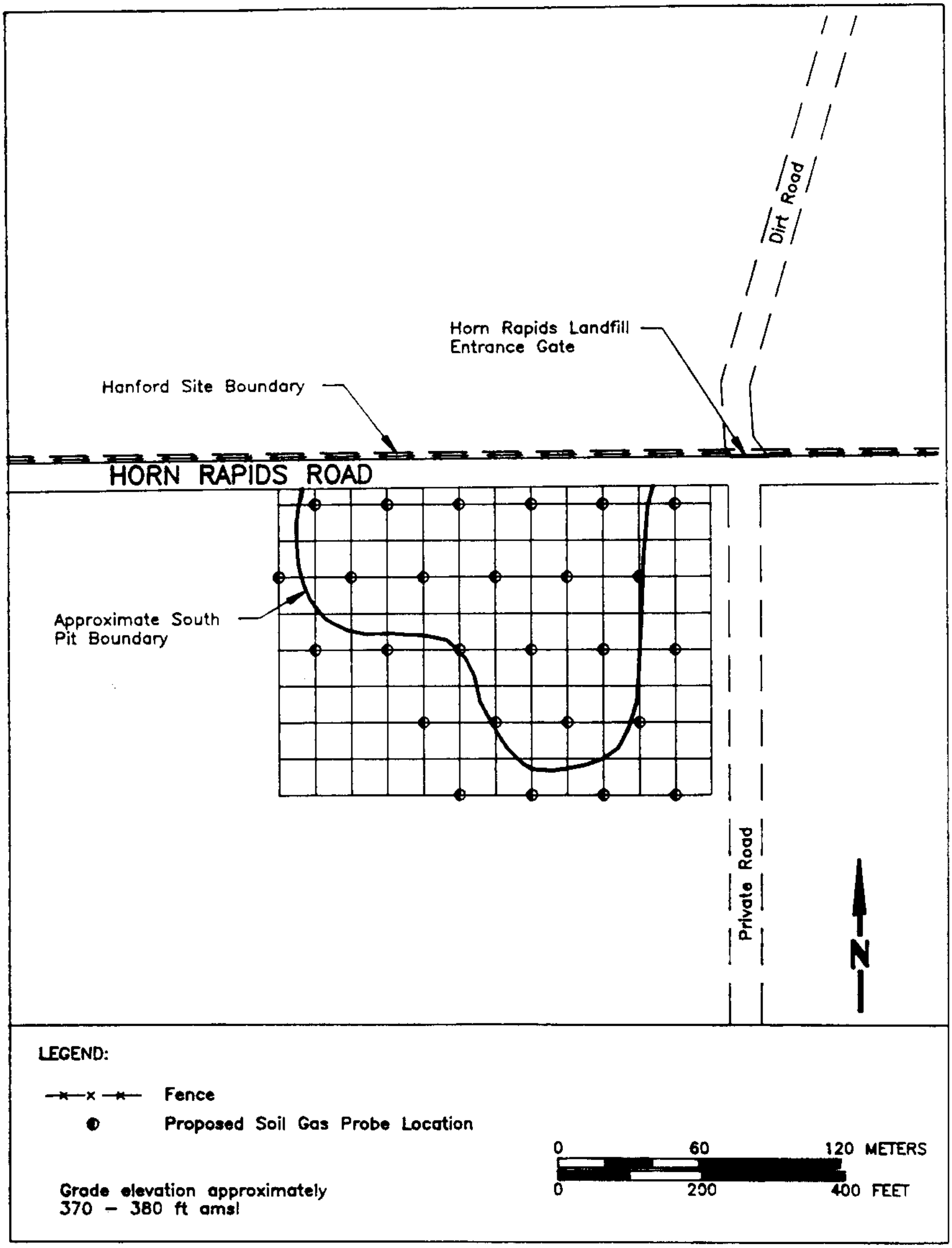

Figure 4-19. Proposed Soil Gas Probe Locations for the South Pit.

4.9 DATA EVALUATION TASKS

Data generated during the Phase II RI will be evaluated in an ongoing manner in order to allow decisions to be made regarding further characterization of the operable unit. The results of these evaluations will be incorporated into the monthly progress reports to make them available to project decision makers.

Data evaluation will be undertaken in tasks corresponding to the various subcomponent investigations:

- Contaminant source data evaluation
- Pedological data evaluation
- Hydrogeologic data evaluation
- Ecological data evaluation.

4.9.1 Task 1—Contaminant Source Data

Information compiled under the source data compilation activity at the South Pit will be used to determine the past operations, occurrence of waste disposal, and types of waste disposed of at the pit. Geophysical survey results from the South Pit will be used to determine the boundaries, depth of fill, and locations of waste disposal in the pit.

Soil gas will be used at UN-1100-6 to determine if a source of the low levels of VOCs found in the surface soils is present in the vadose zone or ground water. The quarterly results from permanent soil gas monitoring at the Horn Rapids Landfill will be used to determine if a rupture has occurred from a suspected buried drum of liquid solvent. A soil gas survey will also be conducted at the South Pit to determine if a source of VOCs is present in soil gas at the pit.

Radiation analysis conducted on archived soil samples from the 1100-1 and 1100-4, and subsurface soil samples at UN-1100-6 will be used to determine if 1100-1, 1100-4, or UN-1100-6 soils are contributing to the low-levels of radioactivity in the ground water near the 1171 Building. Radiation analysis conducted on archived soil samples from Horn Rapids Landfill will be used to determine if the landfill is contributing to the low-level radiation contamination in ground water in the vicinity of the landfill. The results will be compared to background to determine if there is an elevated level of radiation attributable to these operable subunits. Statistically significant levels will be determined by elevated levels above the 0.95/0.95 upper tolerance limits of the background distribution.

A surface radiation survey at the UN-1100-6 will be used to determine if the surface soils of the operable subunit are contributing to the low-level of radioactivity in the ground water in the vicinity of the 1171 Building. A surface radiation survey will also be conducted at the South Pit for health and safety, and also to determine if South Pit surface soils are contributing to the low-level radiation contamination in ground water in the vicinity of the Horn Rapids Landfill. The results of the surveys will be compared to background to determine if there is an elevated level of radiation attributable to these facilities. Statistically significant levels will be determined by elevated levels above the 0.95/0.95 upper tolerance limits of the background distribution.

4.9.2 Task 2—Pedological Data

Results of soil sampling will be plotted to reveal the lateral and vertical distributions of BEHP and radiation (if any) at UN-1100-6, and PCB at the Horn Rapids Landfill and the Ephemeral Pool. Soil sampling results from the South Pit will be used to determine if soils are contaminated at the pit. If contamination is present in the soils at the South Pit the results will be plotted to determine the lateral and vertical distributions. The soil sampling results will be compared to background to determine if there are elevated levels of contaminants attributable to UN-1100-6, Horn Rapids Landfill, and the South Pit. Statistically significant levels will be determined by elevated levels above the 0.95/0.95 upper tolerance limits of the background distribution. Data, and results of chromium oxidation state analysis conducted at the Horn Rapids Landfill, will be used in baseline risk assessment refinement.

4.9.3 Task 3—Hydrogeologic Data

The ground-water sampling results will be compared to background to determine if there are elevated levels of contaminants attributable to 1100-1, 1100-2, 1100-4, and UN-1100-6. If the soils of 1100-1 or 1100-4 are found to be sources of the low-level radiation in the vicinity of the 1171 Building, the results will be used to delineate the extent of contamination in ground water. Results of ground-water analysis at monitoring wells installed at 1100-2 and UN-1100-6 will be used to determine if any ground-water contamination is attributable to the operable subunits. Statistically significant levels will be determined by elevated levels above the 0.95/0.95 upper tolerance limits of the background distribution. Data will be used in baseline risk assessment refinement.

Results from monitoring wells upgradient to the Horn Rapids Landfill will be used to evaluate TCE and nitrate contributions from the landfill. Soil gas results from Horn Rapids Landfill will be evaluated to assist in placement of ground-water monitoring wells. Results of downgradient monitoring wells will be used to determine the extent of contamination in ground water that is attributable to the landfill. Statistically significant levels will be determined by elevated levels above the 0.95/0.95 upper tolerance limits of the background distribution. Data will be used in baseline risk assessment refinement. Aquifer test data will be evaluated for modeling ground-water characteristics.

4.9.4 Task 4—Ecological Data

Data will be evaluated and used to refine RI base maps. Future land- and water-use projections and ground-water receptor point data will be used in refining the baseline risk assessment.

4.10 VERIFICATION OF CONTAMINANT- AND LOCATION-SPECIFIC LEGALLY APPLICABLE OR RELEVANT AND APPROPRIATE ENVIRONMENTAL STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS TASK

This task will have EPA and Ecology verify the potential contaminant- and location-specific ARARs for the contamination attributed to the operable unit. Any new regulations enacted or amended since the Phase I RI will be evaluated. Project staff will work with the regulatory agencies and, taking unit-specific conditions into account, will decide which promulgated environmental standards, requirements, criteria, and limitations are applicable or relevant and appropriate to 1100-EM-1.

4.11 BASELINE RISK ASSESSMENT REFINEMENT TASKS

The purpose of these tasks is to refine the baseline risk assessment contained in the Phase I RI report (DOE-RL 1990). The baseline risk assessment provides an evaluation of the potential threats to human health and the environment in the absence of any remedial action. It will provide the basis for determining whether or not remedial action is necessary and the justification for determining clean-up levels. The Phase I RI risk assessment was developed according to EPA 1989-0X. Further refinement will be conducted according to the following tasks:

- Contaminant identification
- Exposure assessment
- Toxicity assessment
- Risk characterization.

4.11.1 Task 1—Contaminant Identification

This task will modify the list of contaminants identified in Phase I as Phase II RI data are screened to determine the nature and extent of contamination and to identify target substances for the risk assessment. Target substances are selected on the basis of intrinsic toxicological properties, waste volumes, and environmental occurrence.

4.11.2 Task 2—Exposure Assessment Refinement

This task will evaluate exposure pathways to better characterize the potentially exposed receptor (human and environmental) populations and to refine the extent of any exposure determined in the Phase I RI report (DOE-RL 1990). Future land- and water-use projection data (see Section 4.2.1.1) will be used to enhance the analyses of exposures that may occur in the future if no remedial action is undertaken.

The final step will be to revise the qualitative or quantitative estimate of total exposure levels for each receptor population based on refined exposure assessment information.

4.11.3 Task 3—Toxicity Assessment Refinement

This task will modify the toxicity assessment prepared during Phase I RI and used to assess the risks associated with releases of contaminants. Toxicity information will be updated to reflect revised values for slope factors and reference doses, and to evaluate any additional target substances identified during the Phase II RI.

4.11.4 Task 4—Risk Characterization Refinement

This task will modify the Phase I risk characterization contained in the Phase I RI report (DOE-RL 1990). The refined risk characterization will be based on additional contaminant identification, exposure assessment information, and toxicity assessment data. A comparison will be performed between risks associated with actual contaminant levels identified in the exposure assessment and acceptable levels of contamination. Contaminant-specific ARARs, when available, will be used to determine the acceptable levels. When ARARs are not available, acceptable levels will be based on environmental concentrations that will yield exposures no greater than:

- The reference dose, for non-carcinogens
- A 1E-06 to 1E-04 excess lifetime cancer risk, for carcinogens.

Priority will be given to the acceptable environmental concentrations thus determined in establishing contaminant-specific clean-up levels for the final remedial action.

4.12 PHASE II REMEDIAL INVESTIGATION REPORT TASK

A final 1100-EM-1 Operable Unit RI report will be prepared at the end of Phase II RI activities.

5.0 SCHEDULE

The anticipated schedule for completing the RI/FS for the 1100-EM-1 Operable Unit is presented in Figure 5-1. This schedule is based on a staged approach as detailed in the task descriptions in Chapter 4. It is subject to modification as data are collected and evaluated, and the operable unit becomes better characterized. This approach is utilized because it is cost effective and the Phase I RI did not indicate the existence of any imminent and substantial endangerment to human health or the environment.

Major assumptions that were used in developing this schedule include:

- The 1100-1, 1100-4, and UN-1100-6 operable subunits are not identified as sources of the radiation contamination in the 1171 Building vicinity ground water
- One Stage 1 monitoring well, and two Stage 2 monitoring wells are installed at 1100-2 operable subunit
- Only Stage 1 monitoring wells are installed at UN-1100-6 operable subunit
- Two stages of soil sampling are required to delineate the BEHP contamination in soils at the UN-1100-6 operable subunit
- Horn Rapids Landfill soils are not identified as a source of the radiation contamination in the vicinity of the landfill
- Upper confined aquifers are not impacted at any operable subunit
- Eight to ten Stage 1 downgradient monitoring wells, and two upgradient monitoring wells are installed at Horn Rapids Landfill
- Two stages of soil sampling are required to delineate the PCB contamination in soils at the Horn Rapids Landfill
- Three drill rigs are available at all times, and three weeks are required to complete the installation of a monitoring well per drill rig
- Two stages of soil sampling are required to delineate the PCB contamination at the Ephemeral Pool
- The DOE and their contractors will conduct concurrent reviews of a preliminary draft Phase II RI report during the report preparation task; the review will be conducted within a one month period, and completed in time to allow at least 45 days for revision prior to submittal of the draft report to EPA and Ecology
- Two and one-half months are required, after receipt of the last portion of validated field and analytical data, to produce a preliminary draft Phase II RI report for DOE review.

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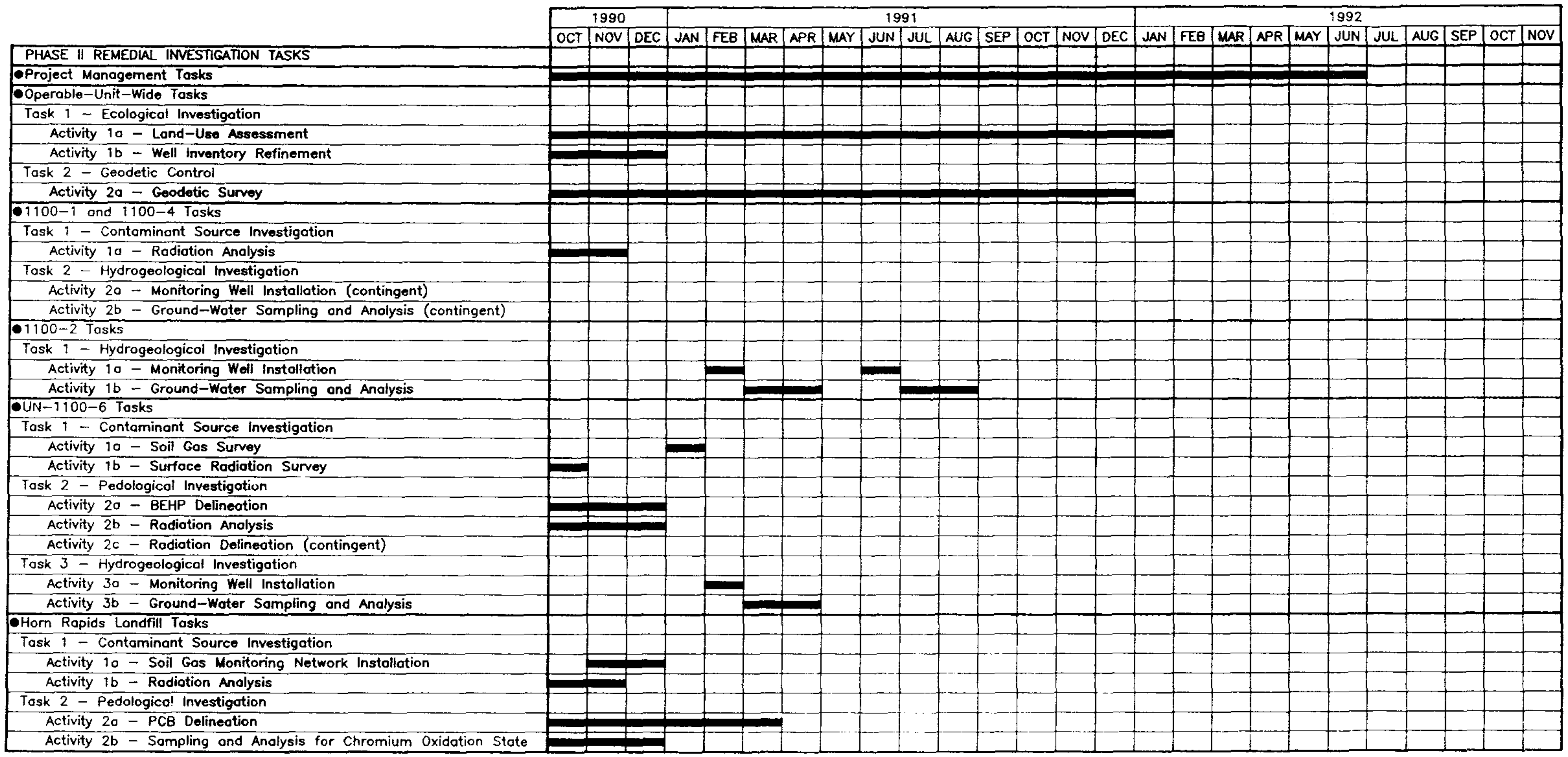

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Figure 5-1. Schedule for the 1100-EM-1 Operable Unit Phase II Remedial Investigation and Feasibility Study. (Sheet 1 of 2)

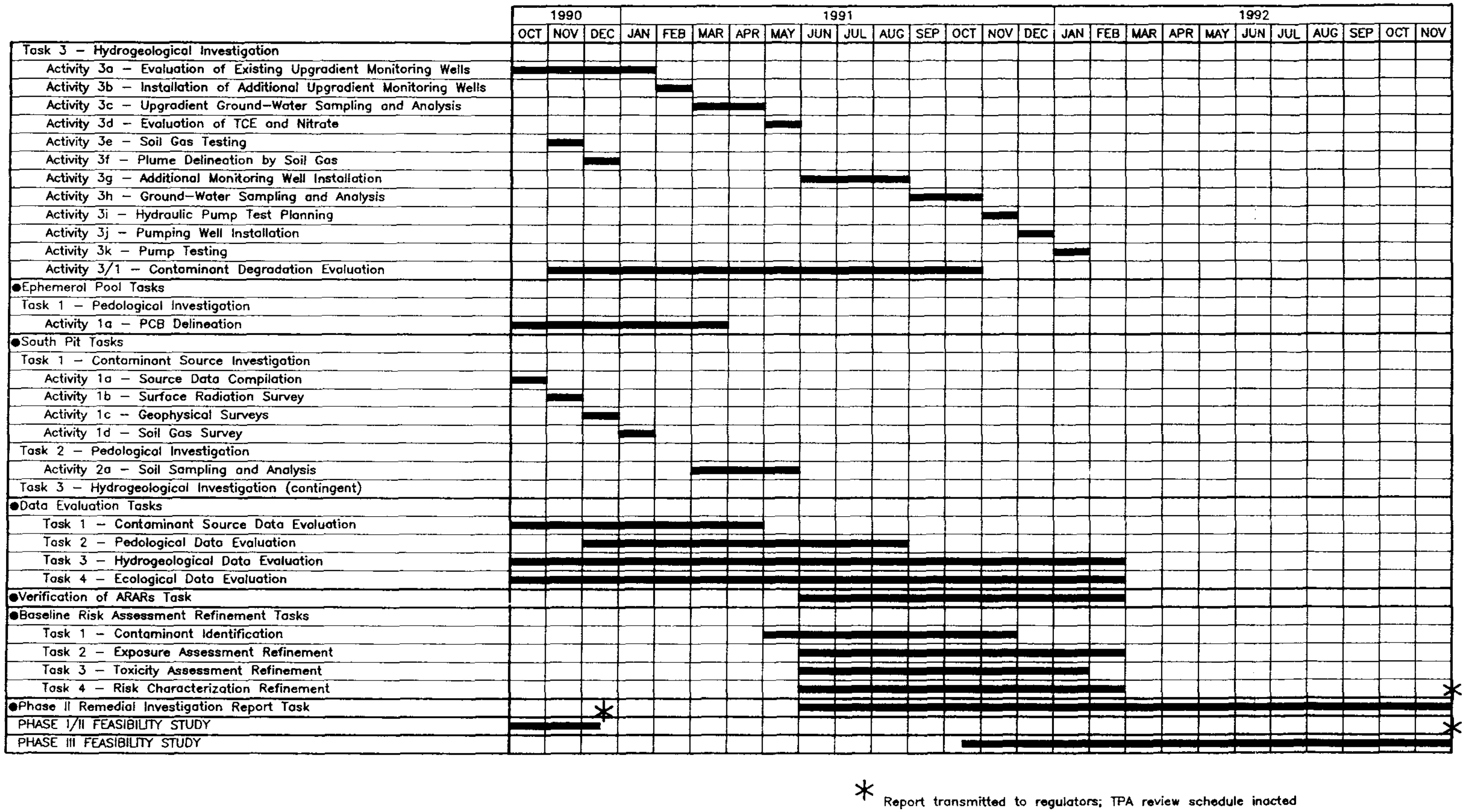

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Figure 5-1. Schedule for the 1100-EM-1 Operable Unit Phase II Remedial Investigation and Feasibility Study. (Sheet 2 of 2)

6.0 REFERENCES

Brown, L.C., 1988, *Environmental Investigation and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

DOE-RL, 1990, *Phase I Remedial Investigation Report for the Hanford Site 11000-EM-1 Operable Unit*, DOE-RL 90-18, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1989, *Remedial Investigation/Feasibility Study Work Plan for the 1100-EM-1 Operable Unit Hanford Site, Richland, Washington*. DOE/RL 88-23, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, Ecology and EPA, 1990, *Strategy for Handling and Disposing of Purgewater at the Hanford Site, Washington*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, Washington State Department of Ecology, Olympia, Washington, and U.S. Environmental Protection Agency, Richland, Washington.

Ecology, EPA and DOE-RL, 1989a, *Hanford Federal Facility Agreement and Consent Order*, Washington State Department of Ecology, Olympia, Washington, U.S. Environmental Protection Agency, Region X, Seattle, Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington

Ecology, EPA and DOE-RL, 1989b, *Community Relations Plan for the Hanford Federal Facility Agreement and Consent Order*, Washington State Department of Ecology, Olympia, Washington, U.S. Environmental Protection Agency, Seattle, Washington and U.S. Department of Energy Richland Operations Office, Richland, Washington.

EPA, 1990, *Aerial Photographic Analysis of Rockwell Hanford Operations Area 1100 NW: Richland, Washington*, TS-PIC-90754, U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

EPA, 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA: Interim Final*, EPA/540/G-89/004, OSWER Directive 9355.3-01, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C.

EPA, 1987a, *Data Quality Objectives for Remedial Response Activities: Development Process*, EPA/540/G-87/003, OSWER Directive 9355.0-7B, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1987b, *Data Quality Objectives for Remedial Response Activities: Example Scenario: PI/FS Activities at a Site with Contaminated Soils and Ground Water*, EPA/540/G-87/004, OSWER Directive 9355.0-7B, U.S. Environmental Protection Agency, Washington, D.C.

McCain, R.G. and W.L. Johnson, 1990, *A Proposed Data Quality Strategy for Hanford Site Characterization*, WHC-SD-EN-AP-023, Westinghouse Hanford Company, Richland, Washington.

Runchal, A. and B. Sagar, 1989, *PORFLO-3: A Mathematical Model for Fluid Flow, Heat, and Mass Transport in Variably Saturated Geologic Media: Users Manual, Version 1.0*, WHC-EP-0041, Westinghouse Hanford Company, Richland, Washington.

USGS, 1987, *Richland, Washington*, Topographic map, Scale 1:24,000, U.S. Geological Survey, Denver, Colorado.

WHC, 1990, *Industrial Safety Manual*, WHC-CM-4-3, Vol. 1-3, Westinghouse Hanford Company, Richland, Washington

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

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GLOSSARY

Accuracy: Accuracy may be interpreted as the measure of the bias in a system. Sampling accuracy is normally assessed through the evaluation of matrix spiked samples and reference samples.

Audit: Audits in environmental investigations are considered to be systematic checks to verify the quality of operation of one or more elements of the total measurement system. In this sense, audits may be of two types: (1) performance audits, in which quantitative data are independently obtained for comparison with data routinely obtained in a measurement system, or (2) system audits, involving a qualitative onsite evaluation of laboratories or other organizational elements of the measurement system for compliance with established quality assurance program and procedure requirements.

Blind sample: A blind sample refers to any type of sample routed to the primary laboratory for purposes of auditing performance relative to a particular sample matrix and analytical method. Blind samples are not specifically identified as such to the laboratory; they may be made from traceable standards or may consist of sample material spiked with a known concentration of a known compound.

Comparability: Comparability is an expression of the relative confidence with which one data set may be compared with another.

Completeness: Completeness is the measure of the amount of valid data actually obtained against the amount expected under normal correct conditions.

Confidence interval: Confidence intervals are applied to bound the value of a population parameter within a specified degree of confidence (i.e., the confidence coefficient), usually 90%, 95%, or 99%. The form of a confidence interval depends on the underlying assumptions and intentions. It assumes different values for different random samples and requires specification of the number of observations on which the interval is based.

Deviation: For the purpose of environmental investigations, deviation refers to a planned departure from established criteria that may be required as a result of unforeseen field situations or that may be required to correct ambiguities in procedures that may arise in practical applications.

Equipment blanks: Equipment blanks consist of organic-free deionized, distilled water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples; they are used to verify the adequacy of sampling equipment decontamination procedures and are normally collected at the same frequency as field duplicate samples.

Field blanks: Field blanks consist of organic-free deionized, distilled water, transferred to a sample container at the site and preserved with the reagent specified for the analytes of interest; they are used to check for possible contamination originating with the reagent or the sampling environment and are normally collected at the same frequency as field duplicate samples.

Field duplicate sample: Field duplicate samples are samples retrieved from the same sampling location using the same equipment and sampling technique, placed in separate identically prepared and preserved containers, and analyzed independently. Field duplicate samples are generally used to verify the repeatability or reproducibility of analytical data and are normally analyzed with each analytical batch or every 20 samples, whichever is greater.

Matrix spiked samples: Matrix spiked samples are a type of laboratory quality control sample; they are prepared by splitting a sample received from the field into two homogenous aliquots (i.e., replicate samples) and adding a known quantity of a representative analyte of interest to one aliquot to calculate percentage of recovery.

Nonconformance: A nonconformance is a deficiency in characteristic, documentation, or procedure that renders the quality of material, equipment, services, or activities unacceptable or indeterminate. When the deficiency is of a minor nature, does not effect a permanent or significant change in quality if it is not corrected, and can be brought into conformance with immediate corrective action, it shall not be categorized as a nonconformance. However, if the nature of the condition is such that it cannot be immediately and satisfactorily corrected, it shall be documented in compliance with approved procedures and brought to the attention of management for disposition and appropriate corrective action.

Precision: Precision is a measure of the repeatability or reproducibility of specific measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. Precision is normally expressed in terms of standard deviation, but may also be expressed as the coefficient of variation (i.e., relative standard deviation) and range (i.e., maximum value minus minimum value). Precision is assessed by means of duplicate/replicate sample analysis.

Quality assurance: Quality assurance refers to the total integrated quality planning, quality control, quality assessment, and corrective action activities that collectively ensure that the data from monitoring and analysis meet all end user requirements and/or the intended end use of the data.

Quality Assurance Program Plan: The Quality Assurance program plan is an orderly assemblage of management policies, objectives, principles, and general procedures by which an agency or laboratory outlines how it intends to produce data of known and accepted quality.

Quality Assurance Project Plan: The Quality Assurance project plan is an orderly assemblage of management policies, project objectives, methods, and procedures that defines how data of known quality will be produced for a particular project or investigation.

Quality control: Quality control refers to the routine application of procedures and defined methods to the performance of sampling, measurement, and analytical processes.

Reference samples: Reference samples are a type of laboratory quality control sample prepared from an independent, traceable standard at a concentration other than that used for analytical equipment calibration, but within the calibration range. Such reference samples are required for every analytical batch or every 20 samples, whichever is greater.

Replicate sample: Replicate samples are two aliquots removed from the same sample container in the laboratory and analyzed independently.

Representativeness: Representativeness is the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of a sampling program.

Split sample: A split sample is produced through homogenizing a field sample and separating the sample material into two equal aliquots. Field split samples are usually routed to separate laboratories for independent analysis, generally for purposes of auditing the performance of the primary laboratory relative to a particular sample matrix and analytical method. See the glossary entry for Audit. In the laboratory, samples are generally split to create matrix spiked samples; see the glossary entry for matrixed spike samples, above.

Trip blanks: Trip blanks are a type of field quality control sample, consisting of pure deionized, distilled water in a clean, sealed sample container, accompanying each batch of containers shipped to the sampling site and returned unopened to the laboratory. Trip blanks are used to identify any possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions.

Validation: Validation is a systematic process of reviewing a body of data against a set of criteria to provide assurance that the data are acceptable for their intended use. Validation methods may include review of verification activities, screening, cross-checking, or technical review.

Verification: Verification is the process of determining whether procedures, processes, data, or documentation conform to specified requirements. Verification activities may include inspections, audits, surveillances, or technical review.

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CONTENTS

CONTENTS
(Continued)

FIGURES

TABLES

1.0 PROJECT DESCRIPTION

1.1 PROJECT OBJECTIVE

The primary objective of the Phase II Remedial Investigation (RI) for the 1100-EM-1 operable unit is to further define the extent and location of sources of radioactive, inorganic, and other types of contaminants in the vadose zone and groundwater. Data resulting from this investigation will be evaluated to determine the most feasible options for treatability investigations, remediation, or closure.

1.2 BACKGROUND INFORMATION

The 1100-EM-1 Operable Unit is located partially outside the boundary at the Hanford Site, near its southeastern corner, as shown on Figure 1. Detailed background information regarding the history and present use of the unit is provided in Chapter 2.0 of the Phase I RI report (DOE-RL 1990); results of Phase I activities are also discussed in detail in the Phase I RI report.

1.3 QUALITY ASSURANCE PROJECT PLAN SCOPE AND RELATIONSHIP TO WESTINGHOUSE HANFORD QUALITY ASSURANCE PROGRAM

This Quality Assurance project plan (QAPP) is designed to support the supplemental work plan for the Phase II characterization of the 1100-EM-1 Operable Unit. It is prepared in compliance with the Westinghouse Hanford Company (Westinghouse Hanford) *Quality Assurance Program Plan for Comprehensive Environmental Response, Compensation, and Liability Act Remedial Investigation/Feasibility Study Activities, WHC-SP-0447* (WHC 1989a), which describes implementation of the overall quality assurance (QA) program requirements defined by the *Westinghouse Hanford Company Quality Assurance Manual, WHC-CM-4-2* (WHC 1989b), as applicable to *Comprehensive Environmental Response Compensation, and Liability Act of 1980* (CERCLA) remedial investigation/feasibility study (RI/FS) environmental investigations. WHC-SP-0447 (WHC 1989a) accommodates the specific requirements for project plan format and content agreed upon in the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), and contains a matrix of procedural resources [(from WHC-CM-4-2 (WHC 1989b) and from the *Westinghouse Hanford Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7 (WHC 1989c)] that have been selected to support this QAPP. Distribution and revision control shall be performed in compliance with quality requirement (QR) 6.0, "Document Control" from WHC-CM-4-2 (WHC 1989b). Interim changes to this QAPP or the supplemental work plan shall be documented, reviewed, and approved as required by Section 6.6 of Environmental Investigation Instruction (EII) 1.9, "Work Plan Review" (WHC 1989c), and shall be documented in monthly unit managers' meeting minutes. The Distribution of the QAPP beyond that indicated by Section 6.5 of EII 1.9 shall be defined by the Westinghouse Hanford project coordinator. All other plans or procedures referenced in the QAPP and shall be made available for regulatory review upon request, at the direction of the project coordinator.

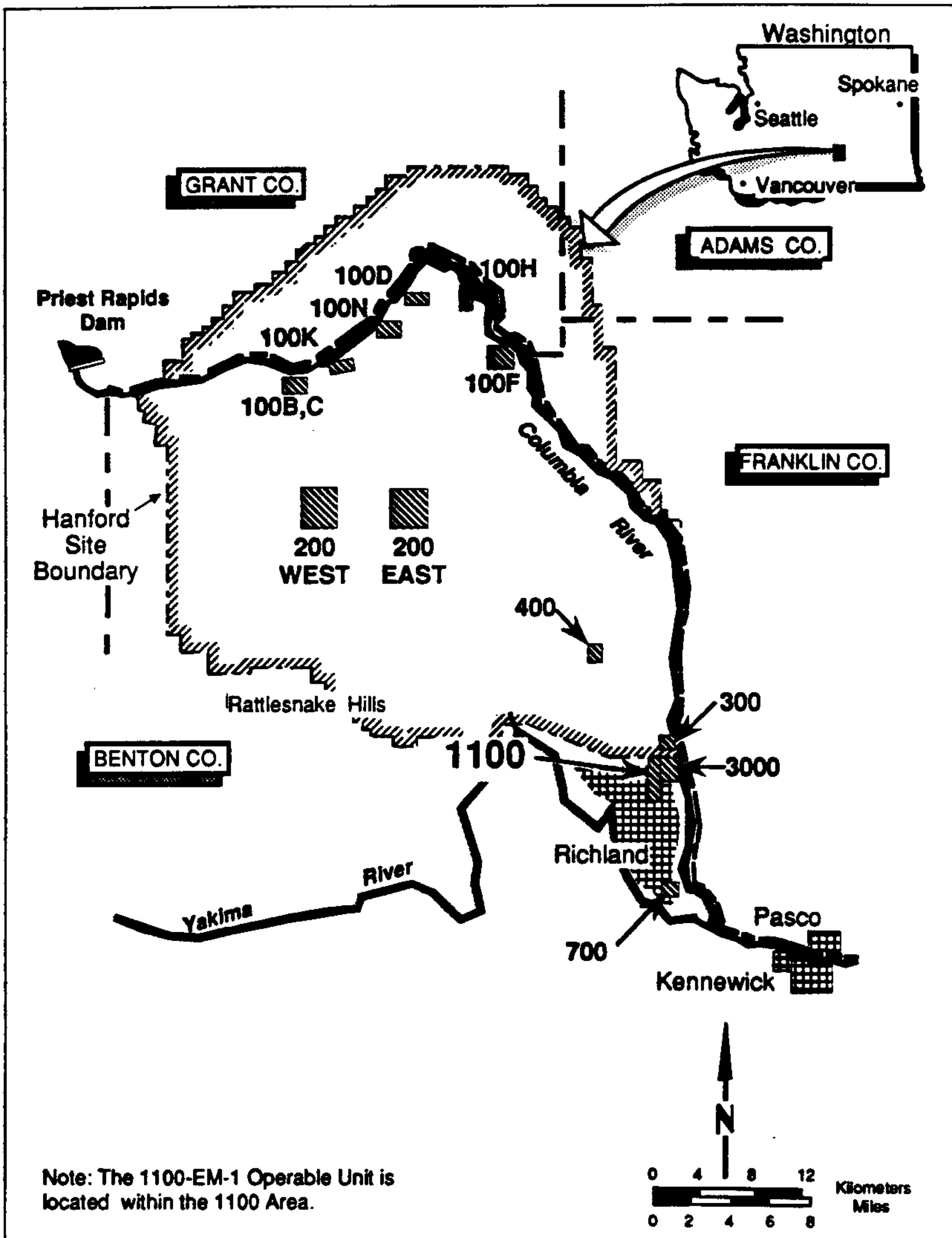

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Figure 1. The Location of the 1100 Area at the Hanford Site.

1.4 TASK DESCRIPTIONS

The Phase II investigations at 1100-EM-1 are subdivided into nine individual tasks and a number of activities; individual task scopes are described in detail in Chapter 4.0 of the supplemental work plan, Sections 4.2 through 4.11. Procedures applicable to the tasks described therein are identified in Chapter 4.0 and Table 2 of this QAPP.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 PROJECT COORDINATOR RESPONSIBILITIES

The Environmental Engineering and Technology function of Westinghouse Hanford has primary responsibilities for coordinating the performance of this investigation. Organizational charts are included in the Project Management Plan (PMP) provided in Chapter 3.0 of the Phase I work plan (DOE 1989) that define personnel assignments and individual Westinghouse Hanford Field Team structures applicable to the types of tasks included in this phase of the investigation.

External participant contractors or subcontractors may be evaluated and selected for certain portions of task activities at the direction of the project coordinator, in compliance with Westinghouse Hanford procedures Quality Requirement (QR) 4.0, "Procurement Document Control"; Quality Instruction (QI) 4.1, "Procurement Document Control"; QI 4.2, "External Service Control"; QR 7.0, "Control of Purchased Items and Services"; QI 7.1, "Procurement Planning and Control"; and QI 7.2, "Supplier Evaluation (WHC 1989b). The primary participant contractor and subcontractor resources for the Hanford Site are listed in Figure 3-2 of the PMP (DOE 1989).

2.2 ANALYTICAL LABORATORIES

The Westinghouse Hanford field sampling team will be responsible for screening all samples for radioactivity and separating samples into two groups for further analysis. Samples with levels of radioactivity exceeding background, as detected by standard field survey equipment, will normally be routed to a Westinghouse Hanford or Hanford Site participant contractor laboratory that is equipped and qualified to analyze radioactive samples. Samples exhibiting levels of radioactivity exceeding background will not be released to an offsite laboratory based on field measurements, but shall be routed to an appropriate laboratory, measured with laboratory radioanalytical equipment, and then released in accordance with Westinghouse Hanford-approved procedures. All analyses shall be coordinated through the Westinghouse Hanford Office of Sample Management (OSM) and shall be performed in compliance with Westinghouse Hanford-approved laboratory QA plans and analytical procedures. The surveillance controls invoked by QI 7.3, "Source Surveillance and Inspection" (WHC 1989b) are applicable to all offsite laboratory operations; QI 10.4, "Surveillances" (WHC 1989b) applies onsite. Applicable quality requirements for subcontractors or participant contractors shall be invoked as part of the approved procurement documentation or work order as noted in Section 4.1.2. Services of alternate qualified laboratories may be procured for radioactive sample analysis, if onsite laboratory capacity is not available, and for the performance of split (performance audit) sample analysis at the Westinghouse Hanford project coordinator's direction. If such alternate laboratory services are required, the laboratory QA plan and applicable analytical procedures shall be approved by Westinghouse Hanford before they are used.

2.3 OTHER SUPPORT CONTRACTORS

Procurements of all contracted field activities shall be in compliance with standard Westinghouse procurement procedures as discussed in Sections 2.1 and 4.2. All work shall be performed in compliance with Westinghouse Hanford-approved QA plans and/or procedures, subject to surveillance controls invoked by QI 7.3, "Source Surveillance and Inspection" for offsite work, or by QI 10.4 "Surveillances" (WHC 1989b) for onsite work. Applicable quality requirements shall be invoked as part of the approved procurement documentation or work order.

3.0 QUALITY ASSURANCE REQUIREMENTS FOR MEASUREMENTS

Additional analytical data from soil and groundwater sampling activities will be obtained during the Phase II RI at 1100-EM-1; these data shall be evaluated to further characterize the extent and nature of radioactive and hazardous contamination and to determine the most feasible options for corrective measures. In compliance with the guidelines provided in *A Proposed Data Quality Strategy for Hanford Site Characterization* (McCain and Johnson 1990) (which interprets applicable portions of *Data Quality Objectives for Remedial Responses Activities; Volume 1 Development Process* (EPA 1987) for use at the Hanford Site), two general types of analysis will be performed: rapid response screening analysis and fully documented and validated confirmatory analyses.

Screening analyses may involve both field or laboratory methods. Laboratory methods used for screening purposes may be identical or similar to those later used for confirmatory analysis, but with less rigorous method-specific QA/QC requirements, documentation requirements, and validation requirements. As a consequence, screening methods are characterized by quick turnaround times and lower costs; however, they may not be compound-specific, and the data may be qualitative or only semiquantitative. Data from screening analyses must be verified in compliance with Section 8.2.1 before use in focusing subsequent, more detailed stages of the sampling investigation. For Phase II investigations at 1100-EM-1, screening analyses will be confined to surface-based radiation surveys and soil gas surveys using field methods, the results of which will be used to guide more detailed sampling and laboratory-based analytical investigations for radioactive and hazardous contaminants. All screening methods will be subject to review and approval by Westinghouse Hanford prior to use.

Fully validated analyses will employ standard EPA reference methods, other standard reference methods, or other methods developed or modified specifically to meet the needs of the Hanford Site. All such analyses shall be documented in compliance with Section 8.1 and validated in compliance with sections 8.2.2 and 8.2.3, as appropriate for the method concerned. For Phase II investigations at 1100-EM-1, such analyses will be performed using standard EPA reference methods as noted in Table 1. Table 1 identifies target values for detection limits, precision, and accuracy that must be adjusted and/or confirmed and accepted by Westinghouse Hanford and the proposed laboratory before final approval of associated subcontracts or work orders. Once these values are established as contractual requirements in compliance with standard procurement procedures (see Section 4.1), Table 1 shall be updated to reference approved detection limit, precision, and accuracy criteria as project requirements; all such changes shall be documented in monthly unit managers' meeting minutes as required by Section 6.6 of EII 1.9, "Work Plan Review" (WHC 1989c).

Goals for data representativeness are addressed qualitatively by the specification of sampling locations and intervals within the Chapter 4.0 and Figures 4-1 through 4-18 of the supplemental work plan. Objectives for completeness for this investigation shall require that contractually or procedurally established requirements for precision and accuracy be met for at least 90% of the total number of requested determinations. Failure to meet this criterion shall be evaluated in the data assessment process described in Chapter 12.0, and shall be subject to any necessary corrective action as discussed in Chapter 13.0. Approved analytical procedures shall require the use of reporting techniques and units specified in the EPA reference methods in Table 1 to facilitate the comparability of data sets in terms of precision and accuracy.

4.0 SAMPLING PROCEDURES

4.1 PROCEDURE APPROVALS AND CONTROL

4.1.1 Westinghouse Hanford Procedures

The Westinghouse Hanford procedures cited in this QAPP have been selected from the Quality Assurance Program Index included in the WHC-SP-0447 (WHC 1989a). Selected procedures include EIIs from the *Environmental Investigations and Site Characterization Manual* (WHC 1989c), QRs and QIs from the *Westinghouse Hanford Company Quality Assurance Manual* (WHC 1989b), and procedures from the *Operational Health Physics Practices Manual* (WHC 1988). All procedures are listed in Table 2, cross referenced to individual subunit investigations by applicability. Procedure approval, revision, and distribution control requirements applicable to EIIs are addressed in EII 1.2, "Preparation and Revision of Environmental Investigations Instructions" (WHC 1989c); requirements applicable to QIs and QRs are addressed in QR 5.0, "Instructions, Procedures, and Drawings"; QI 5.1, "Preparation of Quality Assurance Documents"; QR 6.0, "Document Control"; and QI 6.1, "Quality Assurance Document Control" (WHC 1989b). All procedures shall be made available for regulatory review on request at the direction of the Westinghouse Hanford project coordinator.

4.1.2 Participant Contractor/Subcontractor Procedures

As noted in Section 2.1, participant contractor and subcontractor services shall be procured under the applicable Westinghouse Hanford procedures. Whenever such services

Table 1. Analytical Methods, Analytes of Interest, Quantitation Limits, and Precision and Accuracy Guidelines for the Phase 2 RI at 1100-EM-1
(Page 1 of 7)

Category	Analyte of Interest	Analytical Method	CQL[a], soil, µg/Kg	Precision[b], Soil	Accuracy[b], Soil	CQL[a], water µg/L	Precision[b], Water
Volatile organics	Chloromethane	CLP[c]	10	±35	±25	10	±25
	Bromomethane	CLP[c]	10	±35	±25	10	±25
	Vinyl Chloride	CLP[c]	10	±35	±25	10	±25
	Chloroethane	CLP[c]	10	±35	±25	10	±25
	Methylene Chloride	CLP[c]	5	±35	±25	5	±25
	Acetone	CLP[c]	10	±35	±25	10	±25
	Carbon Disulfide	CLP[c]	5	±35	±25	5	±25
	1,1-Dichloroethene	CLP[c]	5	±35	±25	5	±25
	1,1-Dichloroethane	CLP[c]	5	±35	±25	5	±25
	1,2-Dichloroethene (total)	CLP[c]	5	±35	±25	5	±25
	Chloroform	CLP[c]	5	±35	±25	5	±25
	1,2-Dichloroethane	CLP[c]	5	±35	±25	5	±25
	2-Butanone	CLP[c]	10	±35	±25	10	±25
	1,1,1-Trichloroethane	CLP[c]	5	±35	±25	5	±25
	Carbon Tetrachloride	CLP[c]	5	±35	±25	5	±25
	Vinyl Acetate	CLP[c]	10	±35	±25	10	±25
	Bromodichloromethane	CLP[c]	5	±35	±25	5	±25
	1,2-Dichloropropane	CLP[c]	5	±35	±25	5	±25
	cis-1,3-Dichloropropene	CLP[c]	5	±35	±25	5	±25
	Trichloroethene	CLP[c]	5	±35	±25	5	±25
	Dibromochloromethane	CLP[c]	5	±35	±25	5	±25
	1,1,2-Trichloroethane	CLP[c]	5	±35	±25	5	±25
	Benzene	CLP[c]	5	±35	±25	5	±25
	trans-1,3-Dichloropropene	CLP[c]	5	±35	±25	5	±25
	Bromoform	CLP[c]	5	±35	±25	5	±25
	4-Methyl-2-pentanone	CLP[c]	10	±35	±25	10	±25
	2-Hexanone	CLP[c]	10	±35	±25	10	±25
	Tetrachloroethene	CLP[c]	5	±35	±25	5	±25
	Toluene	CLP[c]	5	±35	±25	5	±25
	1,1,2,2-Tetrachloroethane	CLP[c]	5	±35	±25	5	±25
	Chlorobenzene	CLP[c]	5	±35	±25	5	±25
	Ethyl Benzene	CLP[c]	5	±35	±25	5	±25

Table 1. Analytical Methods, Analytes of Interest, Quantitation Limits, and Precision and Accuracy Guidelines for the Phase 2 RI at 1100-EM-1 (Page 2 of 7)

Category	Analyte of Interest	Analytical Method	CQL[a], soil, µg/Kg	Precision[b], Soil	Accuracy[b], Soil	CQL[a], water µg/L	Precision[b], Water	Accuracy[b], Water
Volatile organics (cont.)	Styrene	CLP[c]	5	±35	±25	5	±25	±25
	Xylenes (Total)	CLP[c]	5	±35	±25	5	±25	±25
Semi-volatile organics	Phenol	CLP[c]	330	±35	±25	10	±25	±25
	bis(2-Chloroethyl) ether	CLP[c]	330	±35	±25	10	±25	±25
	2-Chlorophenol	CLP[c]	330	±35	±25	10	±25	±25
	1,3-Dichlorobenzene	CLP[c]	330	±35	±25	10	±25	±25
	1,4-Dichlorobenzene	CLP[c]	330	±35	±25	10	±25	±25
	Benzyl alcohol	CLP[c]	330	±35	±25	10	±25	±25
	1,2-Dichlorobenzene	CLP[c]	330	±35	±25	10	±25	±25
	2-Methylphenol	CLP[c]	330	±35	±25	10	±25	±25
	bis(2-Chloroisopropyl) ether	CLP[c]	330	±35	±25	10	±25	±25
	4-Methylphenol	CLP[c]	330	±35	±25	10	±25	±25
	N-Nitroso-di-n-dipropylamine	CLP[c]	330	±35	±25	10	±25	±25
	Hexachloroethane	CLP[c]	330	±35	±25	10	±25	±25
	Nitrobenzene	CLP[c]	330	±35	±25	10	±25	±25
	Isophorone	CLP[c]	330	±35	±25	10	±25	±25
	2-Nitrophenol	CLP[c]	330	±35	±25	10	±25	±25
	2,4-Dimethylphenol	CLP[c]	330	±35	±25	10	±25	±25
	Benzoic acid	CLP[c]	1600	±35	±25	50	±25	±25
	bis(2-Chloroethoxy) methane	CLP[c]	330	±35	±25	10	±25	±25
	2,4-Dichlorophenol	CLP[c]	330	±35	±25	10	±25	±25
	1,2,4-Trichlorobenzene	CLP[c]	330	±35	±25	10	±25	±25
	Naphthalene	CLP[c]	330	±35	±25	10	±25	±25
	4-Chloroaniline	CLP[c]	330	±35	±25	10	±25	±25
	Hexachlorobutadiene	CLP[c]	330	±35	±25	10	±25	±25
	4-Chloro-3-methylphenol (para-chloro-meta-cresol)	CLP[c]	330	±35	±25	10	±25	±25
	2-Methylnaphthalene	CLP[c]	330	±35	±25	10	±25	±25
	Hexachlorocyclopentadiene	CLP[c]	330	±35	±25	10	±25	±25
	2,4,6-Trichlorophenol	CLP[c]	330	±35	±25	10	±25	±25

Table 1. Analytical Methods, Analytes of Interest, Quantitation Limits, and Precision and Accuracy Guidelines for the Phase 2 RI at 1100-EM-1 (Page 3 of 7)

Category	Analyte of Interest	Analytical Method	CQL[a], soil, µg/Kg	Precision[b], Soil	Accuracy[b], Soil	CQL[a], water µg/L	Precision[b], Water	Accuracy[b], Water
Semi-volatile organics (cont.)	2,4,5-Trichlorophenol	CLP[c]	1600	±35	±25	50	±25	±25
	2-Chloronaphthalene	CLP[c]	330	±35	±25	10	±25	±25
	2-Nitroaniline	CLP[c]	1600	±35	±25	50	±25	±25
	Dimethylphthalate	CLP[c]	330	±35	±25	10	±25	±25
	Acenaphthylene	CLP[c]	330	±35	±25	10	±25	±25
	2,6-Dinitrotoluene	CLP[c]	330	±35	±25	10	±25	±25
	3-Nitroaniline	CLP[c]	1600	±35	±25	50	±25	±25
	Acenaphthene	CLP[c]	330	±35	±25	10	±25	±25
	2,4-Dinitrophenol	CLP[c]	1600	±35	±25	50	±25	±25
	4-Nitrophenol	CLP[c]	1600	±35	±25	50	±25	±25
	Dibenzofuran	CLP[c]	330	±35	±25	10	±25	±25
	2,4-Dinitrotoluene	CLP[c]	330	±35	±25	10	±25	±25
	Diethylphthalate	CLP[c]	330	±35	±25	10	±25	±25
	4-Chlorophenyl-phenyl ether	CLP[c]	330	±35	±25	10	±25	±25
	Fluorene	CLP[c]	330	±35	±25	10	±25	±25
	4-Nitroaniline	CLP[c]	1600	±35	±25	50	±25	±25
	4,6-Dinitro-2-methylphenol	CLP[c]	1600	±35	±25	50	±25	±25
	N-nitrosodiphenylamine	CLP[c]	330	±35	±25	10	±25	±25
	4-Bromophenyl-phenylether	CLP[c]	330	±35	±25	10	±25	±25
	Hexachlorobenzene	CLP[c]	330	±35	±25	10	±25	±25
	Pentachlorophenol	CLP[c]	1600	±35	±25	50	±25	±25
	Phenanthrene	CLP[c]	330	±35	±25	10	±25	±25
	Anthracene	CLP[c]	330	±35	±25	10	±25	±25
	Di-n-butylphthalate	CLP[c]	330	±35	±25	10	±25	±25
	Fluoranthene	CLP[c]	330	±35	±25	10	±25	±25
	Pyrene	CLP[c]	330	±35	±25	10	±25	±25
	Butylbenzylphthalate	CLP[c]	330	±35	±25	10	±25	±25
	3,3'-Dichlorobenzidine	CLP[c]	600	±35	±25	20	±25	±25
	Benzo(a)anthracene	CLP[c]	330	±35	±25	10	±25	±25
	Chyrsene	CLP[c]	330	±35	±25	10	±25	±25
	bis(2-Ethylhexyl)phthalate	CLP[c]	330	±35	±25	10	±25	±25
	Di-n-octylphthalate	CLP[c]	330	±35	±25	10		

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Table 1. Analytical Methods, Analytes of Interest, Quantitation Limits, and Precision and Accuracy Guidelines for the Phase 2 RI at 1100-EM-1 (Page 4 of 7)

Category	Analyte of Interest	Analytical Method	CQL[a], soil, µg/Kg	Precision[b], Soil	Accuracy[b], Soil	CQL[a], water µg/L	Precision[b], Water	Accuracy[b], Water
Semi-volatile organics (cont.)	Benzo(b)fluoranthene	CLP[c]	330	±35	±25	10	±25	±25
	Benzo(k)fluoranthene	CLP[c]	330	±35	±25	10	±25	±25
	Benzo(a)pyrene	CLP[c]	330	±35	±25	10	±25	±25
	Indeno(1,2,3-cd)pyrene	CLP[c]	330	±35	±25	10	±25	±25
	Dibenz(a,h)anthracene	CLP[c]	330	±35	±25	10	±25	±25
	Benzo(g,h,i)perylene	CLP[c]	330	±35	±25	10	±25	±25
Pesticides, PCBs	alpha-BHC	CLP[c]	8.0	±35	±25	0.05	±25	±25
	beta-BHC	CLP[c]	8.0	±35	±25	0.05	±25	±25
	delta-BHC	CLP[c]	8.0	±35	±25	0.05	±25	±25
	gamma-BHC (Lindane)	CLP[c]	8.0	±35	±25	0.05	±25	±25
	Heptachlor	CLP[c]	8.0	±35	±25	0.05	±25	±25
	Aldrin	CLP[c]	8.0	±35	±25	0.05	±25	±25
	Heptachlor epoxide	CLP[c]	8.0	±35	±25	0.05	±25	±25
	Endosulfan I	CLP[c]	8.0	±35	±25	0.05	±25	±25
	Diedrin	CLP[c]	16.0	±35	±25	0.10	±25	±25
	4,4'-DDE	CLP[c]	16.0	±35	±25	0.10	±25	±25
	Endrin	CLP[c]	16.0	±35	±25	0.10	±25	±25
	Endosulfan II	CLP[c]	16.0	±35	±25	0.10	±25	±25
	4,4'-DDD	CLP[c]	16.0	±35	±25	0.10	±25	±25
	Endosulftan sulfate	CLP[c]	16.0	±35	±25	0.10	±25	±25
	4,4'-DDT	CLP[c]	16.0	±35	±25	0.10	±25	±25
	Methoxychlor	CLP[c]	80.0	±35	±25	0.5	±25	±25
	Endrin ketone	CLP[c]	16.0	±35	±25	0.10	±25	±25
	alpha-Chlordane	CLP[c]	80.0	±35	±25	0.5	±25	±25
	gamma-Chlordane	CLP[c]	80.0	±35	±25	0.5	±25	±25
	Toxaphene	CLP[c]	160.0	±35	±25	1.0	±25	±25
	Aroclor-1016	CLP[c]	80.0	±35	±25	0.5	±25	±25
	Aroclor-1221	CLP[c]	80.0	±35	±25	0.5	±25	±25
	Aroclor-1232	CLP[c]	80.0	±35	±25	0.5	±25	±25
	Aroclor-1242	CLP[c]	80.0	±35	±25	0.5	±25	±25
	Aroclor-1248	CLP[c]	80.0	±35	±25	0.5	±25	±25
	Aroclor-1254	CLP[c]	160.0	±35	±25	1.0	±25	±25

Table 1. Analytical Methods, Analytes of Interest, Quantitation Limits, and Precision and Accuracy Guidelines for the Phase 2 RI at 1100-EM-1 (Page 5 of 7)

Category	Analyte of Interest	Analytical Method	CQL[a], soil, µg/Kg	Precision[b], Soil	Accuracy[b], Soil	CQL[a], water µg/L	Precision[b], Water	Accuracy[b], Water
Pesticides, PCBs (cont.)	Aroclor-1260	CLP[c]	160.0	±35	±25	1.0	±25	±25
Inorganics	Aluminum	CLP[c]	40	±35	±25	200	±20	±20
	Antimony	CLP[c]	12	±35	±25	60	±20	±20
	Arsenic	CLP[c]	2	±35	±25	10	±20	±20
	Barium	CLP[c]	40	±35	±25	200	±20	±20
	Beryllium	CLP[c]	1	±35	±25	5	±20	±20
	Cadmium	CLP[c]	1	±35	±25	5	±20	±20
	Calcium	CLP[c]	1000	±35	±25	5000	±20	±20
	Chromium	CLP[c]	2	±35	±25	10	±20	±20
	Cobalt	CLP[c]	10	±35	±25	50	±20	±20
	Copper	CLP[c]	5	±35	±25	25	±20	±20
	Iron	CLP[c]	20	±35	±25	100	±20	±20
	Lead	CLP[c]	0.6	±35	±25	3	±20	±20
	Magnesium	CLP[c]	1000	±35	±25	5000	±20	±20
	Manganese	CLP[c]	3	±35	±25	15	±20	±20
	Mercury	CLP[c]	0.04	±35	±25	0.2	±20	±20
	Nickel	CLP[c]	8	±35	±25	40	±20	±20
	Potassium	CLP[c]	1000	±35	±25	5000	±20	±20
	Selenium	CLP[c]	1	±35	±25	5	±20	±20
	Silver	CLP[c]	2	±35	±25	10	±20	±20
	Sodium	CLP[c]	1000	±35	±25	5000	±20	±20
	Thallium	CLP[c]	2	±35	±25	10	±20	±20
	Vanadium	CLP[c]	10	±35	±25	50	±20	±20
	Zinc	CLP[c]	4	±35	±25	20	±20	±20
	Cyanide	CLP[c]	2	±35	±25	10	±20	±20
Ions	Nitrate	EPA 300, modified[d]	1	±35	±25	5	±20	±20
Radionuclide scan	alpha	9310[e]	10 pCi/g	±35	±25	1 pCi/l	±20	±20
	beta	9310[e]	10 pCi/g	±35	±25	1 pCi/l	±20	±20
	gamma	9310[e]	10 pCi/g	±35	±25	1 pCi/l	±20	±20

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Table 1. Analytical Methods, Analytes of Interest, Quantitation Limits, and Precision and Accuracy Guidelines for the Phase 2 RI at 1100-EM-1
(Page 6 of 7)

Category	Analyte of Interest	Analytical Method	CQL[a], soil, µg/Kg	Precision[b], Soil	Accuracy[b], Soil	CQL[a], water µg/L	Precision[b], Water	Accuracy[b], Water
Primary drinking water standards[f]	Arsenic	206.2[g]	N/A	N/A	N/A	10	±20	±20
	Barium	208.1[g]	N/A	N/A	N/A	200	±20	±20
	Cadmium	213.2[g]	N/A	N/A	N/A	5	±20	±20
	Chromium	218.1[g]	N/A	N/A	N/A	10	±20	±20
	Lead	239.2[g]	N/A	N/A	N/A	5	±20	±20
	Mercury	245.1[g]	N/A	N/A	N/A	0.2	±20	±20
	Selenium	270.2[g]	N/A	N/A	N/A	5	±20	±20
	Silver	272.1[g]	N/A	N/A	N/A	10	±20	±20
	Nitrate	352.1[g]	N/A	N/A	N/A	5000	±20	±20
	Endrin	509A[h]	N/A	N/A	N/A	0.1	±20	±20
	Lindane	509A[h]	N/A	N/A	N/A	0.05	±20	±20
	Methoxychlor	509A[h]	N/A	N/A	N/A	0.5	±20	±20
	Toxaphene	509A[h]	N/A	N/A	N/A	1.0	±20	±20
	2,4-D	509B[h]	N/A	N/A	N/A	50	±20	±20
	2,4,5-TP(Silvex)	509B[h]	N/A	N/A	N/A	5	±20	±20
	THMs(total)	[i]	N/A	N/A	N/A	50	±20	±20
	Chloroform	502.1[j]	N/A	N/A	N/A	5	±20	±20
	Bromoform	502.1[j]	N/A	N/A	N/A	5	±20	±20
	Bromodichloromethane	502.1[j]	N/A	N/A	N/A	5	±20	±20
	Dibromochloromethane	502.1[j]	N/A	N/A	N/A	5	±20	±20
	Total Coliform bacteria	502.1[j]	N/A	N/A	N/A	1 col/100 ml	±50	±50
	Radium 226+228	304[h]	N/A	N/A	N/A	2.5pCi/L	±20	±20
	Gross alpha	302[h]	N/A	N/A	N/A	7.5 pCi/L	±20	±20
	Gross beta	302[h]	N/A	N/A	N/A	25 pCi/L	±20	±20
	Strontium 90	303[h]	N/A	N/A	N/A	4 pCi/L	±20	±20
	Tritium	306[h]	N/A	N/A	N/A	500	±20	±20
	Benzene	502.2[g]	N/A	N/A	N/A	2.5	±20	±20
	Vinyl chloride	502.2[g]	N/A	N/A	N/A	1	±20	±20
	Carbon tetrachloride	502.2[g]	N/A	N/A	N/A	2.5	±20	±20
	1,2-Dichloroethane	502.2[g]	N/A	N/A	N/A	2.5	±20	±20
	Trichloroethylene	502.2[g]	N/A	N/A	N/A	2.5	±20	±20
	1,1-Dichloroethylene	502.2[g]	N/A	N/A	N/A	3.5	±20	±20
	1,1,1-Trichloroethane	502.2[g]	N/A	N/A	N/A	100	±20	±20
	1,4-Dichlorobenzene	502.2[g]	N/A	N/A	N/A	37.5	±20	±20

Table 1. Analytical Methods, Analytes of Interest, Quantitation Limits, and Precision and Accuracy Guidelines for the Phase 2 RI at 1100-EM-1 (Page 7 of 7)

Category	Analyte of Interest	Analytical Method	CQL[a], soil, µg/Kg	Precision[b], Soil	Accuracy[b], Soil	CQL[a], water µg/L	Precision[b], Water	Accuracy[b], Water
Secondary drinking water standards[k]	Chloride	325.3[g]	N/A	N/A	N/A	10000	±20	±20
	Color	110.2[g]	N/A	N/A	N/A	15 color units	±20	±20
	Copper	220.1[g]	N/A	N/A	N/A	50	±20	±20
	Corrosivity					N/A	±20	±20
	Fluoride	340.2[g]	N/A	N/A	N/A	100	±20	±20
	Foaming agents	425.1[g]	N/A	N/A	N/A	250	±20	±20
	Iron	236.1[g]	N/A	N/A	N/A	100	±20	±20
	Manganese	243.1[g]	N/A	N/A	N/A	15	±20	±20
	Odor	206[g]	N/A	N/A	N/A	1.5 threshold odor#	N/A	N/A
	pH	424[g]	N/A	N/A	N/A	N/A	N/A	N/A
	Sulfate	375.4[g]	N/A	N/A	N/A	10000	±20	±20
	Total Dissolved Solids	160.1[g]	N/A	N/A	N/A	10000	±20	±20
	Zinc	289.1[g]	N/A	N/A	N/A	20	±20	±20
Soil gas sampling parameters	Tetrachloroethylene (PCE)	TO2[m]/8260[e]	1 ppbv[n]	±25%	±25%	N/A	N/A	N/A
	Trichloroethylene (TCE)	TO2[m]/8260[e]	1 ppbv[n]	±25%	±25%	N/A	N/A	N/A
	Trichloroethane (TCA)	TO2[m]/8260[e]	1 ppbv[n]	±25%	±25%	N/A	N/A	N/A

Notes:

[a]CQL = contractual quantitation limit; values expressed are to be considered target values for initial procurement negotiations with the analytical laboratory, and shall be updated to reflect final negotiated values.
[b]Precision is expressed as RPD or Relative Percent Difference; accuracy is expressed as percentage recovery. All values are target values, which must be confirmed in procurement negotiations with the analytical laboratory.
[c]CLP = methods contained in current EPA contract laboratory program (CLP) statements of work.
[d]Methods is from Determination of Inorganic Anions in Aqueous and Solid Samples by Ion Chromatography (Lindahl 1984), modified from U.S. EPA Method 300.0 (EPA 1984).
[e]Method is from Test Methods for Evaluating Solid Waste (SW-846) (EPA 1986a).
[f]Defined in 40CFR 141.
[g]Methods are from Methods for Chemical Analyses of Water and Waste (EPA 1979).
[h]Methods are from Standard Methods for the Examination of Water and Wastewater 16th ed. (APHA 1985).
[i]Method is defined in 40CFR 141, Subpart C, Appendix C.
[j]Method is from Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water (EPA 1986b).
[k]Defined in 40CFR 143.3.
[m]TO-series method is from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air (EPA 1984b).
[n]ppbv = parts per billion by volume.

Table 2. Supporting Procedures Matrix for Phase 2 of the 1100-EM-1 Remedial Investigation
(Sheet 1 of 4)

Procedure	Title or Subject	Source	Operable Unit-Wide Investigation	1100-1, -4 Subunit Investigation	1100-2 Subunit Investigation	UN-1100-6 Subunit Investigation	Horn Rapids Landfill Investigation	Ephemeral Pool/Pit 1 Investigation	South Pit Investigation	Data Evaluation	Risk Assessment Refinement
EII 1.1	Hazardous Waste Site Entry Requirements	WHC-CM-7-7[a]	X	X	X	X	X	X	X		
EII 1.2	Preparation & Revision of Environmental Investigation Instructions	WHC-CM-7-7[a]	X	X	X	X	X	X	X	X	X
EII 1.4	Deviation from Environmental Investigation Instructions	WHC-CM-7-7[a]	X	X	X	X	X	X	X	X	X
EII 1.5	Field Logbooks	WHC-CM-7-7[a]	X	X	X	X	X	X	X		
EII 1.6	Records Management	WHC-CM-7-7[a]	X	X	X	X	X	X	X	X	X
EII 1.7	Indoctrination, Training & Qualification	WHC-CM-7-7[a]	X	X	X	X	X	X	X	X	X
EII 1.9	Work Plan Review	WHC-CM-7-7[a]	X	X	X	X	X	X	X	X	X
EII 1.10	Identifying, Evaluating, and Documenting Suspect Waste Sites	WHC-CM-7-7[a]							X		
EII 1.11	Technical Data Management	WHC-CM-7-7[a]	X	X	X	X	X	X	X	X	
EII 3.2	Health and Safety Monitoring Instruments	WHC-CM-7-7[a]		X	X	X	X		X		
EII 4.2	Interim Control of Unknown, Suspect Hazardous, and Mixed Waste	WHC-CM-7-7[a]		X	X	X	X	X	X		
EII 5.1	Chain of Custody	WHC-CM-7-7[a]		X	X	X	X	X	X		
EII 5.2	Soil and Sediment Sampling	WHC-CM-7-7[a]					X	X	X		
EII 5.4	Field Decontamination of Drilling, Well Development, and Sampling Equipment	WHC-CM-7-7[a]		X	X	X	X	X	X		
EII 5.5	Decontamination of Equipment for RCRA/CERCLA Sampling	WHC-CM-7-7[a]		X	X	X	X	X	X		
EII 5.7A	Hanford Geotechnical Sample Library Control	WHC-CM-7-7[a]		X	X	X	X	X	X		

Table 2. Supporting Procedures Matrix for Phase 2 of the 1100-EM-1 Remedial Investigation
(Sheet 2 of 4)

Procedure	Title or Subject	Source	Operable Unit-Wide Investigation	1100-1, -4 Subunit Investigation	1100-2 Subunit Investigation	UN-1100-6 Subunit Investigation	Horn Rapids Landfill Investigation	Ephemeral Pool/Pit 1 Investigation	South Pit Investigation	Data Evaluation	Risk Assessment Refinement
EII 5.8	Groundwater Sampling	WHC-CM-7-7[a]		X	X	X	X				
EII 5.9	Soil Gas Sampling	WHC-CM-7-7[a]					X	X		X	
EII 5.11	Sample Packaging and Shipping	WHC-CM-7-7[a]		X	X	X	X	X	X		
EII 6.1	Activity Reports of Field Operations	WHC-CM-7-7[a]	X	X	X	X	X	X	X		
EII 6.7	Groundwater Well and Borehole Drilling	WHC-CM-7-7[a]		X	X	X	X				
EII 6.8	Well Completion	WHC-CM-7-7[a]		X	X	X	X				
EII 8.3	Remediation of Groundwater Wells	WHC-CM-7-7[a]		X	X	X	X				
EII 9.1	Geologic Logging	WHC-CM-7-7[a]		X	X	X	X	X	X		
EII 10.1	Aquifer Testing	WHC-CM-7-7[a]					X				
EII 10.2	Measurement of Ground-Water Levels	WHC-CM-7-7[a]		X	X	X	X				
EII 10.3	Purge Water Management	WHC-CM-7-7[a]		X	X	X	X				
EII 10.4	Well Development Activities	WHC-CM-7-7[a]		X	X	X	X				
EII 11.1	Geophysical Logging	WHC-CM-7-7[a]							X		
EII 11.2	Geophysical Survey Work	WHC-CM-7-7[a]							X		
[b]	Analytical Data Validation	[b]		X	X	X	X	X	X		
[b]	Geodetic Surveying	[b]	X								
WHC-CM-04-12[c]	Surface Radiation Survey	WHC-CM-4-12[c]				X					
[b]	Ground Penetrating Radar Surveying	[b]							X		
[b]	Electromagnetic Surveying	[b]							X		

Table 2. Supporting Procedures Matrix for Phase 2 of the 1100-EM-1 Remedial Investigation
(Sheet 3 of 4)

Procedure	Title or Subject	Source	Operable Unit-Wide Investigation	1100-1, -4 Subunit Investigation	1100-2 Subunit Investigation	UN-1100-6 Subunit Investigation	Horn Rapids Landfill Investigation	Ephemeral Pool/Pit 1 Investigation	South Pit Investigation	Data Evaluation	Risk Assessment Refinement
D2216	Standard Methods for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures	ASTM[d]	X	X	X		X				
QR 6.0	Document Control	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 6.1	Quality Assurance Document Control	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QR 5.0	Instruction, Procedures, and Drawings	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 5.1	Preparation of Quality Assurance Documents	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QR 4.0	Procurement Document Control	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 4.1	Procurement Document Control	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 4.2	External Services Control	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QR 7.0	Control of Purchased Items and Services	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 7.1	Procurement Planning and Control	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 7.2	Supplier Evaluation	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 7.3	Source Surveillance and Inspection	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QR 17.0	Quality Assurance Records	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 17.1	Quality Assurance Records Control	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 12.0	Control of Measuring and Test Equipment	WHC-CM-4-2[e]	X	X	X	X	X	X	X		
QI 12.1	Acquisition and Calibration of Portable Measuring and Test Equipment	WHC-CM-4-2[e]	X	X	X	X	X	X	X		
QI 12.2	Measuring and Test Equipment Calibration by User	WHC-CM-4-2[e]	X	X	X	X	X	X	X		
QI 10.4	Surveillance	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X

Table 2. Supporting Procedures Matrix for Phase 2 of the 1100-EM-1 Remedial Investigation
(Sheet 4 of 4)

Procedure	Title or Subject	Source	Operable Unit-Wide Investigation	1100-1, -4 Subunit Investigation	1100-2 Subunit Investigation	UN-1100-6 Subunit Investigation	Horn Rapids Landfill Investigation	Ephemeral Pool/Pit 1 Investigation	South Pit Investigation	Data Evaluation	Risk Assessment Refinement
QR 18.0	Audits	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 18.1	Audit Programming and Scheduling	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 18.2	Planning, Performing, Reporting, and Follow-up of Quality Audits	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 2.5	Qualification of Quality Assurance Program Audit Personnel	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QR 16.0	Corrective Action	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 16.1	Trending/Trend Analysis	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 16.2	Corrective Action Reporting	WHC-CM-4-2[e]	X	X	X	X	X	X	X	X	X
QI 15.1	Nonconforming Item Reporting	WHC-CM-4-2[e]	X	X	X	X	X	X	X		
QI 15.2	Nonconformance Report Processing	WHC-CM-4-2[e]	X	X	X	X	X	X	X		

Notes:

[a] Environmental Investigations and Site Characterization Manual (WHC 1989b).

[b] Procedures shall be developed by participant or support contractors in compliance with Section 4.3.2, or by Westinghouse Hanford in compliance with EII 1.2 (WHC 1989b).

[c] Procedures are contained in the Operational Health Physics Practices Manual (WHC 1988).

[d] Procedures are from 1990 Annual Book of ASTM Standards, Volume 4.08: Soil and Rock; Building Stones; Geotextiles (ASTM 1989).

[e] Westinghouse Hanford Company Quality Assurance Manual (WHC 1989a).

for Westinghouse Hanford are required, requirements for the review and approval of all applicable procedures shall be included in the procurement document or work order, as applicable. In addition to the submittal of analytical procedures, analytical laboratories shall be required to submit the current revision of their internal QA program plans. Prior to use, all analytical laboratory plans and procedures shall be reviewed and approved by qualified personnel, as directed by the project coordinator; all reviewers shall be qualified under the requirements of EII 1.7, "Indoctrination, Training, and Qualification" (WHC 1989c). All participant contractor or subcontractor procedures, plans, and/or manuals shall be retained as project quality records in compliance with EII 1.6, "Records Management" (WHC 1989c); QR 17.0, "Quality Assurance Records"; and QI 17.1, "Quality Assurance Records Control" (WHC 1989b). All such documents shall be made available for regulatory review on request at the direction of the Westinghouse Hanford project coordinator.

4.1.3 Procedure Change Control

Deviations from established EIIs that may be required in response to unforseen field situations may be authorized in compliance with EII 1.4, "Deviation from Environmental Investigations Instructions"(WHC 1989c). Documentation, review, approval, and disposition requirements shall be as specified therein. Other types of change requests applicable to QRs and QIs shall be approved, as required, by QR 6.0, "Document Control", and QI 6.1, "Quality Assurance Document Control" (WHC 1989b). Deviations from established radiation surveying and monitoring procedures shall be authorized only within applicable portions of the guidelines established by the *Operational Health Physics Practices Manual*, WHC-CM-4-12 (WHC 1988). As noted in Section 1.4 above, interim changes to this QAPP, the supplemental work plan, or other plan-level documents shall be documented, reviewed, and approved in compliance with Section 6.6 of EII 1.9, "Work Plan Review" (WHC 1989c).

4.2 SAMPLING PROCEDURES

4.2.1 Soil Sample Acquisition

All soil sampling shall be conducted in compliance with EII 5.2, "Soil and Sediment Sampling" (WHC 1989c). Borehole drilling in support of soil sample acquisition shall be in compliance with EII 6.7, "Groundwater Well and Borehole Drilling"(WHC 1989c). Other applicable EIIs and procedures related to soil sampling activities are specified in Table 2.

4.2.2 Water Sample Acquisition

All water sampling shall be performed in compliance with EII 5.8, "Groundwater Sampling." Other EIIs and procedures related to water sampling, groundwater well installation, development, and maintenance are specified in Table 2.

4.2.3 Soil Gas Sample Acquisition

All soil gas sampling shall be conducted in compliance with EII 5.9, "Soil Gas Sampling"; other supporting procedures and EIIs are specified in Table 2.

4.3 SAMPLE IDENTIFICATION, LOCATION, AND FREQUENCY

All samples shall be assigned an eight-character identifier in compliance with the protocols described in Table 3. Page 1 of Table 3 provides two-character codes for each subunit in the Phase II RI. Pages 2 and 3 of Table 3 provide two-character codes for all anticipated sample types, cross-referenced to the individual subunit investigations in which they will be acquired. Page 4 of Table 3 provides an example of a complete identifier; the example (HR 3 ES 15 2) would be interpreted as the second semivolatile soil sample acquired at the 15-ft interval at borehole 3 in the Horn Rapids landfill subunit.

Sample location and frequency shall be as defined in Chapter 4.0 of the supplemental work plan (see Sections 4.2 through 4.8 and Figures 4-1 through 4-19). Field quality control (QC) sample frequencies shall meet the minimum requirements defined in Chapter 9.0 below.

4.4 SAMPLE CONTAINER PREPARATION, HANDLING, PRESERVATION, AND SHIPPING

Sample container selection, preparation, and preservation shall be as specified in EII 5.2, "Soil and Sediment Sampling"; EII 5.8, "Groundwater Sampling"; or EII 5.9, "Soil Gas Sampling" (WHC 1989c), as appropriate for the type of sample involved. All samples shall be packaged and shipped in compliance with the applicable requirements of EII 5.11, "Sample Packaging and Shipping" (WHC 1989c), subject to the chain of custody controls described in Chapter 5.0 below.

4.5 SAMPLING EQUIPMENT DECONTAMINATION

Field support equipment and sample acquisition equipment shall be decontaminated prior to use as required by EII 5.4, "Field Decontamination of Drilling, Well Development, and Sampling Equipment", and/or EII 5.5, "Decontamination of Equipment for RCRA/CERCLA Sampling" (WHC 1989c), as appropriate for the equipment type.

5.0 SAMPLE CUSTODY

All samples obtained during the course of this investigation shall be controlled, as required, by EII 5.1 "Chain of Custody" (WHC 1989c) from the point of origin to the analytical laboratory. Laboratory chain-of-custody procedures shall be reviewed and approved in compliance with the requirements of Section 4.1 above, as applicable, and shall

Table 3. 1100-EM-1 Phase 2 RI Sample Designation Protocol
Page 1 of 4

SUBUNIT	SUBUNIT CODE
1100-1	01
1100-2	02
1100-4	04
UN-1100-6	N6
Horn Rapids Landfill	HR
Ephemeral Pool	EP
South Pit	SP

Table 3. 1100-EM-1 Phase 2 RI Sample Designation Protocol
Page 2 of 4

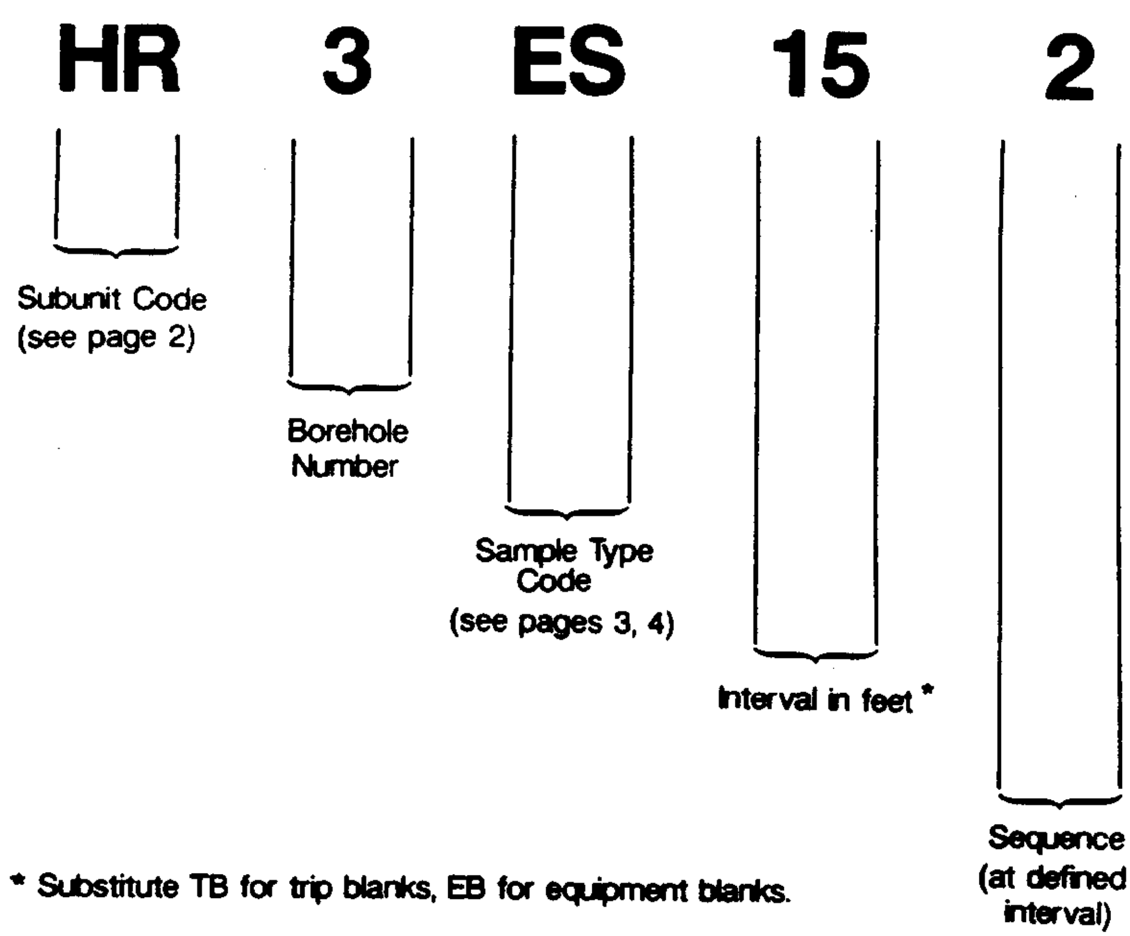
Sample Type	Type Code	1100-1	1100-2	1100-4	UN-1100-6	Horn Rapids	Ephemeral Pool	South Pit
volatile organics, soil	VS							X
volatile organics, water	VW		X		X	X		
semivolatile organics, soil	ES				X			X
semivolatile organics, water	EW		X		X	X		
pesticides/PCBs, soil	PS					X	X	X
pesticides/PCBs, water	PW		X		X	X		
inorganics, soil	MS					X		X
inorganics, water	MW		X		X	X		
nitrate ion, soil	NS					X		
nitrate ion, water	NW					X		
radionuclides, water	RW	X		X		X		
radionuclides, soil	RS	X		X	X	X		
primary drinking water, volatile inorganics	1V				X	X		
primary drinking water, semivolatile inorganics	1E				X	X		
primary drinking water, inorganics	1M		X		X	X		
primary drinking water, pesticides/PCBs	1P		X		X	X		

Table 3. 1100-EM-1 Phase 2 RI Sample Designation Protocol
Page 3 of 4

Sample Type	Type Code	1100-1	1100-2	1100-4	UN-1100-6	Horn Rapids	Ephemeral Pool	South Pit
secondary drinking water, coliform bacteria	2B		X		X	X		
secondary drinking water, ions	2N		X		X	X		
secondary drinking water, corrosivity	2C		X		X	X		
secondary drinking water, odor	2O		X		X	X		
secondary drinking water, organics	2V		X		X	X		
secondary drinking water, foaming agents	2F		X		X	X		
secondary drinking water, total dissolved solids	2D		X		X	X		
secondary drinking water, pH	2H		X		X	X		
soil gas	SG		X		X	X		X
in-situ moisture	MC	X	X	X	X	X		

Table 3. 1100-EM-1 Phase 2 RI Sample Designation Protocol
Sheet 4 of 4

Example



* Substitute TB for trip blanks, EB for equipment blanks.

ensure the maintenance of sample integrity and identification throughout the analytical process. At the direction of the Westinghouse Hanford project coordinator, requirements for the return of residual sample materials after completion of analysis shall be defined in accordance with procedures defined in the procurement documentation to subcontractor or participant contractor laboratories. Chain-of-custody forms shall be initiated for returned residual samples, as required by the approved procedures applicable within the laboratory. Results of analyses shall be traceable to original samples through the unique numerical sample identifier discussed in Chapter 4.0 and Table 3 above. All analytical results shall be controlled as permanent project quality records as required by QR 17.0, "Quality Assurance Records," (WHC 1989b) and EII 1.6, " Records Management," (WHC 1989c).

6.0 CALIBRATION PROCEDURES

Calibration of all Westinghouse Hanford measuring and test equipment, whether in an existing inventory or purchased for this investigation, shall be controlled as required by QR 12.0, "Control of Measuring Test Equipment"; QI 12.1, "Acquisition and Calibration of Portable Measuring and Test Equipment" (WHC 1989b); QI 12.2, "Measuring and Test Equipment Calibration by User" (WHC 1989b); EII 3.1, "User Calibration of Health and Safety M&TE" (WHC 1989c); and/or WHC-CM-4-12 (WHC 1988). Routine operational checks for Westinghouse Hanford field equipment shall be as defined within applicable EIIs, procedures or governing manual sections; similar information shall be provided in Westinghouse Hanford-approved participant contractor or subcontractor procedures.

Calibration of laboratory analytical equipment shall be as defined by Westinghouse Hanford-approved laboratory QA project plans or the applicable reference methods specified in Table 1.

7.0 ANALYTICAL PROCEDURES

Analytical methods identified in Table 1 shall be selected or developed and approved before they are used, in compliance with appropriate Westinghouse Hanford procedure and/or procurement control requirements. As noted in Section 3.0, Table 1 provides general guidelines and reference sources for target contractual quantitation limits and target values for precision and accuracy for each analyte of interest. Once individual laboratory statements of work are negotiated, and procedures are approved in compliance with the requirements of Section 4.1.2, Table 1 shall be revised to include actual method references, approved contractual quantitation limit, precision, and accuracy criteria as project requirements; all such changes shall be documented as required by Section 6.6 of EII 1.9 "Work Plan Review" (WHC 1989c), and shall be documented as part of monthly unit managers' meeting minutes.

All analytical procedures approved for use in this investigation shall require the use of standard reporting techniques and units to facilitate the comparability of data sets in terms of precision and accuracy. All approved procedures shall be retained in the project quality records and shall be available for review upon request at the direction the Westinghouse Hanford project coordinator.

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

8.1 DATA REDUCTION AND DATA PACKAGE PREPARATION

All subcontractor or participant contractor analytical laboratories shall be responsible for preparing a report summarizing the results of analysis and for preparing a detailed data package that includes identification of samples, sampling and analysis dates, raw analytical data, reduced data, data outliers, reduction formulae, recovery percentages, quality control check data, equipment calibration data, supporting chromatograms or spectrograms, and documentation of any nonconformances affecting the measurement system in use during sample analysis. Data reduction schemes shall be contained within individual laboratory analytical methods and/or QA project plans, subject to Westinghouse Hanford review and approval as discussed in Section 4.1. The completed data package shall be reviewed and approved by the analytical laboratory's QA manager before it is submitted to the Westinghouse Hanford Office of Sample Management (OSM) for validation. The requirements of this section shall be included in procurement documentation or work orders, as appropriate, in compliance with standard Westinghouse Hanford procurement control procedures noted in Section 4.1.

8.2 VALIDATION

Data validation shall be performed by the Westinghouse Hanford OSM in compliance with procedures approved by the project coordinator. At a minimum, OSM data validation procedures shall meet the requirements of Sections 8.2.1, 8.2.2, and 8.2.3 below.

8.2.1 Screening Analyses – Verification and Report Preparation Requirements

Screening analyses shall have been performed in compliance with Westinghouse Hanford-approved procedures, as noted in Section 4.1. Verification of screening data quality shall be in compliance with applicable Westinghouse Hanford EIIs; verification of screening data obtained using laboratory methods shall, at a minimum, be verified by comparison with laboratory data validated in compliance with Sections 8.2.2 and 8.2.3 below.

8.2.2 Standard Analyses -- Validation and Report Preparation Requirements

All standard procedure analyses shall be validated in general compliance with WHC-CM-5-3, Section 2.2, for organics analyses and WHC-CM-5-3, Section 2.1 (WHC 1990) for inorganics analyses.

8.2.3 Special Analyses -- Validation and Report Preparation Requirements

All validation of radionuclide analyses shall be performed in compliance with specific procedures developed by the OSM; all such procedures shall be approved by the project coordinator, and shall address the following minimum requirements:

- review of calibration data for each instrument/technique
- review of verification data for determination of lower limit of detection (LLD) and/or minimum detectable activity (MDA)
- review of blank data
- review of spike sample recovery data
- review of detector efficiency calculations and data for each applicable geometry
- review of counting error calculation data
- review of ingrowth correction factors, as applicable to sample result calculations
- review of duplicate analysis data
- review of laboratory control sample data
- verification of receipt of all raw data for all instruments used to report sample data, plus all routine QA/QC data
- verification of receipt of all analytical results in compatible electronic format
- review of chain of custody records.

Validation of all organic and inorganic samples in radioactive matrices shall be in compliance with Section 8.2.2 above.

8.3 FINAL REVIEW AND RECORDS MANAGEMENT CONSIDERATIONS

At the discretion of the Westinghouse Hanford project coordinator, all screening verification reports, validation reports and supporting analytical data packages shall be subjected to a final technical review by a qualified reviewer before they are submitted to the regulatory agencies, or are included in reports or technical memoranda. All reports, data packages, and review comments shall be retained as permanent project quality records in compliance with EII 1.6, "Records Management" (WHC 1989c), and QR 17.0, "Quality Assurance Records" (WHC 1989b).

9.0 INTERNAL QUALITY CONTROL

All analytical samples shall be subject to in-process QC measures in both the field and the laboratory. The following minimum field QC requirements apply for validated analyses. These requirements are adapted from *Test Methods for Evaluating Solid Waste* (EPA 1986), as modified by the proposed rule changes included in the Federal Register (EPA 1989a).

- Field duplicate samples: For each shift of sampling activity under an individual sampling subtask, a minimum of 5% of the total collected samples shall be duplicated, or one duplicate shall be collected for every 20 samples, whichever is greater. Duplicate samples shall be retrieved using the same equipment and sampling technique and shall be placed into two identically prepared and preserved containers. All field duplicates shall be analyzed independently as an indication of gross errors in sampling techniques.

- Split samples: At the Westinghouse Hanford project coordinator's direction, field or field duplicate samples may be split in the field and sent to an alternate laboratory as a performance audit of the primary laboratory. Frequency shall meet the minimum schedule requirements of Chapter 10.0.

- Blind samples: At the Westinghouse Hanford project coordinator's direction, blind or double-blind reference samples may be introduced into any sampling round (in lieu of split samples) as a performance audit of primary laboratory. Blind sample type and frequency shall be as directed by the Westinghouse Hanford project coordinator; frequency shall meet the minimum schedule requirements for performance audits described in Chapter 10.0.

- Field blanks: Field blanks shall consist of pure deionized distilled water, transferred into a sample container at the site and preserved with the reagent specified for the analytes of interest. Field blanks are used as a check on reagent and environmental contamination and shall be collected at the same frequency as field duplicate samples.

- Equipment blanks: Equipment blanks shall consist of pure deionized distilled water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples. Equipment blanks are used to verify the adequacy of sampling equipment decontamination procedures and shall be collected at the same frequency as field duplicate samples.

- Trip blanks: Trip blanks consist of pure deionized distilled water added to one clean sample container, accompanying each batch of containers shipped to the sampling activity. Trip blanks shall be returned unopened to the laboratory and are prepared as a check on possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions. In compliance with standard Westinghouse Hanford procurement procedures, requirements for trip blank preparation shall be included in procurement documents of work orders to the sample container supplier and/or preparer.

Internal QC checks for fully validated analyses shall be as specified by the laboratory's approved QA plan and shall meet the following minimum requirements:

- Matrix spike/matrix spike duplicate samples: Matrix spike and matrix spike duplicate samples require the addition of a known quantity of a representative analyte of interest to the sample as a measure of recovery percentage and as a test of analytical precision. The spike shall be made in a replicate of a field duplicate sample. Replicate samples are separate aliquots removed from the same sample container in the laboratory. Spike compound selection, quantities, and concentrations shall be described in the laboratory's approved analytical methods. One sample shall be spiked for each analytical batch, or once every 20 samples, whichever is greater.

- QC reference samples: A QC reference sample shall be prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. Reference samples are required as an independent check on analytical technique and methodology and shall be run with every analytical batch, or every 20 samples, whichever is greater.

The minimum requirements of this section shall be invoked in procurement documents or work orders, in compliance with standard Westinghouse Hanford procedures as noted in Section 4.1.

10.0 PERFORMANCE AND SYSTEM AUDITS

As discussed in Section 5.12 and Appendix C of *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans,* QAMS-005 (EPA 1983), audits in environmental investigations are considered to be systematic checks that verify the quality of operation of one or more elements of the total measurement system. Such audits may be of two types: (1) performance audits, in which quantitative data are independently obtained for comparison with data routinely obtained by the measurement system; or (2) system audits, involving a qualitative onsite evaluation of laboratories (or other organizational elements of the measurement system) for compliance with established quality assurance program and procedural requirements. For this investigation, performance audit requirements shall be met by the analysis of a minimum of one split sample for each analytical method identified in Table 1. At the project coordinator's option, blind reference samples may be used for performance audit purposes in lieu of split samples. Performance audit samples shall be analyzed by an independent laboratory in compliance with approved methods based on the same reference standards as are invoked for the primary laboratory. All analytical procedures shall be approved by Westinghouse Hanford before they are used as described in Section 4.1 of this QAPP. System audit requirements shall be implemented through the use of procedure QI 10.4, "Surveillance" (WHC 1989b). At a minimum, at least one system audit shall be performed; so that any required corrective action may be implemented in time to have a beneficial effect on project quality, the audit shall be scheduled shortly after the initiation of project activity.

Additional performance and system audits may be scheduled as a consequence of corrective action requirements (see Chapter 13.0), or may be performed upon request by the Westinghouse Hanford QA coordinator, the project coordinator, the U.S. Department of Energy-Richland Operations Office, the Washington State Department of Ecology, or the EPA. Any discrepancies observed during the evaluation of performance audit results or during system audit surveillance activities that cannot be immediately corrected to the satisfaction of the investigator shall be documented as nonconformances and resolved in compliance with procedures QI 15.1, "Nonconforming Item Reporting," and QI 15.2, "Nonconformance Report Processing" (WHC 1989b). In addition, at the direction of the QA coordinator, all aspects of 1100-EM-1 project activities also may be evaluated as part of operable unit-wide QA program audits under the procedural requirements of WHC-CM-4-2 (WHC 1989b). Program audits shall be conducted in compliance with QR 18.0, "Audits"; QI 18.1, "Audit Programming and Scheduling"; and QI 18.2, "Planning, Performing, Reporting, and Follow-up of Quality Audits", by auditors qualified in compliance with QI 2.5, "Qualification of Quality Assurance Program Audit Personnel" (WHC 1989b).

11.0 PREVENTIVE MAINTENANCE

All measurement and testing equipment used in the field and laboratory that directly affects the quality of the field and analytical data shall be subject to preventive maintenance measures that ensure minimization of measurement system downtime and corresponding schedule delays. Laboratories shall be responsible for performing or managing the maintenance of their analytical equipment. Maintenance requirements, spare parts list, and instructions shall be included in individual methods or in laboratory QA plans, subject to Westinghouse Hanford review and approval. Westinghouse Hanford field equipment shall be drawn from inventories subject to standard preventive maintenance procedures. Field procedures submitted for Westinghouse Hanford approval by participant contractors or subcontractors shall contain provisions for preventive maintenance, maintenance schedules, and spare parts lists to ensure minimization of equipment downtime.

12.0 DATA ASSESSMENT PROCEDURES

As noted in Section 4.9 of the supplemental work plan, the data generated during the Phase II RI will be monitored on an ongoing basis. Data evaluation summaries shall be prepared and reported to the project coordinator on a monthly basis in order to facilitate any necessary redirection or emphasis of the characterization effort. Where data are generated in sufficient quantity to warrant such analysis, the project coordinator may direct the application of specific statistical or probabilistic techniques in the process of data comparison and analysis. Such techniques are likely to include the calculation of tolerance limits, and the calculation of confidence limits, as discussed in the following sections.

12.1 TOLERANCE LIMIT CALCULATIONS

Each hazardous substance has a certain background distribution in a given environmental medium. Before a substance can be regarded as a site-specific contaminant, it must be found to occur at concentrations exceeding (or for pH, lying outside) the local background distribution. Site-specific tolerance limits will be calculated to make these determinations in an objective manner.

All environmental-medium-specific background distributions will be assumed to be normal, unless non-normality can be demonstrated. One-sided tolerance limits corresponding to the 95th percentile of the background distribution, with a degree of confidence of 95%, will be calculated in accordance with the methodology provided in EPA (1989b). Two-sided tolerance limits corresponding to the 5th and 95th percentiles of the background distribution, with a degree of confidence of 95%, will be calculated for pH in accordance with the methodology provided in Miller and Freund (1965).

12.2 CONFIDENCE LIMIT CALCULATIONS

During a baseline risk assessment, reasonable maximum exposures concentrations and other factors are estimated. In accordance with EPA (1989c), reasonable maximum risk assessment factors are calculated by substituting a mean value with a conservatively biased estimates of the mean. Such estimates are obtained from the calculation of an upper or lower (whichever provides the conservative estimate) confidence limit of the distribution of the mean.

Mean value distributions used in exposure assessment will be assumed to be normal. One-sided, 95% confidence limits will be calculated in accordance with the methodology provided in Miller and Freund (1965).

13.0 CORRECTIVE ACTION

Corrective action requests required as a result of surveillance reports, nonconformance reports, or audit activity shall be documented and dispositioned as required by QR 16.0, "Corrective Action"; QI 16.1, "Trending/Trend Analysis"; and QI 16.2, "Corrective Action Reporting" (WHC 1989b). Other measurement system procedure or plan corrections that may be required as a result of data assessment or routine review processes shall be resolved as required by governing procedures or shall be referred to the Westinghouse Hanford project coordinator for resolution. Copies of all surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project quality records upon completion or closure.

14.0 QUALITY ASSURANCE REPORTS

As previously stated in Chapters 10.0 and 13.0, project activities shall be regularly assessed by performance and system auditing and associated corrective action processes. Surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project quality records upon completion or closure of the activity. A report summarizing all audit, surveillance, and instruction change authorization activity (see Section 4.4), as well as any associated corrective actions or trend analysis reports, shall be prepared for the Westinghouse Hanford project coordinator by the QA coordinator at the completion of the South Pit investigation. Such information will be evaluated and integrated into the evaluations addressed by the data evaluation and risk assessment tasks. The report shall include an assessment of the overall adequacy of the total measurement system with regard to the data quality objectives of this phase of the investigation.

15.0 REFERENCES

APHA, 1985, *Standard Methods for the Examination of Water and Wastewater, 16th Edition,* American Public Health Association, Washington, D.C.

DOE, 1989, *Remedial Investigation/Feasibility Study Work Plan for the 1100-EM-1 Operable Unit Hanford Site, Richland, Washington;* U.S. Department of Energy, Richland, Washington.

DOE-RL, 1990, *Phase I Remedial Investigation Report for the Hanford Site 1100-EM-1 Operable Unit,* U.S. Department of Energy-Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE-RL, 1989, *Hanford Federal Facility Agreement and Consent Order,* Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy-Richland Operations Office, Olympia, Washington.

EPA, 1979, *Methods for Chemical Analysis of Water and Wastes,* EPA-600/4-79-020 U.S. Environmental Protection Agency/Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

EPA, 1983, *Interim Guidelines and Specifications for Preparation of Quality Assurance Project Plans,* QAMS-005/80, U.S. Environmental Protection Agency, Office of Exploratory Research, Washington, D.C.

EPA, 1984, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air;* U.S. Environmental Protection Agency, Atmosphere Research and Exposure Assessment Laboratory, Research Triangle Park, North Carolina.

EPA, 1986a, *Test Methods for Evaluating Solid Waste* (SW-846), Third Edition; U.S. Environmental Protection Agency/Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1986b, *Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water;* U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses;* U.S. Environmental Protection Agency/Hazardous Site Evaluation Division, Washington, D.C.

EPA, 1988b, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (OSWER directive 9335.3-01, Draft); U.S. Environmental Protection Agency/Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1988c, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses;* U.S. Environmental Protection Agency/Hazardous Site Evaluation Division, Washington, D.C.

EPA, 1989a, *Hazardous Waste Management System; Testing and Monitoring Activities* (Proposed Rule); U.S. Environmental Protection Agency, in Federal Register, Vol. 54, No. 13, pp 3212-3228.

EPA, 1989b, Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, U.S. Environmental Protection Agency, Office of Solid Waste, Washington, D.C.

EPA, 1989c, Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Interim Final, OSWER 9285.7-01a, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C.

Lindahl, P.C., 1984, *Determination of Inorganic Anions in Aqueous and Solid Samples of Ion Chromatography,* EPA-600/4-84-017, Argonne National Laboratory, Argonne, Illinois.

McCain R.G. and W.L. Johnson, 1990, *A Proposal Data Quality Strategy for Hanford Site Characterization,* WHC-SD-EN-AP-023, Rev. No. 0, Westinghouse Hanford Company, Richland, Washington.

Miller, I. and J.E. Freund, 1965, Probability and Statistics for Engineers, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

WHC, 1988, *Operational Health Physics Practices Manual,* WHC-CM-4-12, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989a, *Quality Assurance Program Plan for Comprehensive Environmental Response, Compensation, and Liability Act Remedial Investigation/Feasibility Study Activities,* WHC-SP-0447, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989b, *Environmental Investigations and Site Characterizations Manual,* WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989c, *Westinghouse Hanford Company Quality Assurance Manual,* WHC-CM-4-2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990, *Westinghouse Hanford Company Sample Management and Administration Manual*, WHC-CM-5-3, Westinghouse Hanford Company, Richland, Washington.

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