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Information on Hazardous Substance Releases Within the 1100 Area

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Information on Hazardous Substance Releases Within the 1100 Area

Prepared for: Hanford Natural Resource Trustee Council as a support document for the 1100 Area Preassessment Screen

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ACRONYMS

ALE	Arid Lands Ecology Reserve
BEHP	bis (2-ethylhexyl) phthalate
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFWQC	chronic freshwater quality criteria
COPC	contaminants of potential concern
DDT	dichlorodiphenyltrichloroethane
Ecology	Washington State Department of Ecology
EM	equipment maintenance
EPA	U.S. Environmental Protection Agency
HQ	hazard quotient
HRL	Horn Rapids Landfill
HWQHC	human water quality health criteria
HWQWC	human water quality welfare criteria
ICR	incremental cancer risk
IU	isolated unit
JP	jet propellant
LFI/FFS	Limited Field Investigation/Focused Feasibility Study
MCL	maximum contaminant level
MCLG	maximum contaminant level goals
MTCA	*Model Toxics Control Act*
NPL	National Priorities List
OU	operable unit
PAS	preassessment screen
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
ppbv	parts per billion by volume
ppm	parts per million
RAO	remedial action objective
RI/FS	Remedial Investigation/Feasibility Study
RL	U.S. Department of Energy, Richland Operations Office
ROD	Record of Decision
SQL	Sample Quantitation Limit
SVOC	semivolatile organic compounds
TAL	target analyte list
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TCL	target compound list
TPH	total petroleum hydrocarbons
USACE	U.S. Army Corp of Engineers
UST	underground storage tank
UTL	upper tolerance limit
VOC	volatile organic compounds
WIDS	waste information data system

1.0 INFORMATION ON THE SITE

1.1 Information on the Site and on the Discharge or Release

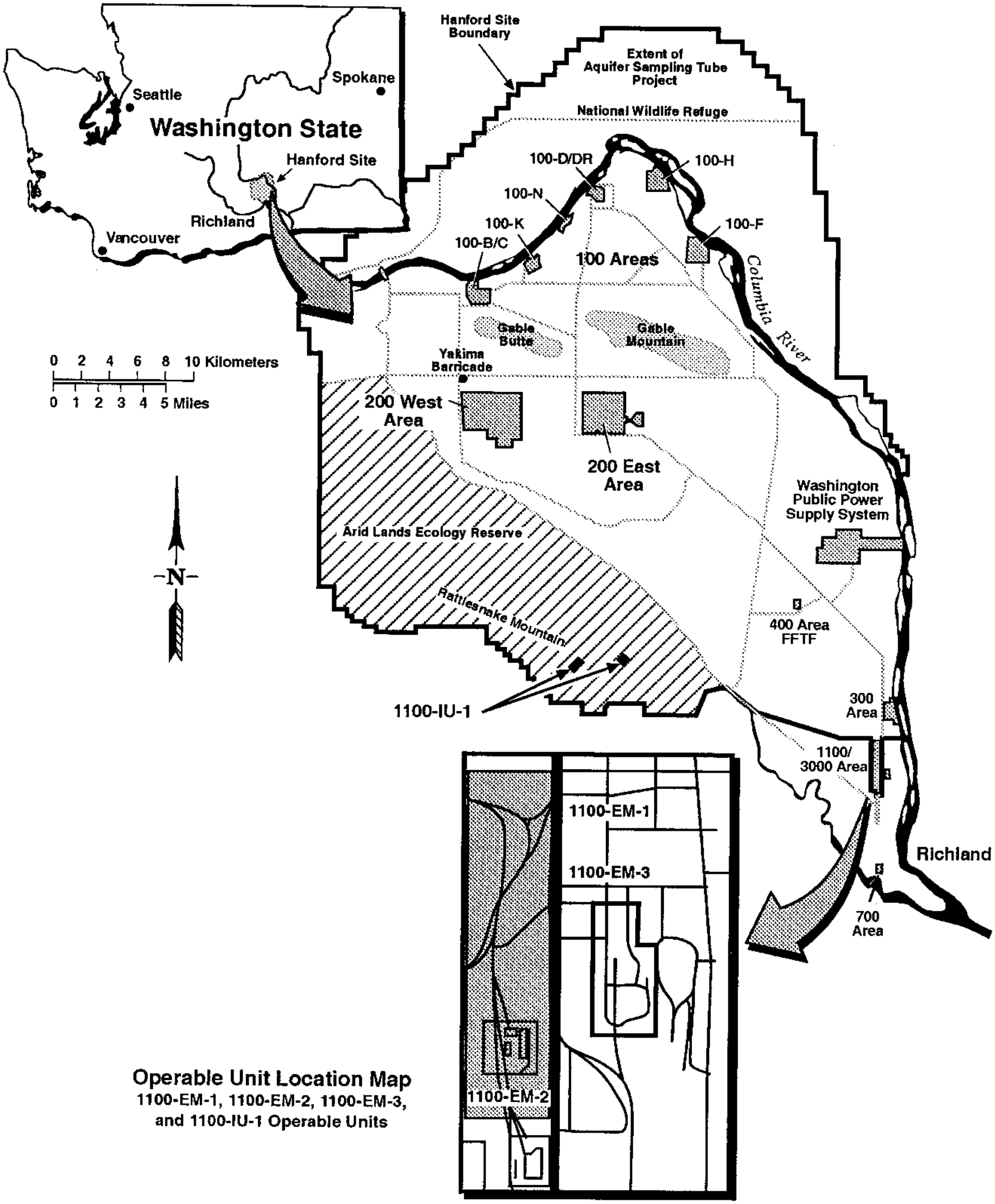
The Hanford 1100 Area National Priorities List (NPL) site (Figure 1) consists of four operable units (OU): 1100-EM-1, 1100-EM-2, 1100-EM-3, and 1100-IU-1. Each OU is designated with a three-part code: the first part indicates the NPL site affiliation; the second part describes the OU type (equipment maintenance [EM] and isolated unit [IU]); and the third part is the number specific to the OU. The 1100 Area was listed on the NPL (54 FR 41015, Oct. 4, 1989), based on the proximity of the 1100-EM-1, 1100-EM-2, and 1100-EM-3 OUs to groundwater wells that supply drinking water to the City of Richland (DOE-RL 1995b).

The 1100-EM-1, 1100-EM-2, and 1100-EM-3 are located in the southern-most portion of the Hanford Site; these OUs contain the central warehousing, vehicle maintenance, and transportation distribution center for the entire Hanford Site. The 1100-IU-1 is located within the Fitzner-Eberhardt Arid Lands Ecology Reserve (ALE) on the northeastern slope of Rattlesnake Mountain, approximately 24 km west of the 1100 Area (EPA 1993).

The closest surface water bodies to the 1100 Area are the Columbia and Yakima Rivers. These rivers are approximately 1,200 and 6,500 m, respectively, from the 1100 Area. Available floodplain information indicates that the 1100-EM-2, 1100-EM-3, and 1100-IU-1 are not located within the limits of the Columbia and Yakima River flood plains (DOE-RL 1992c).

The 1100-EM-1 was designated the highest priority among the Hanford Site 1100 Area OUs because of the potential for contamination at the Antifreeze Tank Site and the Battery Acid Pit and their proximity to the North Richland well field. Remedial Investigation/ Feasibility Study (RI/FS) activities at the 1100-EM-1 were initiated in 1989, and a Phase I RI/FS was completed in August 1990. A baseline risk assessment was conducted as part of the RI/FS to evaluate current and potential effects of the 1100-EM-1 contaminants on human health and the environment (DOE-RL 1992b). In the fall of 1992, the U.S. Environmental Protection Agency (EPA), U.S. Department of Energy, Richland Operations Office (RL), and the Washington State Department of Ecology (Ecology) accelerated the study and evaluation of the three other OUs so that all remedial actions in the 1100 Area could proceed as a single project. The Limited Field Investigation/Focused Feasibility Study (LFI/FFS), an addendum to the 1100-EM-1 RI/FS, details the streamlined approach for 1100-EM-2, 1100-EM-3, and 1100-IU-1 (DOE-RL 1992c). The LFI/FFS characterized the nature and extent of contamination in groundwater and soils near these OUs. The only evaluation of risk to the environment within the 1100-EM-2, 1100-EM-3, and 1100-IU-1 involved a comparison of contaminant concentrations to *Clean Water Act* (33 U.S.C. sec. 1251, et seq.) ambient water quality criteria. Overall potential risk from these OUs was evaluated by comparing possible waste-contaminant levels with existing State and Federal health-based guidelines, principally, the Washington State *Model Toxics Control Act* (MTCA) (Chapter 70.105D RCW) (DOE-RL 1992c). The investigations for the 1100-EM-2, 1100-EM-3, and 1100-IU-1 were not as exhaustive as1100-EM-1; the risk assessment approach was qualitative and the remedial action objectives (RAO) were more broadly defined. The guidelines from the qualitative evaluation form the basis of the cleanup goals for the 1100-EM-2 and

Figure 1. Hanford Site 1100 Area National Priorities List Site.



1100-EM-3 (DOE-RL 1995b). The Record of Decision (ROD) specified that contamination found in the IU area would also be cleaned to Washington State's MTCA specifications (DOE-RL 1994d). The ROD also stated, "There are no contaminants that pose risks to ecological receptors" (EPA 1993). None of the 1100 Area documents, reviewed as part of this preassessment screen (PAS), investigated or discussed natural resource injury, as defined in 43 CFR 11.

During the 1100-EM-1 remedial process, background soil and groundwater values were one factor in deciding whether or not cleanup of hazardous substances was warranted. "Project specific background soil samples were obtained from, or near in the case of actual surface samples, three boreholes located in and near the western portion of 1100-EM-1 in areas that appeared to be undisturbed by operable unit activities. No discernable differences in parameter concentrations (existed) between locations; therefore, all samples were combined to provide a description of operable-unit-specific background conditions" (DOE-RL 1990). Nine surface samples and 12 subsurface samples were used to describe background values. Surface soils were considered to be soils within the uppermost 0.6 m of the ground surface, while subsurface samples were soils that were below 0.6 m. Chemical analysis parameters for both surface and subsurface soil samples consisted of EPA target analyte list (TAL) and target compound list (TCL) parameters (EPA 1988a and 1988b, respectively). In addition, surface asbestos samples were obtained from the Horn Rapids Landfill (HRL), and ethylene glycol was analyzed in subsurface samples from 1100-4 (Antifreeze Tank Site).

Soil background conditions were characterized by means of the one-sided upper tolerance limit (UTL) of the 95th percentile (alpha = 0.05) to distribute each parameter. The method to calculate this value is provided in EPA 1989. If a parameter was not detected in a given sample, one-half the Sample Quantitation Limit (SQL) was used as a surrogate value in the statistical calculation. If a given parameter was never detected in a respective set of background samples, the highest reported SQL for the parameter was substituted for the UTL (DOE-RL 1990).

Groundwater samples for 1100-EM-1 provided OU-specific background data for the unconfined aquifer from three Phase I remedial investigation monitoring wells (MW-2, MW-7, MW-8). One well, MW-9, was designated as the 1100-EM-1 background well for the upper confined aquifer. The selected wells were located either hydraulically upgradient or in a position that was not impacted by potential 1100-EM-1 or adjacent contaminant sources. Aquifer water quality conditions were characterized for conventional, TAL, and TCL parameters (DOE-RL 1990).

Operable-unit specific background values were not established for 1100-EM-2, 1100-EM-3, and 1100-IU-1. The main objective for these sites was to determine if contaminants were present at concentrations above the ROD cleanup goals (DOE-RL 1995b). Therefore, background values were not a factor in cleanup decisions for these OUs.

Any hazardous substance above background levels could potentially be a release, as defined in 43 CFR 11.14 (hh). Thus, in this report, hazardous substances within 1100-EM-1 that were above the 1100-EM-1 soil or groundwater background values are listed in the tables throughout this report. All hazardous substances in 1100-EM-1 and the other OUs that do not have site-specific background values are listed in the tables.

1.1.1 1100-EM-1

The 1100-EM-1 is the largest of the three OUs in the main portion of the 1100 Area (Figure 2). The 1100-EM-1 is part of the central warehousing, vehicle maintenance, and transportation distribution center for the Hanford Site. Previous activities included landfill operations at the HRL, as well as office, warehousing, and transportation-related operations (DOE-RL 1995b). The 1100-EM-1 was divided into multiple sites, based on the nature of previous use and potential contaminants (Figure 2).

The dominant plant communities within and surrounding the 1100-EM-1 Operable Unit include Snow buckwheat (*Eriogonum niveum*), cheatgrass (*Bromus tectorum*) – Sandberg's bluegrass (*Poa secunda*), sagebrush (*Artemisia tridentata*), and rabbitbrush (*Chrysothamnus* spp.) communities. Minor community types include sand dunes and disturbed cheatgrass communities. For the most part, the sagebrush communities are degraded with a large portion of the understory dominated by cheatgrass. However, there are scattered patches of relatively high quality sagebrush habitat with significant amounts of native bunchgrasses in the understory. The only plant species of concern observed in the area in or around the 1100-EM-1 was the stalked-pod milk-vetch (*Astragalus sclerocarpus*), which is a watch species of the Washington Natural Heritage Program (Brandt 1998).

Approximately 34 species of birds are commonly associated with the shrub-steppe habitat near Richland and on the ALE Reserve. Passerine birds are probably the most common. The cheatgrass community near Richland is used by horned larks (*Eremophila alpestris*), western meadowlarks (*Sturnella neglecta*), and savannah sparrows (*Passerculus sandwichensis*). The long-billed curlew (*Numenius americanus*) were found to nest in cheatgrass communities and disturbed sites (i.e., landfills) (DOE-RL 1994a). Areas dominated by cheatgrass are important nesting areas for Swainson's hawk (*Buteo swainsoni*) and long-billed curlew. In the spring, cheatgrass areas are also heavily used by migrating Canada geese (*Branta canadensis*). Common mammals in sagebrush-bunchgrass habitats are the Great Basin pocket mouse (*Perognathus parvus*), Townsend's ground squirrel (*Spermophilus townsendii*), deer mouse (*Peromyscus maniculatus*), bobcat (*Lynx rufus*), badger (*Taxidea taxus*), and coyote (*Canis latrans*) (DOE-RL 1994a).

The geology near 1100-EM-1 is characterized by four stratigraphic units: surface eolian deposits underlain by Pasco gravels of the Hanford Formation, the sandy gravels, gravelly sands, silty sandy gravels, and silty gravelly sands of the Ringold Formation, and the Columbia River basalt bedrock (DOE-RL 1992a).

The depth to groundwater at 1100-EM-1 ranges from 6 m (20 ft) at Horn Rapids Landfill to 15 m (50 ft) at 1100-1, 1100-4, and the Ephemeral Pool. The water table in and around the 1100 Area fluctuates based on the Columbia River water stage and variable recharge at the North Richland well field. The flow of groundwater is in a northeasterly direction with groundwater discharge from the unconfined aquifer to the Columbia River and to wells in the North Richland well field, depending on well field operations (DOE-RL 1992a).

The 1100-EM-1 investigations started in 1989, and a Phase I Remedial Investigation Report was produced in 1990. These activities were followed with a Phase I and II Feasibility Study Report in 1990. The Phase II remedial investigations began in 1991, and a Draft Phase II Remedial Investigation Report/Phase III Feasibility Study was submitted in 1992 (DOE-RL 1995b).

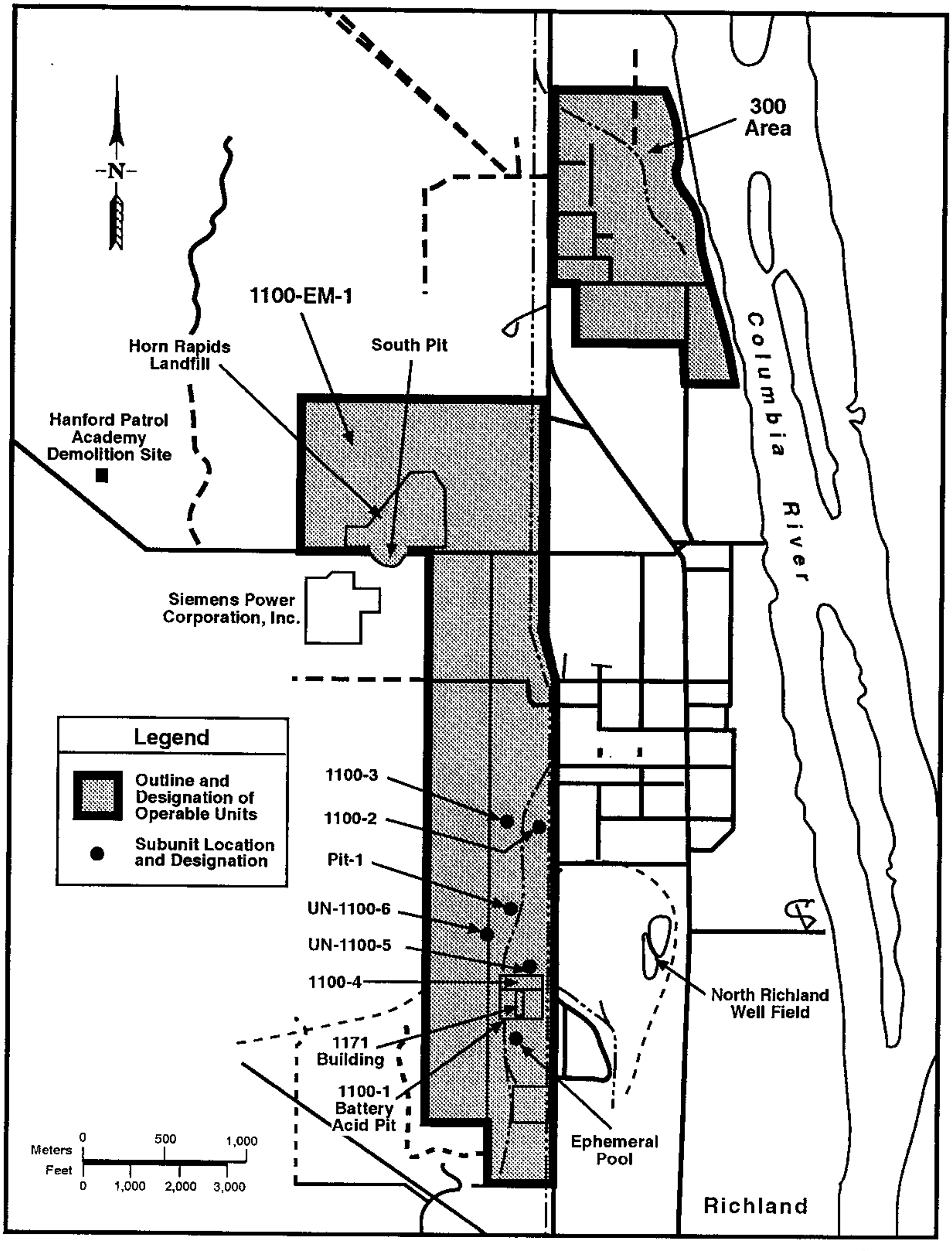
Operations at 1100-EM-1 have included the use of solvents, fuels, oils, and polychlorinated biphenyls (PCBs). Based on past practices and anecdotal information from the 1100-EM-1, 10 sites were identified for investigation: the battery acid pit, the paint and solvent pit, the antifreeze and degreaser pit, the antifreeze tank site, the discolored soil site, the HRL, ephemeral pool, Pit #1, UN-1100-5-Radiation Contaminant Incident, and the Hanford Patrol Academy. Eliminated from further consideration for remediation during the Phase I remedial investigations were Pit #1 and the UN-1100-5-Radiation Contaminant Incident site because of a lack of substantive contamination detected. The Hanford Patrol Academy was also not addressed further during the remedial investigations because it was to be addressed by the *Resource Conservation and Recovery Act of 1976* (42 U.S.C. sec. 6901, et seq.) corrective action process (DOE-RL 1992a).

Investigations at 1100-EM-1 included radiological surveys, geophysical surveys, soil-gas surveys, intrusive trenching activities to explore subsurface conditions, surface and subsurface soil sampling and laboratory analyses, groundwater level monitoring, and groundwater sampling and laboratory analysis. Surface radiation surveys were conducted at all 1100-EM-1 sites, and all radiation surveys were negative.

During the Phase I remedial investigation, soil contaminants in the 1100-EM-1 area were screened to identify contaminants of potential concern (COPC). Risk-based values such as hazard quotients (HQ), as well as the incremental cancer risk (ICR) for carcinogens, were calculated using maximum concentrations from Phase I data. Contaminants that exceeded the EPA-derived risk levels of HQ >1 and an ICR >1E-06 were considered a COPC. The contaminants that did not exceed the EPA risk values were eliminated from further consideration with a high degree of confidence that the contaminant posed either no or only insignificant risk to human health and the environment (DOE-RL 1990). Groundwater contaminants were also screened by comparing maximum contaminant values to primary maximum contaminant levels (MCL), maximum contaminant level goals (MCLG), human water quality health criteria (HWQHC), chronic freshwater quality criteria (CFWQC), secondary MCLs, and human water quality welfare criteria (HWQWC). Sites within 1100-EM-1 without COPCs did not require additional investigation (DOE-RL 1990).

The COPCs from this initial screen were further evaluated using more realistic contaminant fate, transport, and risk assessment assumptions. An environmental evaluation, consisting of an environmental exposure assessment, an environmental toxicity assessment, and an environmental risk characterization, was conducted. The purpose of the environmental evaluation was to determine pathways, indicator receptor populations, and magnitudes of contaminant intake for the 1100-EM-1. The environmental exposure assessment identified the long-billed curlew and the Swainson's hawk as two potential receptors of the soil COPCs, arsenic, chromium, and PCBs. These two sensitive bird species were known to nest near 1100-EM-1. The Columbia River aquatic community was identified as a potential receptor of the groundwater COPC, TCE.

Figure 2. 1100-EM-1 Site Locations.



Contaminant intake estimates were derived for the two bird species for the three soil COPCs, while a conservative water column TCE concentration--to which the aquatic community might be exposed--was estimated (4E-08 mg/L).

The environmental toxicity assessment evaluated the contaminant intake estimates for the two bird species with available toxicity data. Because no toxicity values on birds were published for arsenic, chromium, and PCBs, the lowest value for any species was chosen that showed any sort of toxic effect. The TCE water column concentration was compared with the EPA chronic water quality criteria of 21.9 mg/L to evaluate toxic effects to the aquatic community.

The environmental risk characterization qualitatively evaluated the potential for and the magnitude of any threats to the receptors from the COPCs. The risk characterization stated, "It appears that there is no qualitative reason to suspect significant adverse toxicological impacts to the Swainson's hawks nesting to the west of the landfill. While the above analysis indicates that the long-billed curlews nesting in the immediate vicinity of the landfill should not be impacted, the results do not lie outside of the anticipated error range. Therefore, the results are less clear for the curlews, and, according to the analysis, if any adverse impact to these organisms were to be suspected, chromium toxicity would be most likely." "While there is no evidence to support a conclusion of adverse contaminant impacts to the Swainson's hawks and long billed curlews known to inhabit the Horn Rapids Landfill vicinity, such impacts to the curlews cannot be ruled out. However, the evaluation presented for this sensitive terrestrial community is simplistic and far from certain" (DOE-RL 1990). With respect to TCE, the risk characterization states, "The comparison of a conservatively biased prediction of trichloroethene concentrations in the Columbia River indicates, with a fair degree of certainty, that no adverse impacts to aquatic communities will occur" (DOE-RL 1990).

The Phase I remedial investigation of 1100-EM-1 also included a biological survey. The biological survey was conducted in the early spring of 1989 for the Battery Acid Pit, Discolored Soil Site, 1100-2 Disposal Site, and the HRL. The purpose of the survey was to locate major habitat types, disturbance areas, and to evaluate any evidence of, or potential for, uptake of toxic substances by plants or animals. Follow up surveys were recommended for May or June at the Discolored Soil Site, 1100-2 Disposal Site, and HRL to document migratory species that may utilize these sites; however, no followup survey data has been identified. The survey concluded that there was no visible evidence of plant or wildlife stress at any of the subunits; therefore, biota sampling was not recommended. Complete results of the survey are in Appendix A of DOE-RL 1990.

During the RI/FS for the 1100-EM-1, a baseline risk assessment was conducted using Phase I and II data (DOE-RL 1992b). A list of COPCs was developed, evaluated, and screened in accordance with the Hanford Site Baseline Risk Assessment Methodology and in consultation with EPA Region 10. The Hanford Site Baseline Risk Assessment Methodology is based on EPA's *Risk Assessment Guidance for Superfund* and other EPA guidance (national and Region 10). Potential risks to human receptors were evaluated using a Baseline Residential Scenario Risk Assessment and a Baseline Industrial Scenario Risk Assessment. The Baseline Industrial Scenario Risk Assessment evaluated potential threats to industrial workers posed by contaminants detected at each site within the 1100-EM-1. The Baseline Residential Scenario

Risk Assessment evaluated potential threats to onsite residents at each site within the 1100-EM-1 (DOE-RL 1992b).

A qualitative Ecological Risk Assessment (ERA) was conducted as part of the 1100-EM-1 baseline risk assessment during the RI/FS. The ERA addressed site-specific ecological risks by comparing potential exposure to contaminant toxicity using COPCs derived from Phase I and II data. The long-billed curlew and Swainson's hawk were identified as the potential receptors and the pathway of contaminant exposure was assumed to be via prey ingestion. Aquatic species were not addressed, since it had been demonstrated through groundwater modeling that contaminants in the groundwater would not likely reach the Columbia River above drinking water standards (DOE-RL 1992a). Contaminant intake rates (Table 1) were compared to toxicological values for that contaminant (Table 2) with the most conservative endpoint used where available (DOE-RL 1992a). All maximum COPC values were found at HRL except for BEHP, chlordane, and heptachlor, which were found at the discolored soils site (DOE-RL 1992b).

The risk characterization for the ERA found that none of the contaminant uptake rates exceeded the contaminant toxicological values. "For the Swainson's hawk, uptake rates for zinc, bis (2-ethylhexyl) phthalate (BEHP), beta-hexachlorocyclohexane (B-HCH), 1,1,1-trichloro-2,2-bis (p-chlorophenyl ethane, 4,4'-dichlorodiphenyltrichloroehane (DDT), and PCB were between 10 and 80 times lower than the corresponding toxicity value. Uptake rates for copper, thallium, and chlordane were between 2,000 and 20,000 times lower, and the remaining uptake rates were more than 300,000 times below toxicity values. For the long-billed curlew, arsenic, barium, nickel, vanadium, zinc, and BEHP had uptake rates 20 to 100 times less than toxicity values. The other contaminants were more than 100 times less than toxicity values" (DOE-RL 1992a). Therefore, the ecological implications section for the 1100-EM-1 concludes as follows: "Using highly conservative assumptions and models, no uptake rates for the long-billed curlew or the Swainson's hawk exceeded toxicity values. Contaminants with uptake rates that were closest to toxicity values were zinc for the hawk and BEHP for the long-billed curlew, which were approximately 10 and 20 times less than toxicity values, respectively. Therefore, it is unlikely that COPCs at 1100-EM-1 would have an impact on these birds that was distinguishable from background conditions. Although significant uncertainties exist in this assessment, there has been little evidence of ecological damage" (DOE-RL 1992a).

Maximum concentrations of hazardous substances at the 1100-EM-1 sites are presented in Table 3. Table 4 presents the maximum concentration of groundwater hazardous substances within the 1100-EM-1 sites. TCE is currently the only hazardous substance released into the 1100-EM-1 that has exposed a measurable area of groundwater. The TCE plume, delineated using a contour line of the 5 μg/L MCL, was 58.32 hectares using 1996 data (Hartman et al. 1996), and is currently 53.05 hectares using 1997 data (Hartman et al. 1997). Investigations for the 1100-EM-1 sites are as follows.

Table 1. Results of Uptake Calculations for 1100-EM-1.[1] (EPA 1993)

Contaminant	Plant Uptake (mg/kg)	Insect Uptake (mg/kg)	Small Mammal Uptake (mg/kg)	Swainson's Hawk Uptake Rate (mg/kg/d)	Long-Billed Curlew Uptake Rate (mg/kg/d)
Antimony	0.16	0.16	1.2×10^{-6}	1.6×10^{-8}	1.1×10^{-3}
Arsenic	0.14	0.14	1.1×10^{-6}	1.4×10^{-8}	0.00079
Barium	1.32	1.32	5.2×10^{-6}	6.2×10^{-8}	0.0072
Beryllium	0.56	0.56	2.2×10^{-6}	2.8×10^{-8}	0.0031
Chromium	3.42	3.42	1.2×10^{-4}	1.5×10^{-6}	0.019
Copper	17.6	17.6	2.6	0.043	0.096
Lead	3.85	3.85	6×10^{-6}	7.4×10^{-8}	0.021
Nickel	15.7	15.7	1.2×10^{-4}	1.6×10^{-6}	0.086
Thallium	0.21	0.21	4.2×10^{-3}	5.2×10^{-5}	0.0011
Vanadium	3.5	3.5	1.3×10^{-4}	1.5×10^{-6}	0.019
Zinc	326	326	360	4.4	1.8
BEHP	9100	9100	50000	0.12	1
Beta-HCH	0.035	0.035	0.56	0.0069	2×10^{-4}
Chlordane	0.093	0.093	0.51	1.3×10^{-6}	1×10^{-5}
DDT	0.22	0.22	1.3	0.015	0.0012
Heptachlor	0.0013	0.0013	0.018	4.4×10^{-8}	1.4×10^{-7}
PCBs	38	38	210	2.5	0.2

[1]Uptake calculations based on the maximum soil contaminant concentration listed in Table 3.

Table 2. Toxicological Values. (EPA 1993)

Contaminant	Toxicity[1]	Toxicity Parameter	Organism	Comments
Antimony	0.35 mg/kg bw/d	LOAEL	Rat	Chronic Oral
Arsenic	0.014 mg/kg/d	LOAEL	Human	Chronic Oral
Barium	0.21 mg/kg/d	NOAEL	Human	Chronic Drinking
Beryllium	0.54 mg/kg bw/d	NOAEL	Rat	Chronic Oral
Chromium	2.4 mg/kg bw/d	NOAEL	Rat	1-year Drinking
Copper	152 mg/kg	TDLo	Rat	Chronic Oral
Lead	4.3 mg/kg/d	LOAEL	Hawk	Subchronic Oral
Nickel	5 mg/kg/d	NOAEL	Rat	Chronic Oral
Thallium	0.7 mg/kg/d	LOAEL	Rat	Chronic Oral
Vanadium	0.89 mg/kg/d	NOAEL	Rat	Chronic Oral
Zinc	96 mg/kg/d	NOAEL	Mouse	Drinking Water
BEHP	19 mg/kg bw/d	LOAEL	Guinea Pig	Chronic Oral
Beta-HCH	0.33 mg/kg/d	NOAEL	Rat	Subchronic Oral
Chlordane	0.055 mg/kg/d	NOEL	Rat	30 mo Oral
DDT	0.49 mg/kg/d	NOAEL	Hawk	Lifetime dosing
Heptachlor	0.15 mg/kg/d	NOEL	Rat	2-year Oral
PCBs	325 mg/kg	TDLo	Mammals	Subchronic Oral

[1]Values from IRIS
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
TDLo = Toxic Dose Low
NOEL = No Observed Effect Level

1.1.1.1 1100-1 The Battery Acid Pit. The Battery Acid Pit is an unlined, sand-filled sump or french drain approximately 30 m from the southwest corner of the 1171 Building (Figure 2). Waste acid from vehicle batteries was disposed at this site. The pit was approximately 1.8 m in diameter and 1.8 m deep. The pit is no longer visible because it was filled and graded to match the surrounding surface when it was no longer in use. Historical documents record an estimated 57,000 L of battery acid waste may have been disposed during operation (1954 to 1977) (DOE-RL 1992a).

Information from interviews with former site workers suggested that other substances, including waste oil, waste antifreeze, and spent solvents, were also deposited in the pit. Documentation does not exist to support these claims. Periodically, during facility operation, the acid-laden sand fill was removed and deposited at an undetermined location and fresh sand fill was installed (DOE-RL 1992a).

At the time of the Phase I biological survey, the site was completely devoid of flora and fauna. In addition, this area was not considered to be used to any significant degree by plants or animals in the future due to its proximity to the 1100 Area maintenance activities (DOE-RL 1990a). Baseline condition for this site is a parking lot devoid of natural resources (CTUIR 1998).

A geophysical survey was conducted to locate the pit. Five soil-gas probes were installed as part of the Phase I remedial investigation; soil-gas contaminants were not detected. A single soil boring was drilled, yielding one sample from the surface and seven from the subsurface strata. Inorganic contaminants were found in surface and subsurface samples. Organic contaminants were not detected.

Arsenic was the only COPC, encountered in one subsurface sample at a concentration barely exceeding background levels (DOE-RL 1990). The Phase I remedial investigation conclusions state that although the potential for contamination at the 1100-1 site was a factor in listing the 1100 Area on the NPL, no problems have been identified with this site. The Phase I remedial investigation recommended that Phase I soil samples be analyzed for gross radioactivity to determine the potential for source contributions to the elevated radiation observed near the 1171 Building. Additional work was not required (DOE-RL 1990). Concentrations of hazardous substances are listed in Table 3.

1.1.1.2 1100-2 The Paint and Solvent Pit. The Paint and Solvent Pit is a semicircular depression located approximately 1.6 km north of the 1171 Building (Figure 2). The pit has an approximate diameter of 108 m and a depth of 1.2 to 1.8 m. Originally a sand and gravel pit, the site was used from 1954 through 1985 to dispose of construction debris. Principal components of the waste include concrete rubble, asphalt, and wood debris. Undocumented disposal of waste paint, solvent, and paint thinner was also reported to have occurred (DOE-RL 1992a).

Table 3. Summary of the Hazardous Substances Released. (3 Pages)

Site	Hazardous Substances Released	Soil Back-ground (ppm) (1)	Maximum Concentration (ppm) (Pre-Remedy)	Cleanup Level (ppm)	Confirmatory Sample Concentration Range (ppm)	Volume of Soil Excavated
			1100-EM-1 OPERABLE UNIT			
Battery Acid Pit	copper	19.11	37.9	(2)		
	lead	12.64	266			
	mercury	0.10	0.39 (3)			
	nickel	19.00	20.9			
	sodium	241.52	479			
	zinc	62.20	100 (3)			
	acetone	0.022	0.026			
Paint & Solvent Pit	chromium	12.94	16.8	(2)		
	copper	19.11	24.4			
	lead	12.64	94.6			
	manganese	355	366 (3)			
	sodium	241.52	374			
	thallium	0.39	0.48			
	xylene	0.005	0.006			
	zinc	50.4	54.9 (3)			
	chlorobenzene	0.005	0.006			
	Methylene chloride	0.005	0.042			
	toluene	0.005	0.011			
	trichloroethene	0.005	0.006			
	tetrachloroethene	0.005	0.035			
	4,4'-DDT	0.033	0.057			
	4,4'-DDE	0.033	0.042			
Antifreeze & Degreaser Pit	chromium	12.94	14.0	(2)		
	thallium	0.39	0.40			
	lead	12.64	26.4			
	copper	19.5	31.7 (3)			
	cobalt	16.8	17.8 (3)			
	sodium	419	999 (3)			
	zinc	50.4	60 (3)			
	manganese	355	381 (3)			
	acetone	0.043	0.092			
	2-butanone	0.011	0.017			
	methyl chloride	0.005	0.120			
	toluene	0.005	0.006			
Antifreeze Tank	arsenic	2.92	5.8 (3)	(2)		
	beryllium	0.27	0.93 (3)			
	copper	19.5	19.8 (3)			
	lead	5	5.7 (3)			
	silver	0.54	2.0 (3)			
	sodium	419	726 (3)			
	thallium	0.41	0.48 (3)			
	zinc	50.4	63.8 (3)			
	ethylene glycol	NA	2.6			
Discolored Soil Site	lead	12.64	22.1		(4)	

Table 3. Summary of the Hazardous Substances Released. (3 Pages)

Site	Hazardous Substances Released	Soil Back-ground (ppm) (1)	Maximum Concentration (ppm) (Pre-Remedy)	Cleanup Level (ppm)	Confirmatory Sample Concentration Range (ppm)	Volume of Soil Excavated
	zinc	62.20	111		(4)	
	heptachlor	0.017	0.065		(4)	
	alpha chlordane	0.170	1.00		(4)	
	gamma chlordane	0.158	0.86		(4)	
	BEHP	0.690	25,000	71	0.108 - 10.4	70 m^3
	TCA	0.005	0.035		(4)	
	4,4'-DDE	0.033	0.17		(4)	
	acetone	0.043	0.190		(4)	
	2-butanone	0.011	0.069		(4)	
	methylenechloride	0.005	0.020		(4)	
	toluene	0.005	0.008			
	di-n-octyl-phthalate	0.690	46		(4)	
Horn Rapids Landfill	antimony	3.70	15.6			
	arsenic	2.92	6.6 (3)			
	beryllium	0.74	1.3			
	cadmium	0.36	2.4 (3)			
	cobalt	16.8	42.5 (3)			
	copper	19.5	1280 (3)			
	chromium	47.3	1250 (3)		(4) 284 (5)	
	cyanide	0.52	0.56			
	lead	5	854 (3)			
	mercury	0.10	1.3			
	nickel	26	557 (3)		(4)	
	selenium	0.39	0.97			
	silver	0.54	7.7 (3)			
	thallium	0.41	0.46 (3)			
	zinc	50.4	3160 (3)			
	acetone	0.022	0.200 (3)			
	2-butanone	0.011	0.035			
	methylene chloride	0.005	0.043			
	toluene	0.005	0.016			
	4-nitrophenol	3.300	3.800			
	beta-BHC	0.017	0.094		(4)	
	PCE	0.005	0.006			
	total PCBs	1.510	100.550	5	ND - 3.117	1,224 m^3
	aroclor-1254	0.340	0.640 (3)		ND	
	aroclor-1248	0.170	100		ND - 3.04	
	BEHP	0.350	1.000 (3)			
	naphthalene	0.690	1.10			
	alpha chlordane	0.170	0.77		(4)	
	heptachlor	0.017	0.02		(4)	
	Endosulfan II	0.033	0.110		(4)	
	Endrin	0.033	0.28		(4)	
	Endrin ketone	0.033	0.140		(4)	

Table 3. Summary of the Hazardous Substances Released. (3 Pages)

Site	Hazardous Substances Released	Soil Back-ground (ppm) (1)	Maximum Concentration (ppm) (Pre-Remedy)	Cleanup Level (ppm)	Confirmatory Sample Concentration Range (ppm)	Volume of Soil Excavated
	Dieldrin	0.033	1.20		(4) 0.072 (5)	
	4,4'-DDT	0.033	0.52		(4) 0.45 (5)	
	4,4'-DDD	0.033	0.26			
	4,4'-DDE	0.033	1.2		(4)	
	potassium permanganate	NA	82,000		(4)	
	chromium (6)	0.0078	NA		0.004 - 0.023	
	TCE (6)	NA	0.110	0.005	0.075 - 0.014	
Ephemeral Pool	lead	12.64	54.2			
	zinc	62.20	67.5			
	PCBs	1.510	42.0	1	0.065 - 1.04	115 m^3
	Endosulfan II	0.033	0.16		(4)	
	Endrin	0.033	0.039		(4)	
	heptachlor	0.017	0.029			
	alpha chlordane	0.170	1.10			
	gamma chlordane	0.158	1.70			
1100-EM-2 OPERABLE UNIT						
Tar Flow Area	lead	NA	404	250	2.87 - 5.4	1,155 m^3 (8)
	TPH (7)	NA	80,000	200	<100	
Well 699-S41-E12	chromium (6)	NA	0.872		0.168	
1100-EM-3 OPERABLE UNIT						
1240 French Drain	chromium	NA	949	400	4.06 - 10.3	98 m^3 (8)
	lead	NA	619	240	1.54 - 4.53	
	PCBs	NA	<1			
1240 Suspect Spill Area	lead	NA	44,200	250	3.27 - 5.59	69 m^3
1100-IU-1 OPERABLE UNIT						
Control Center Disposal Pits	lead	NA	1,450	N/A		
Missile Bunker Sump	PCBs (9)	NA	150 $\mu g/100\ cm^2$	10 $\mu g/100\ cm^2$	<0.1 - 3.0	
Missile Bunker Discharge Ditch	PCBs	NA	>1 - <10 on site ND off site			
Horseshoe Landfill	DDT	NA	945	1.0	<1 - 1.7	1,912 m^3
	DDD	NA	360		<1	(4)
	DDE	NA	27.2		<1	(4)
	butyl-benzyl phthalate	NA	18			
	diethyl phthalate	NA	0.190			
	BEHP	NA	14			
Elevator Doors	PCBs (9)	NA	330 $\mu g/100\ cm^2$	10 $\mu g/100\ cm^2$	None	

(1) Soil background corresponds to surface or subsurface values depending upon where the contaminant was located
(2) No Response Action required at the Site
(3) Subsurface concentration, below 0.61 m (all other values are surface concentrations, 0 to 0.61-m depth)
(4) Excavated incidental to site cleanup, but not included in confirmatory sampling
(5) Maximum concentration of hazardous substance outside of the designated cleanup area
(6) Groundwater value (mg/L)
(7) Nonhazardous Substance cleanup
(8) Volume resulted from multiple contaminant cleanup levels
(9) Not a Release to the Environment
NA = Not Available

Table 4. Maximum Concentrations of Groundwater Hazardous Substances for 1100-EM-1. (EPA 1993)

Hazardous Substances (units)	Background Concentration	Maximum Concentration	MCL
Acetone (μg/L)	10	31	(1)
Chloroform (μg/L)	1	5	100
Chromium (μg/L) (2)	7.8	57.5	50
Copper (μg/L)	5.22	71.9	1300
Ammonia (μg/L)	150	870	(1)
C12 Hydrocarbon (μg/L)	NA	100	(1)
Diethyl phthalate (μg/L)	10	34	(1)
Lead (μg/L)	13.7	25.3	50
Methylene chloride (μg/L)	1	13	5 (3)
Nickel (μg/L) (2)	15	140	100 (3)
Silver (μg/L)	4	11.7	50
Sodium (μg/L)	29500	56900	(1)
1,1,1-Trichloroethane (TCA)(μg/L)	1.2	3	200
Trichloroethene (μg/L) (2)	1	110	5
Tetrachloroethene (μg/L)	1	4	5
Toluene (μg/L)	1	2	2000 (3)
Zinc (μg/L)	8.3	223	(1)
Gross Alpha (pCi/L)	8.4	12.2	15
Gross Beta (pCi/L) (2)	18	95.4	50
Radium (pCi/L)	1.7	2.36	20

(1) No MCL value for this hazardous substance
(2) Bold = Hazardous substance exceeds MCL
(3) Proposed MCL

At the time of the Phase I biological survey, the part of the site between the road and the railroad track had been heavily disturbed with little topsoil remaining. Little plant cover was documented; the predominant species were rabbitbrush, cheatgrass, and tumbleweeds. The other small part of the site located on the opposite side (west) of the railroad track was not heavily disturbed and supported some sagebrush and Sandberg's bluegrass. Pocket mouse excavations were noted to be common, along with signs of past badger excavations. Two bird species were observed at the site: the meadowlark and horned lark. The site was noted as a potential nesting area for horned lark. A followup survey was recommended during May and June to document any migratory bird species in the area (DOE-RL 1990a). The field notes from the 1997 Trustee tour of the 1100 Area were similar to the biological survey. The baseline condition for the part of the site between the road and the railroad track is a former borrow pit filled with construction debris, covered with backfill material in the eastern portion of the pit. The part of the site on the west side of the railroad tracks has been highly disturbed by heavy vehicles, while supporting a remnant old-growth sagebrush stand with many signs of wildlife (CTUIR 1998).

A geophysical survey was conducted over the floor of the pit; rubble and other construction debris were found. During the Phase I remedial investigation, soil-gas samples were collected and analyzed. Relatively high readings of tetrachloroethene (PCE) were found in the southwest corner of the site. Peak concentrations of PCE were as high as 727 parts per billion by volume (ppbv), with values decreasing in all directions away from the maximum concentration. Areal distribution of the positive soil-gas readings suggested the potential for an isolated, shallow accumulation or small surface spill within the pit. Additional volatile contaminants were not detected during the soil-gas survey (DOE-RL 1992a).

Four surface samples and 29 subsurface soil samples were collected from four boreholes at this site. In addition, soil samples were obtained at 20 surface locations within the pit area. Inorganic, organic, and pesticide contaminants were detected in surface and subsurface soil samples.

"Chromium (was) the only soil column COPC, 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 less than the mean background concentration..." (DOE-RL 1990). The Phase I remedial investigation conclusion for this site recommended the installation of a groundwater well due to the detection of PCE from the soil-gas survey, and the fact that no wells are currently located immediately down gradient from this site. Concentrations of hazardous substances are listed in Table 3. No further work was required.

1.1.1.3 1100-3 The Antifreeze and Degreaser Pit. The Antifreeze and Degreaser Pit is a shallow, roughly circular depression located approximately 1.6 km north of the 1171 Building on the west side of the Hanford Rail Line (Figure 2). Originally a sand and gravel source for construction activities, it was used from 1979 to 1985 as a disposal site for waste construction material (principally roofing and concrete rubble). The pit is approximately 76 m in diameter and 1.8 to 2.4 m deep. Occasional disposal of waste antifreeze and degreaser solutions from the 1171 Building was suspected, but not documented (DOE-RL 1992a).

The biological survey identified this site as heavily disturbed with exposed cobbles and very little topsoil. Annual exotics (i.e., tumbleweed and cheatgrass) were growing in the pit; however, rabbitbrush, Sandberg's bluegrass, and a few sagebrush plants were growing on the outer edges of the pit. No signs of small mammal activity were observed in the pit. The survey noted the potential for horned larks to be nesting among the cobbles in the pit, and starlings were seen foraging in the pit (DOE-RL 1990a). The baseline condition for this site is a borrow pit shallowly filled with construction debris and covered with approximately 1.5 m (5 ft) of backfill material (CTUIR 1998).

A geophysical survey was conducted over the floor of the pit; rubble and other construction debris were found. Forty-three soil-gas samples were collected, and no contaminants were detected. Twenty-three surface samples were collected, and 24 subsurface samples were obtained from four boreholes. Inorganic contaminants were detected in surface and subsurface samples. Organic contaminants were not detected.

Arsenic and chromium were the two soil COPCs, as identified during the 1100-EM-1 screening criterion. "Arsenic was encountered in only a single surface sample at a concentration barely exceeding background, and chromium was encountered at elevated concentrations only in the surface stratum at two locations" (DOE-RL 1990). The Phase I remedial investigation conclusion stated that no further direct characterization was necessary due to an absence of contamination at levels that could be reasonably expected to pose a threat to human health or the environment. Therefore, response actions pursuant to *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA), the NCP, and the Tri-Party Agreement were not required (DOE-RL 1990). Concentrations of hazardous substances are listed in Table 3.

1.1.1.4 1100-4 The Antifreeze Tank. The Antifreeze Tank was a 19,000-L-steel, underground storage tank (UST) used to store waste vehicle antifreeze. The tank was located beneath the floor of the northern-most portion of the 1171 Building (Figure 2). The tank was installed in 1976 and emptied, cleaned, and removed in 1986 due to suspected leaks. Three soil samples were collected from the base of the excavation upon removal of the tank. Antifreeze was not detected.

In November 1989, 13 vadose zone samples were collected. Ethylene glycol was detected in one of the samples at a concentration of 2.6 parts per million (ppm) (DOE-RL 1992a).

Arsenic was the only contaminant found at elevated levels of potential concern, but only in a single saturated soil sample obtained from below the water table at a depth of approximately 15 m below the ground surface. The Phase I remedial investigation further stated that arsenic was not regarded as a soil COPC. Phase I remedial investigation conclusions state that although potential for contamination at The Antifreeze Tank Site was a factor in designating the 1100 Area on the NPL, no problems have yet to be identified with this site. In addition, it was recommended that Phase I soil samples be analyzed for gross radioactivity to determine the potential for source contributions to the elevated radiation observed near the 1171 Building. Additional work was not required (DOE-RL 1990). Concentrations of hazardous substances are listed in Table 3.

1.1.1.5 UN-1100-6 The Discolored Soil Site. This 0.2 hectare site is located approximately 610 m northwest of the 1171 Building on the west side of the Hanford Rail Line (Figure 2). The site consists of an elongated, east-west oriented depression with a 1.8 by 3.1-m patch of oily, dark-stained soil at the eastern end. The source of the soil discoloration appeared to be the isolated, unauthorized disposal of contents of one or more containers of liquid material to the ground surface. No record exists that identifies the nature or origin of the waste material deposited at the site (DOE-RL 1992a).

The biological survey noted that the site and its immediate surroundings were disturbed. Major plants species occurring on the site included rabbitbrush, tumbleweeds, tansy mustard, and Sandberg's bluegrass. No signs of vegetative stress were observed, and the rabbitbrush and cheatgrass growing on the discolored areas were doing well. Minimal, small mammal activity was observed at the site. A few shallow holes dug by badgers were noted, along with one observance of white crowned sparrows and a foraging marsh hawk in the area. A followup survey was recommended during May and June to document any migratory bird species in the area (DOE-RL 1990a). The baseline condition for this site would be similar to the surrounding area that is also heavily disturbed, and is slowly recolonizing with rabbitbrush and some sagebrush. Additionally, a recent disturbance of the site (due to a rail expansion project) would be included as part of the baseline (CTUIR 1998).

Fifteen surface soil samples were obtained during the Phase I remedial investigation. Contaminants identified in surface soil samples collected during the Phase I remedial investigation included inorganic, organic, and pesticide compounds. Concentrations of hazardous substances are listed in Table 3. Alpha chlordane, gamma chlordane, heptachlor, DDE, di-n-octyl phthalate, 1,1,1-trichloroethane (TCA), and BEHP exceeded background soil concentrations in the same six sample locations (DOE-RL 1990). Maximum concentrations of lead, zinc, acetone, 2-butanone, methylene chloride, and di-n-octyl-phthalate were also found to exist in the samples where BEHP exceeded background soil concentrations. After a thorough review of analytical results from the surface soil sampling and a field examination of the site, it was deemed to be an inefficient use of time, given the project schedules, and not cost effective to perform sampling of subsurface soils (DOE-RL 1992a).

During the Phase II remedial investigation, 14 soil-gas probes were installed at the site. Analysis of samples from the probes did not identify any contaminants. Additional soil-gas work was not performed (DOE-RL 1992a).

Remediation of the discolored soil site began in February 1995, with the excavation and stockpiling of 70 m^3 of waste material to achieve the MTCA B cleanup level of 71 mg/kg for BEHP. The contaminated soil was excavated to an average depth of 0.61 m, with a 0.9 to 1.2-m depth at two locations. The site was regraded to a smooth, uniform surface. The BEHP-contaminated soil was incinerated (DOE-RL 1995b). Because alpha chlordane, gamma chlordane, heptachlor, DDE, di-n-octyl phthalate, hexanone, TCA, and BEHP were found in the same sample locations, it is probable that most of the contamination was removed with the excavation activities. However, no post-remedial sampling for these contaminants, except for BEHP, was conducted.

1.1.1.6 The Horn Rapids Landfill. The HRL is located north of Horn Rapids Road near its intersection with Stevens Drive (Figure 2). The HRL site extends over approximately 20 hectares of generally flat terrain within the 600 Area, and operated from the 1940s into the 1970s as an uncontrolled landfill. Originally a borrow pit for sand and gravel, the HRL was used primarily as a landfill for office and construction waste, asbestos, sewage sludge, fly ash, and reportedly, numerous drums of unidentified organic liquids. Five disposal trenches were identified through a study of historical aerial photographs, onsite investigations, and geophysical surveys. Surface debris consisting of auto truck tires, wood, metal shavings, soft drink cans and bottles, and other small pieces of refuse were scattered across the site. A single trench, the western-most of the identified waste disposal trenches, was posted with signs warning that the trench contained asbestos (DOE-RL 1992a).

The biological survey noted the heavily disturbed nature of this site, along with the fact that fire had at one time impacted the site. Major plant species observed included rabbitbrush, cheatgrass, Sandberg's bluegrass, tumbleweed, and plantain. Other plant species included phlox, prickly pear cactus, bitterbrush, yarrow, goatsbeard, tansy mustard, tumblemustard, aster, and some native wheatgrass. Only a few sagebrush plants were present because of the previous fire. Mammals observed (including tracks) included a small colony of Townsend ground squirrels, pocket mice, cottontail rabbits, coyotes, mule deer, and badgers. Bird species observed at the site included ring billed gulls, killdeer, ravens, marsh hawks, meadowlarks, horned larks, and long billed curlews. The survey noted that HRL or the surrounding environs do not seem to have many curlew pairs that were nesting on the site; therefore, any operations at HRL should have a negligible impact on the curlews. The survey noted that HRL should support burrowing owls; however, none were observed. A followup survey was recommended during May and June to document any migratory bird species in the area (DOE-RL 1990a).

During the Phase I remedial investigation, geophysical surveys were performed that did not detect accumulated waste outside of the five identified waste disposal trenches. Soil-gas surveys were performed at the HRL and surrounding areas to assist in vadose zone sampling. Two hundred and eleven temporary soil-gas extraction points were installed in the landfill area. Samples collected from these points detected TCE, TCA, and PCE. TCE was detected at 17 of the 36 permanent soil-gas extraction points installed within the limit of the HRL, with concentrations ranging from 3 to 233 ppbv. Fifty surface soil samples and 55 subsurface soil samples were collected. Boreholes were intentionally sited to avoid drilling through known and suspected waste deposits. This action placed substantial limitations on the representativeness of the soil-quality results of the Phase I data (DOE-RL 1992a). The hazardous substances and their maximum concentrations are listed in Table 3.

During the Phase II remedial investigation, additional soil-gas surveys, geophysical surveys, and surface and subsurface soil sampling were performed. Phase II soil-gas surveys detected TCE at concentrations from 2 to 255 ppbv in 36 of the 53 probes. The highest TCE concentrations were obtained outside the disturbed portions at the eastern limits of the HRL. Additional geophysical surveys were conducted in an attempt to identify drums containing organic solvents said to have been buried at the HRL. Areas that might have represented an accumulation of drums were further investigated, with test pits. During excavation of the test pits, various types of debris along with two small deposits of chemicals, were discovered. One deposit (white crystalline powder) was identified as sodium bisulfate and the other deposit (bright purple stained soil) was identified as potassium permanganate. Thirteen subsurface soil samples that were taken from the test pits detected manganese and Dieldrin; neither had been detected during Phase I sampling. Eight surface soil samples were taken to identify the areal extent of PCB contamination in the HRL. Fifteen additional surface soil samples were taken to further characterize two surface depressions in the HRL. Endosulfan II and Endrin were additional contaminants detected in the surface soil samples during the Phase II remedial investigation (DOE-RL 1992a).

Remedial actions began in January 1995, with the clearing and road construction at the HRL. The cleanup level for HRL was established for PCBs based on the MTCA C cleanup level of 5 ppm. This cleanup level was designated as a RAO in the ROD to prevent soil ingestion and dermal contact with soils containing PCBs above 5 ppm. Excavation of the PCB-contaminated soil in the HRL began in January 1995. Soils containing PCBs were detected only in the south-central portion of HRL. Other contaminants detected in the same area as the PCB contamination included the following: heptachlor, DDT, DDE, beta-HCH, and vanadium (DOE-RL 1995b). The maximum nickel concentration was also found in the same area as the PCB contamination. The PCB-contaminated soil was excavated until field observation and field screening indicated that the soil did not exceed the 5 ppm cleanup level. Confirmatory soil samples were collected and analyzed only for PCB contamination. The confirmatory sampling results indicated that contamination remained in excess of the PCBs cleanup criteria, and additional soil was excavated in March 1995. A total of 1,224 m^3 of PCB-contaminated soil (principally, PCB Aroclor-1248) was excavated and stockpiled for eventual disposal. Following the removal of this material, two confirmatory samples for PCBs were collected. Both samples were below the cleanup level of 5 ppm PCB. One confirmatory sample did not detect PCBs while the other sample had a total PCB concentration of 3.117 ppm. The construction of the closure cap for the HRL began in January 1995, and was completed in April 1995. The cap was constructed of material from a nearby borrow area, Pit #6, near the 300 Area. The PCB-contaminated soil was transported in March and April 1995. To stabilize the topsoil and protect the landfill cap, the area was revegetated with crested wheatgrass and Siberian wheatgrass in November 1995 (DOE-RL 1995b). These species were selected because the main objective for revegetation was stabilization rather than to re-establish a native community. Five different planting treatments were evaluated to determine the best technique and provide information that will be used to plan future restoration projects. In June 1996 and 1997, the vegetation growing on the landfill was measured for percent canopy cover and percent frequency. At this time, the revegetation efforts appear to be successful (Henckel 1996).

TCE-contaminated groundwater was found upgradient and downgradient of the HRL. Additionally, technetium-99 was detected through the groundwater monitoring network, but no further information was provided. During the environmental evaluation of the Phase I remedial investigation, potential exposure of aquatic biota to TCE in groundwater could not be quantitatively assessed due to a lack of data on the magnitude and extent of contamination (DOE-RL 1990). The characterization and analysis performed for Phase II indicated that groundwater contamination has moved to the 1100-EM-1, near the HRL (DOE-RL 1995b). An adjacent facility (Siemens Power Corporation) was investigating soil and groundwater contamination as an independent action in accordance with the MTCA (EPA 1993). The 1100 Area ROD established the natural attenuation alternative as the remedial action for the TCE plume. Monitoring to evaluate the success of natural attenuation is performed on an annual basis. Five groundwater-monitoring wells were installed in August 1995, downgradient of the landfill to facilitate compliance evaluation and the RAOs of the ROD. Compliance with the TCE MCL concentration of 5 μg/L is anticipated by the year 2017. The surface area of the groundwater that has been exposed to TCE was calculated to be 58 hectares based on 1996 monitoring data (Hartman et al. 1996) and 53 hectares from 1997 data (Hartman et al. 1997). This exposed area calculation is based on the 5 μg/L TCE concentration.

1.1.1.7 The Ephemeral Pool. The Ephemeral Pool site is a long, narrow, manmade depression located along the western edge of the asphalt-paved 1171 Building parking area (Figure 2). The depression acted as a drainage collection point for precipitation runoff to flow from the parking area surface. Overall dimensions are approximately 6.1 m wide (east-west) by a 183- to 213-m length (north-south). The Ephemeral Pool was designed to collect runoff from the parking area and direct it to a central culvert approximately at the lengthwise midpoint of the depression. Settlement and/or poor grading of the depression floor resulted in the formation of a series of linked pools after rainfall events. A pervious gravel lining encouraged infiltration of the collected runoff into the vadose zone beneath this site (DOE-RL 1992a). The Ephemeral Pool site borders the 1171 Building parking lot and the railroad track. The sparse vegetation that occurs on the site is composed of exotic annuals (i.e., cheatgrass and tumbleweed) (CTUIR 1998).

Two surface soil samples were taken within the Ephemeral Pool during the Phase I remedial investigation. The results indicated the presence of PCBs in low to moderate concentrations (300 to 4,700 μg/kg). Surface soil samples identified the presence of inorganic and organic contaminants (DOE-RL 1992a). "Chlordane, heptachlor, and PCBs were the identified COPCs. Heptachlor was detected in one of two soil samples collected during the Phase I remedial investigation" (DOE-RL 1992a). Maximum concentrations of hazardous substances are listed in Table 3.

Six surface soil samples were collected during the Phase II remedial investigation and submitted for PCB and pesticide analysis. Laboratory results confirmed the presence of alpha (210 to 1,100 μg/kg) and gamma (330 to 1,700 μg/kg) chlordane. Two of the six samples detected concentrations of PCBs (Aroclor-1260) at 11,000 and 42,000 μg/kg (DOE-RL 1992a). Chlordane and PCB distribution in surface soils is identified in Figure 3. "Chlordane was identified at all sampling locations during the Phase II remedial investigation, with relatively high concentrations detected at either end of the Ephemeral Pool (sample sites E-1, E-5, and E-6). Elevated PCB concentrations were identified at sample locations E-2 and E-3… It (was) assumed that the PCB and chlordane contaminants (were) restricted to near-surface soils due to their relative immobility in soil/water systems. Other contaminants (zinc, Endosulfan II, and Endrin) (were) measured at levels that pose no known substantive risk to the environment or public health. Lead was measured at levels below cleanup criteria" (DOE-RL 1992a).

Ephemeral Pool remediation was based on PCB contamination, with the MTCA A cleanup level of 1 ppm. This cleanup level was designated as a RAO in the ROD to prevent soil ingestion and dermal contact with soils containing PCBs above 1 ppm. Remediation of the site began in February 1995. Excavation and stockpiling of waste (principally, the PCB Aroclor-1260) began

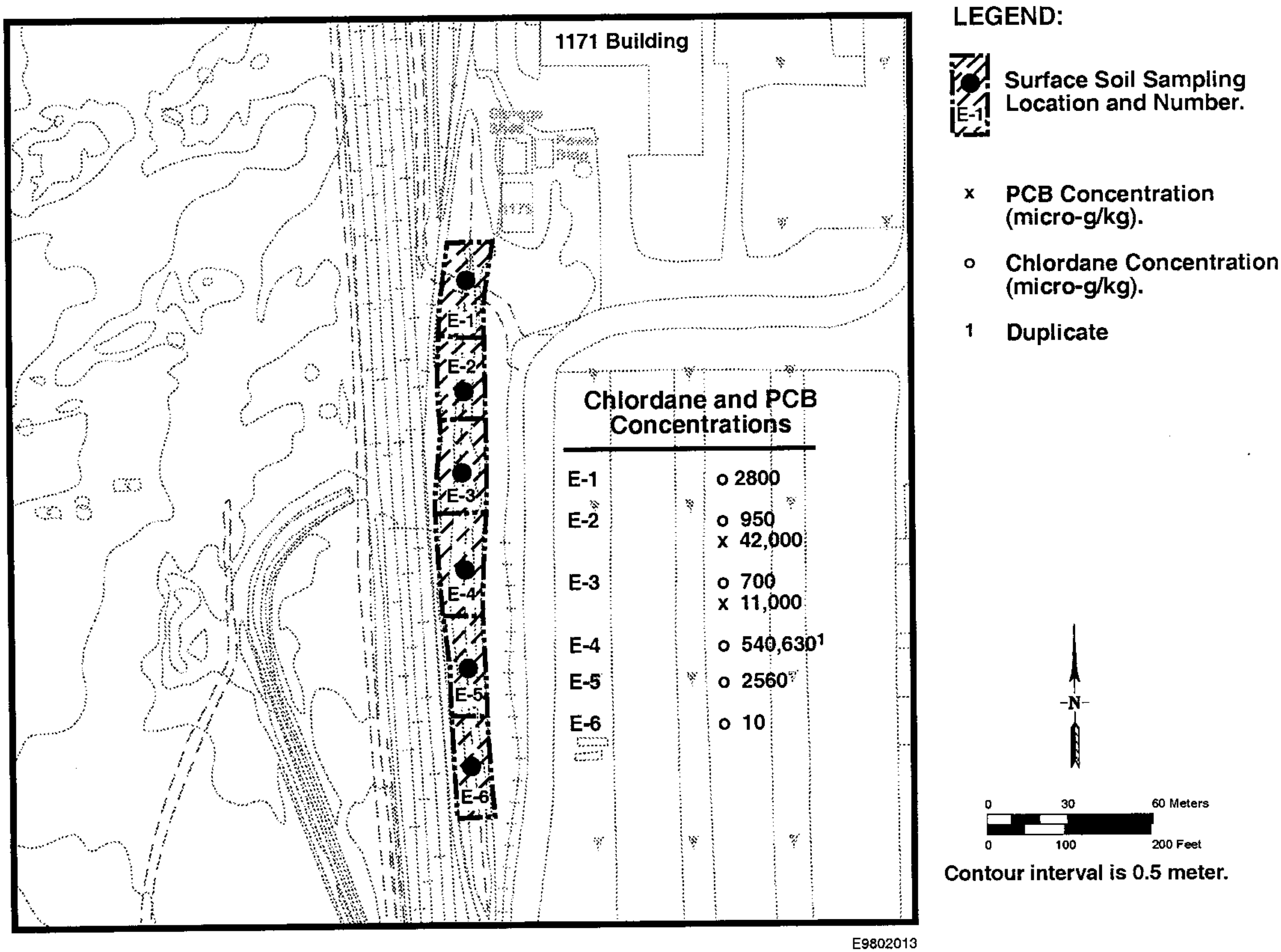


Figure 3. Ephemeral Pool - Chlordane and PCB Distribution in Surface Soils.

in March 1995. Approximately 70 m^3 of contaminated soil was excavated. A large volume of contaminated soil with PCB concentrations between 0.5 and 2 mg/kg remained when work was halted to consult with the regulatory agencies and RL. Following consultation, final excavation and stockpiling resumed, and an additional 45 m^3 of waste material was removed. Fourteen confirmatory soil samples were collected and analyzed for PCB contamination. PCBs were detected in 7 samples, with a range of 0.065 to 1.04 mg/kg. Confirmatory sampling data indicated that the removal action met the requirements based on the cleanup level of 1 mg/kg for PCBs. The site was regraded to a smooth, uniform surface, and the contaminated soil was excavated and stockpiled. The PCB-contaminated soil was disposed at a RCRA, Class C/TSCA (*Toxic Substances Control Act*, 15 U.S.C. Chapter 53) offsite hazardous waste landfill in April 1995 (DOE-RL 1995b). Endosulfan II and Endrin were found in the same area as the PCB contamination.

1.1.2 1100-EM-2

The 1100-EM-2 is located within the southern portion of 1100-EM-1 (Figures 1 and 4) (DOE-RL 1994b). Before 1950, a few small farms occupied what is now 1100-EM-2. The main feature is the 1171 Building, which was constructed in the early 1950s as a vehicle service maintenance and repair facility. The site also served as a warehousing and transportation distribution center. Principal sites were identified for investigation during the LFI/FFS.

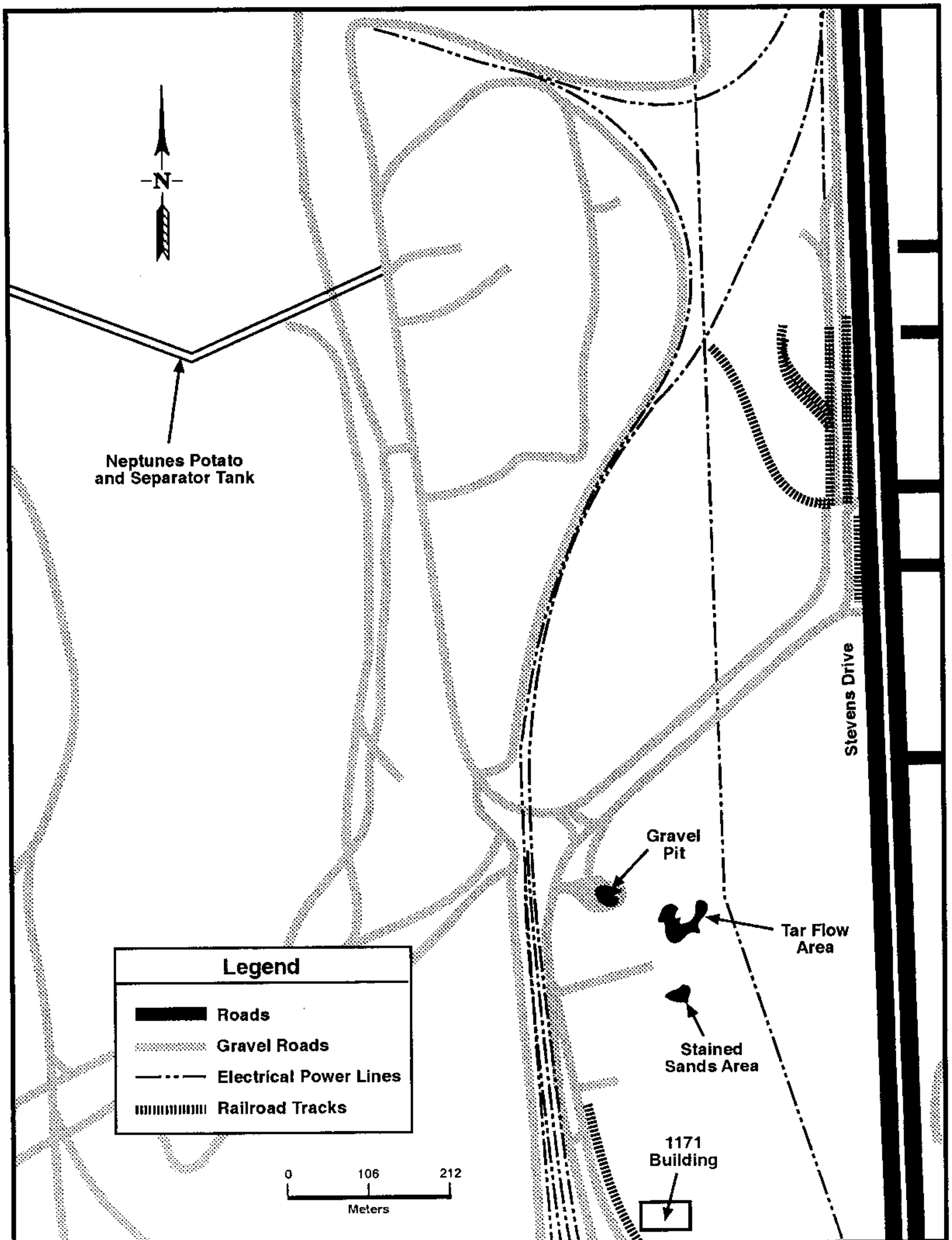
Remedial investigations at 1100-EM-2 were conducted during the LFI/FFS process between October 1992 and January 1993. Initially, the Hanford Site waste information data system (WIDS) was reviewed for data on waste types handling practices, or known soil or groundwater contamination at 1100-EM-2. Historical information, including aerial photographs and as-built construction drawings, was also reviewed. Each site was inspected and, whenever possible, knowledgeable personnel were interviewed (EPA 1993).

The main waste management sites at 1100-EM-2 consist of used oil tanks, steam pad and hoist ram storage tanks, and a hazardous waste staging area. Operations at 1100-EM-2 potentially included the use of solvents, fuels, oils, and PCBs. Sites initially investigated during the LFI/FFS were the tar flow area, stained sands area, Neptune's Potato and Separator Tank, several used oil tanks (#4 to #6), steam pads (#1 and #2), the bus shop underground hoist ram, the 700 Areas, waste solvent tank, bus lot dry wells, and a hazardous waste staging area (DOE-RL 1992c). At the time of the investigation, many of the sites were actively regulated by Washington State or EPA under a statute other than the CERCLA.

The tar flow, stained sands, and Neptune's Potato and Separator Tank areas were designated for further examination. Geophysical surveys, soil-gas sampling, and soil sampling were conducted in 1994 to investigate these sites. After further investigation, only the tar flow and stained sands were identified for remediation (DOE-RL 1995b). Maximum concentrations of hazardous substances are listed in Table 3.

The only hazardous substance to exceed an MCL in 1100-EM-2 was chromium from one well near the 1171 Building. High chromium concentrations have been detected since this well was installed. The well was constructed of stainless steel, of which chromium is a component.

Figure 4. 1100-EM-2 Site Locations.



E9712065.3

Additionally, the well has a high level of suspended solids. These two factors were stated by Dave Einan (Ecology et al. 1998) of EPA as being the reason that the chromium concentration in this well is interpreted as representing trivalent chromium, not hexavalent chromium. Filtered and unfiltered 1997 data also supports this claim with chromium concentrations of 3.3 μg/L and 220 μg/L, respectively (Ecology et al. 1998). Groundwater hazardous substances for the 1100-EM-2 are listed in Table 5.

Table 5. Maximum Concentrations of Groundwater Hazardous Substances for 1100-EM-2. (DOE-RL 1992c)

Hazardous Substance (units)	No. of Rounds Detected	Maximum Concentration	MCL
Chromium (μg/L) (2)	4/6	170	50
Copper (μg/L)	1/6	30	(1)
Lead (μg/L)	3/6	2.4	50
Manganese (μg/L)	6/6	352	(1)
Nickel (μg/L) (2)	5/6	137	100 (3)
Sodium (μg/L)	6/6	49800	(1)
Gross Alpha (pCi/L) (2)	5/6	17	15
Gross Beta (pCi/L)	6/6	24	50

(1) No MCL value for this hazardous substance
(2) Bold = Hazardous substance exceeds MCL
(3) Proposed MCL

Terrestrial vegetation in the 1100-EM-2 Operable Unit includes the presence of some sagebrush and bunchgrass communities, however, little wildlife habitat remains due to light industrial and commercial activities (DOE 1992c). Both waste sites within the 1100-EM-2, the Tar Flow area and the Stained Sands area, are located on a stabilized sand dune that has been significantly altered by earth-moving activity, including the dumping of small cobbles on top of the sand dune. During the 1100 Area tour in the fall of 1997, the Trustees noted that the dune supported quite a few native species (i.e., Indian ricegrass and rabbitbrush). Small rodent and beetle holes were common, a variety of scat was present, and a well-used wildlife pathway was noted (CTUIR 1998).

The general geologic stratigraphic column for 1100-EM-1 is applicable to 1100-EM-2 (DOE-RL 1992c). Please see Section 1.1.1 for more specific detail on the geology of 1100-EM-1. The prevailing groundwater flow of the unconfined aquifer at 1100-EM-2 is from west to east. The unconfined aquifer is approximately 10.8 m (35.5 ft) thick below a 12 to 18 m (40 to 60-ft) unsaturated zone. Seasonal, localized disruption of this flow occurs due to recharge at the North Richland well field that reverses the groundwater flow to the westward direction.

Thus, most of the time, groundwater flow is diverted around the North Richland well field (DOE-RL 1992c).

1.1.2.1 Tar Flow Area. This site is located about 320 m north of the northwest corner of the 1171 Building within a sand borrow area. A soft tar-like substance covered an irregular area of approximately 61 by 20 m. The source of tar-like material is unknown. Based on the 1994 investigation results and the cleanup goals for 1100-EM-2, the tar-flow area was identified for remedial action. The LFI/FFS noted that the vegetation was sparse in the Tar Flow area. Surface soil samples detected the presence of total petroleum hydrocarbons (TPH) and lead. Maximum concentrations of TPH (80,000 mg/kg) and lead (404 mg/kg) were detected to be above cleanup goals. As identified in the ROD, the remedial objective was to excavate all soil with TPH exceeding 200 mg/kg and lead concentrations exceeding 250 mg/kg (DOE-RL 1995a).

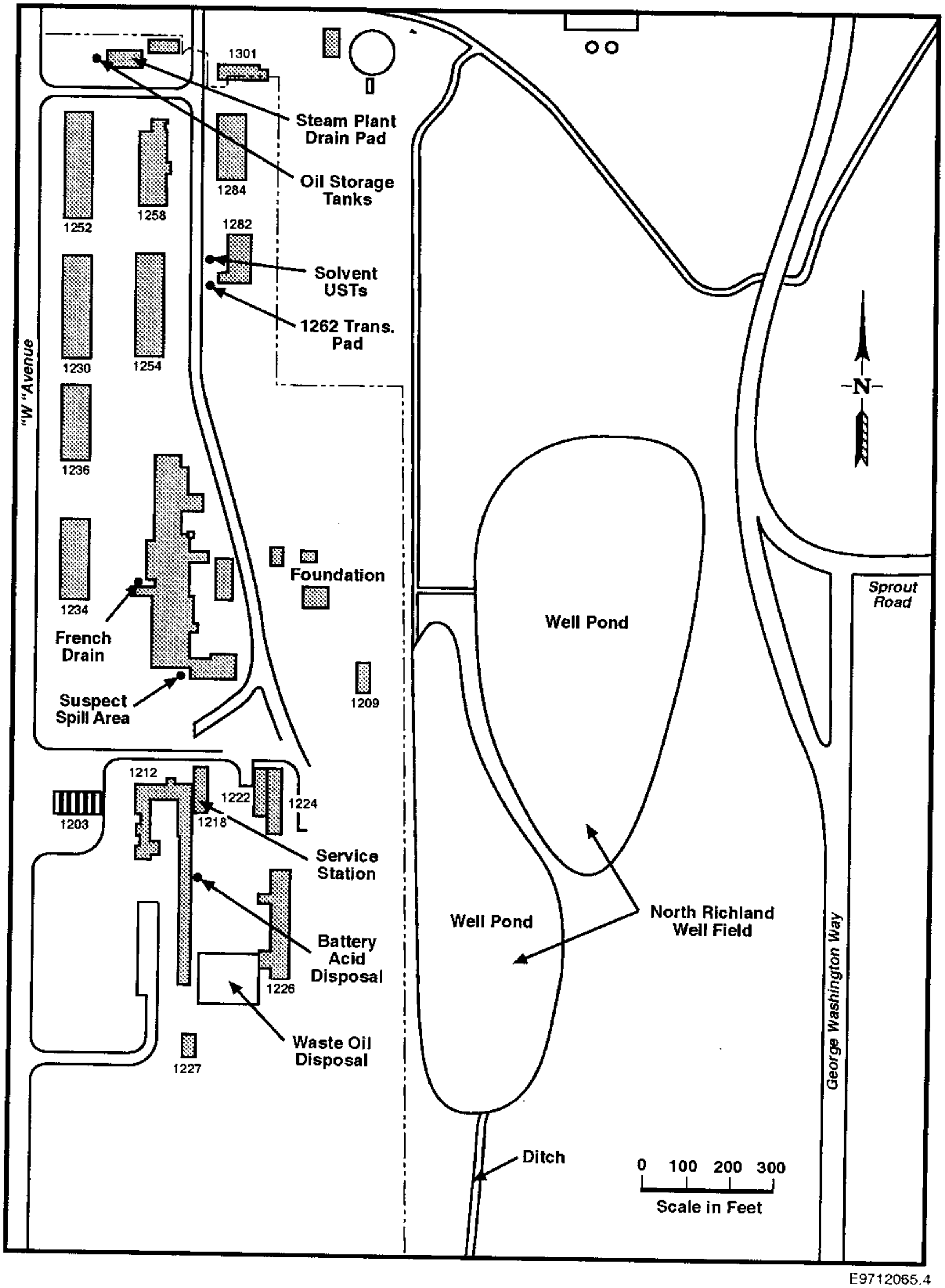
The remediation of the tar-flow area began in June 1995. Approximately 1,155 m^3 of contaminated soil was excavated from the area. The waste transportation and disposal was completed in September 1995. Following excavation, confirmatory sampling indicated that the removal actions met the cleanup levels established in the ROD (DOE-RL 1995b). The excavated sand was not replaced, and more sand may have been borrowed from this site.

1.1.2.2 Stained Sands Area. The Stained Sands area, located approximately 274 m north of the northwest corner of the 1171 Building, is an area of visibly stained sands on the east slope of a sand dune. The stained soils covered an area of approximately 6 by 6 m. No vegetation was observed in the stained area during the LFI/FFS investigation. Soil samples were collected and analyzed for volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), metals, TPH, and PCBs (DOE-RL 1995c). Contaminants were not detected in the samples; therefore, remediation was not required.

1.1.3 1100-EM-3

The 1100-EM-3 is located about 600 m northeast of 1100-EM-2 (Figure 5). The 1100-EM-3 OU contains approximately 20 permanent structures, some of which date back to 1951 (DOE-RL 1994b). These buildings form the 3000 Area. Before 1943, 1100-EM-3 was primarily used for agricultural activities. In 1943, new construction of temporary office buildings supporting construction and engineering activities at the newly formed Hanford Site began at 1100-EM-3. Throughout the 1940s, 1100-EM-3 and surrounding areas were used for office space and as an off-loading and warehousing area for construction supplies delivered on the Atomic Energy Commission Hanford Works Railroad. By 1951, most of the temporary buildings were removed or demolished and replaced by permanent structures. The 1100-EM-3 was part of a larger military camp, "Camp Hanford," and contained automotive repair and maintenance shops, gasoline storage and dispensing stations, an artillery repair and maintenance shop, a laundry, a dry cleaner, a cold storage, warehouses, a bakery, troop barracks, and administrative offices. During the last 25 to 30 years, 1100-EM-3 was used for office and warehouse facilities to support Hanford Site construction activities. Past activities at the OU included paint and sandblast operations, vehicle maintenance and repair, hazardous material storage, RCRA waste accumulation areas, warehousing, fabrication shops radio maintenance, and radiography and research administrative offices (DOE-RL 1992c).

Figure 5. 1100-EM-3 Site Locations.



Terrestrial vegetation in the 1100-EM-3 Operable Unit includes the presence of sagebrush and bunchgrass communities; however, little wildlife habitat remains due to light industrial and commercial activities (DOE-RL 1992c).

The general geologic stratigraphic column for 1100-EM-1 is applicable to 1100-EM-3 (DOE-RL 1992c). Please see Section 1.1.1 for specific details on the geology of 1100-EM-1. The prevailing groundwater flow of the unconfined aquifer at 1100-EM-3 is from west to east. The unconfined aquifer is approximately 10.8 m (35.5 ft) thick below a 12 to 18 m (40 to 60 ft) unsaturated zone. Seasonal, localized disruption of this flow occurs due to recharge at the North Richland well field that reverses the groundwater flow to the westward direction. Thus, most of the time, groundwater flow is diverted around the North Richland well field (DOE-RL 1992c).

Investigations at 1100-EM-3 were conducted during the LFI/FFS process between October 1992 and January 1993. Initially, the Hanford Site WIDS was reviewed for data on waste types, handling practices, or known soil or groundwater contamination at 1100-EM-3. Historical information, including aerial photographs and as-built construction drawings, was also reviewed. Each site was inspected and, whenever possible, knowledgeable personnel were interviewed (DOE-RL 1992c).

Key waste sites at 1100-EM-3 include several hazardous waste storage and staging areas, a used oil UST, and contaminated soil from a previously removed UST (Figure 5). Based on past practices at 1100-EM-3, approximately 22 sites were identified during the LFI/FFS (DOE-RL 1992c). At the time of the investigation, many of the sites were actively regulated by Washington State or EPA under a statute other than CERCLA. These sites were removed from further consideration for remedial action during the LFI/FFS. Sites remaining in the CERCLA investigation for 1100-EM-3 were the 1240 Suspect Spill Area, 1240 French Drain, 1226 Suspect Waste Oil Disposal Area, 1212/1217 Suspect Battery Acid Disposal Area, 1218 Service Station, 1262 Solvent Tanks, 1262 Transformer Pad, JA Jones Oil Storage Tanks, and JA Jones Steam Plant Drain Pad. These remaining sites were further investigated by geophysical surveys, soil-gas sampling, and soil sampling. Based on the remediation investigation results and the cleanup goals for 1100-EM-3, the French Drain, 1240 Suspect Spill Area, and the 1262 Solvent Tanks were identified for remedial action (DOE-RL 1995b). Maximum hazardous substance concentrations for these three sites are listed in Table 3. Groundwater hazardous substances for the 1100-EM-3 sites are listed in Table 6. The following is a detailed discussion of the 1100-EM-3 sites identified for remediation.

1.1.3.1 1240 French Drain. This site is located on the west-side of the 1240 Building next to a loading dock (Figure 5). The area surrounding the site is a large, gravel parking lot. No biological resources are present near the site. Baseline condition for this site is a clean, gravel parking lot (CTUIR 1998). No evidence of spills into the drain have been documented; however, the drain was reported to discharge to the surrounding soils. Soils within the drain were sampled for VOCs, metals, PCBs, and TPH at 0.1525-m and 0.5-m depths. The bottom of the drain is located at a 0.5-m depth. Analyses identified lead, TPH, chromium, and PCBs present in the soil. Maximum concentrations of lead (619 ppm), TPH (80,000 ppm), and chromium (949 ppm) exceeded the ROD cleanup levels for those contaminants (250 ppm, 200 ppm, and 400 ppm, respectively). Offsite analysis of PCBs determined that concentrations in the drain were below 1 ppm (DOE-RL 1995a).

Table 6. Maximum Concentrations of Groundwater Hazardous Substances for 1100-EM-3. (DOE-RL 1992c)

Hazardous Substance (μg/L)	No. of Rounds Detected	Maximum Concentration	MCL
Chromium	4/6	38.8	50
Cyanide	1/6	0.01	(1)
Lead	3/6	3.8	50
Manganese	6/6	114	(1)
Sodium	6/6	20900	(1)
Phenol	1/6	5	(1)
BEHP	2/6	6	(1)
Tetrachloroethene	1/6	2	(1)
C12 Hydrocarbon	1/6	100	(1)

(1) No MCL value for this hazardous substance

Remediation of the French Drain began in July 1995. A total of 98 m^3 of soil contaminated with lead, TPH, and chromium were excavated and stockpiled. Confirmatory sampling indicated that the removal action met the ROD cleanup level requirements for lead, TPH, and chromium. The site was regraded, and base materials were spread over the disturbed area. The soil was transported and disposed in September 1995 (DOE-RL 1995b).

1.1.3.2 1240 Suspect Spill Area. This site is located at the north end of the 1240 Building (Figure 5). The area surrounding the site is a large parking lot. The soil of this site was visibly stained over a 0.93 m^2 area. The spill reportedly consisted of a pliable adhesive mixed with metal fragments and floor sweepings. A geophysical survey was conducted to locate underground utilities before intrusive sampling took place. Two soil samples were collected at a depth of 0.15 m and analyzed for SVOCs, VOCs, metals, and PCBs. Two soil samples contained lead (44,200 and 16,200 ppm) that exceeded the ROD cleanup level of 250 ppm.

Remediation of the spill area began in July 1995, with excavation and stockpiling of 69 m^3 of lead-contaminated soil. Confirmatory sampling indicated that the removal action met the cleanup requirements for lead (250 mg/kg) identified in the ROD. The site was regraded, and base materials were spread over the disturbed area. The soil was stabilized, transported, and disposed in September 1995 (DOE-RL 1995b).

1.1.3.3 1262 Solvent Tanks. The USTs were located west of the 1262 Building beneath an asphalt parking lot. The USTs were suspected to have contained solvent, potentially carbon tetrachloride (CCl_4), from dry-cleaning operations during Hanford's military era.

Upon excavation of the tanks in June 1995, it was discovered that one tank was filled with fluid and the other tank contained only residual fluid. Analysis of fluid samples indicated that the contents were nonhazardous water (DOE-RL 1995b). The water was removed and discharged to the Richland sanitary sewer. The tanks were cleaned and removed in July 1995. Confirmatory sampling from the soil below the tanks and the sides of the excavation detected no hazardous substances (DOE-RL 1995b).

1.1.4 1100-IU-1

The 1100-IU-1 is located within the area known as the Arid Lands Ecology (ALE) Reserve (Figure 6). The ALE is approximately 195 km^2 and is located on the northeastern slope of the Rattlesnake Hills, approximately 24 km from the 1100 Area. The land that comprises ALE was set aside as a Research Natural Area in 1967 by the Atomic Energy Commission to preserve shrub-steppe vegetation in Washington State and allow research in such habitat (USFWS 1996).

The 1100-IU-1 consists of two main areas (Figure 7). One area is located at the top of Rattlesnake Mountain and is known as the Nike Missile Control Center (Figure 8). It is a compound with a pumphouse, small support structures, and launch-control facilities. The second area, the Nike Missile Launch Site, is located on the southeast slope of the Rattlesnake Hills and includes a number of permanent structures used to maintain the missile site and house operations personnel (Figure 9).

The dominant plant community, found nearly on the entire crest of Rattlesnake Mountain where the Nike Missile Control Center is located, consists of a thyme buckwheat (*Eriogonum thymoides*) and Sandberg's bluegrass (*Poa secunda*) association. Community composition also includes rock buckwheat (*Eriogonum sphaerocephalum*), desert yellowdaisy (*Erigeron linearis*), Hood's phlox (*Phlox hoodii*), narrowleaf goldenweed (*Happlopappus stenophyllus*), bottlebrush squirreltail (*Sitanion hystrix* var. *hordeoides*), and a number of forbs, including rosy balsamroot (*Balsamorhiza rosea*), Hooker's balsamroot (*B. hookeri*), and low hawksbeard (*Crepis modocensis*). This community type, which is typically represented on lithosolic soils, is in good, rather than excellent, condition due to some disturbance from roads and facilities (i.e., Nike Missile Control Center) (Wilderman 1994).

Figure 6. Location of 1100-IU-1 Within ALE.

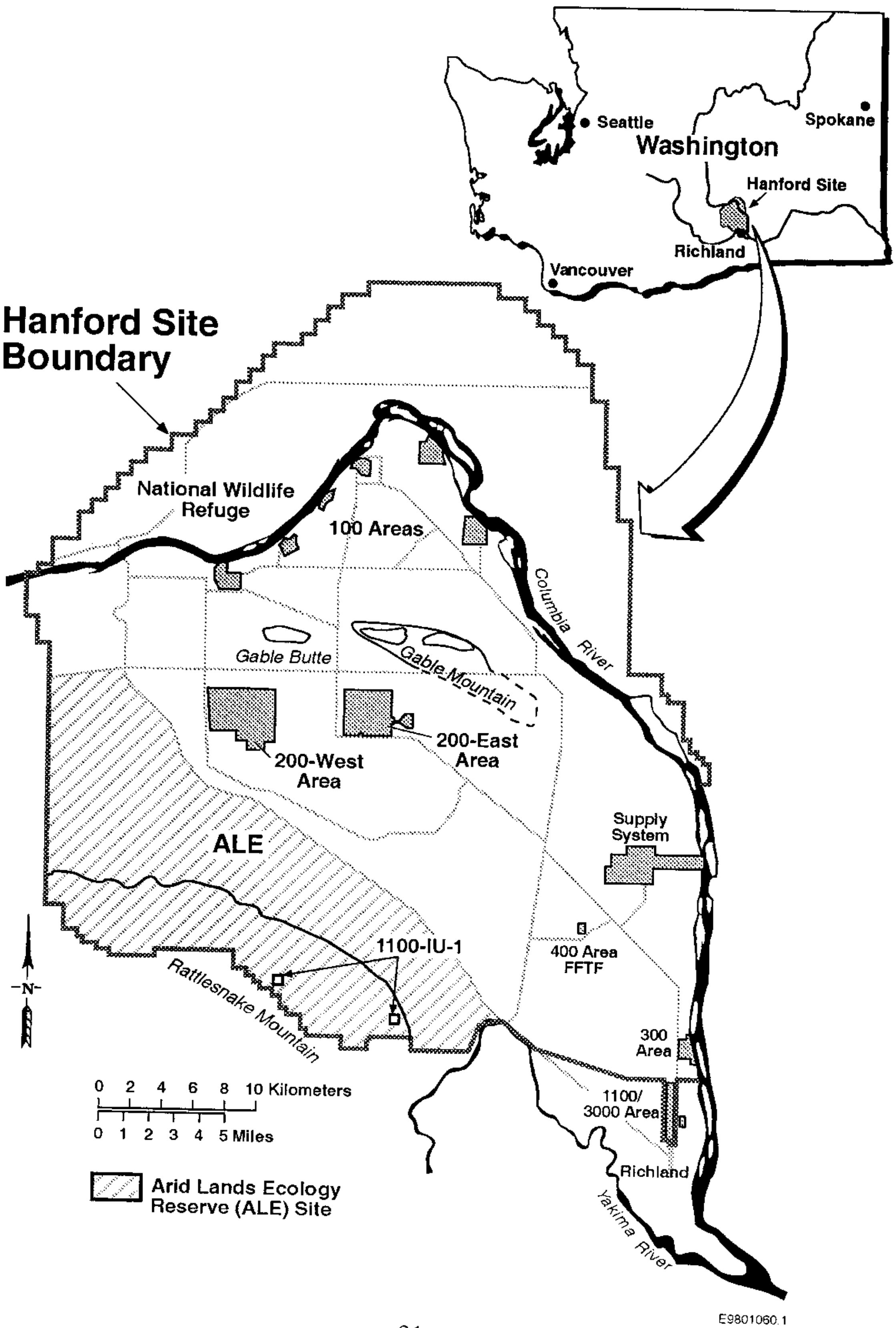


Figure 7. Hanford Arid Lands Ecology Reserve, Two Main Areas Within 1100-IU-1.

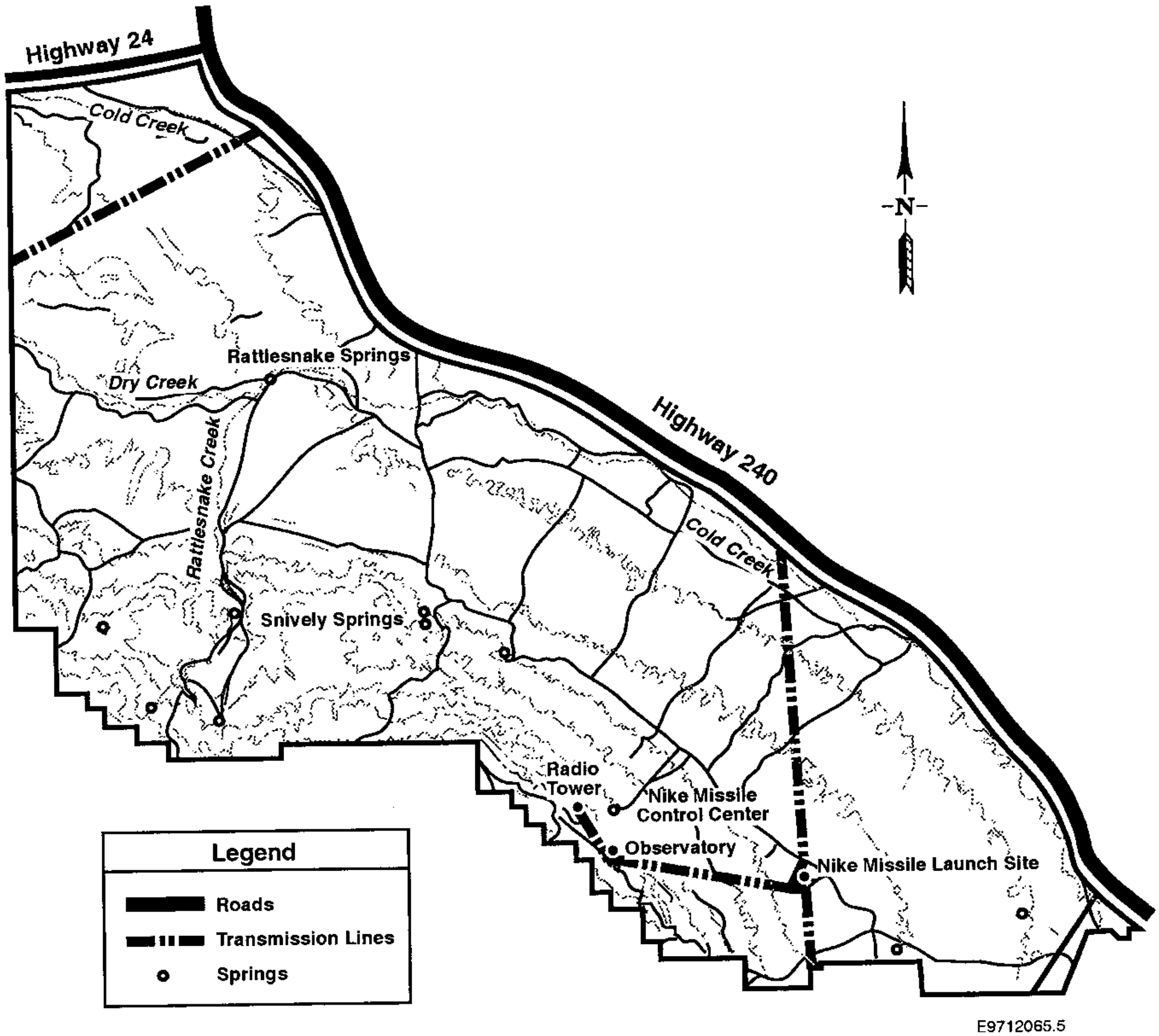


Figure 8. Nike Missile Control Center.

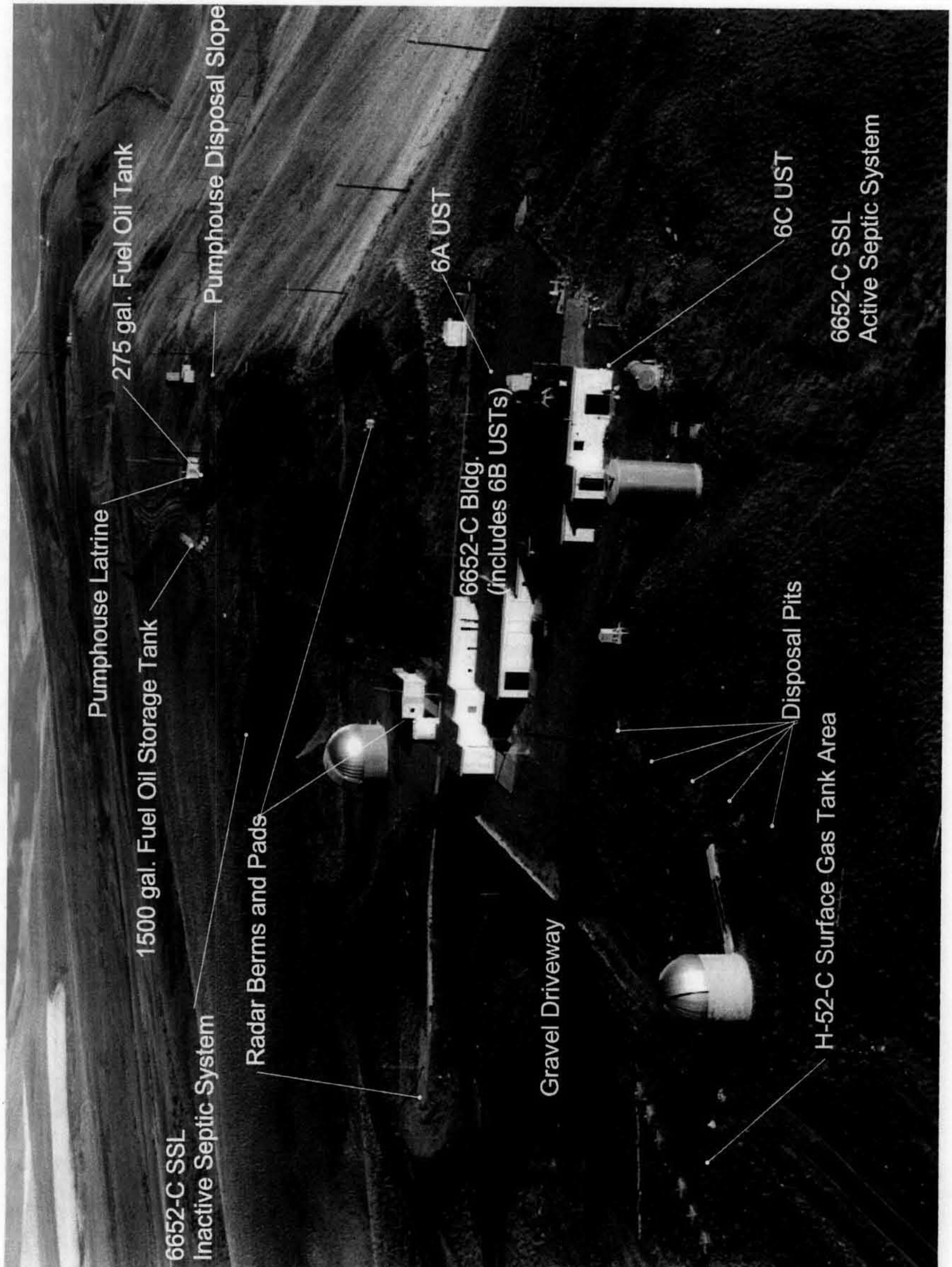
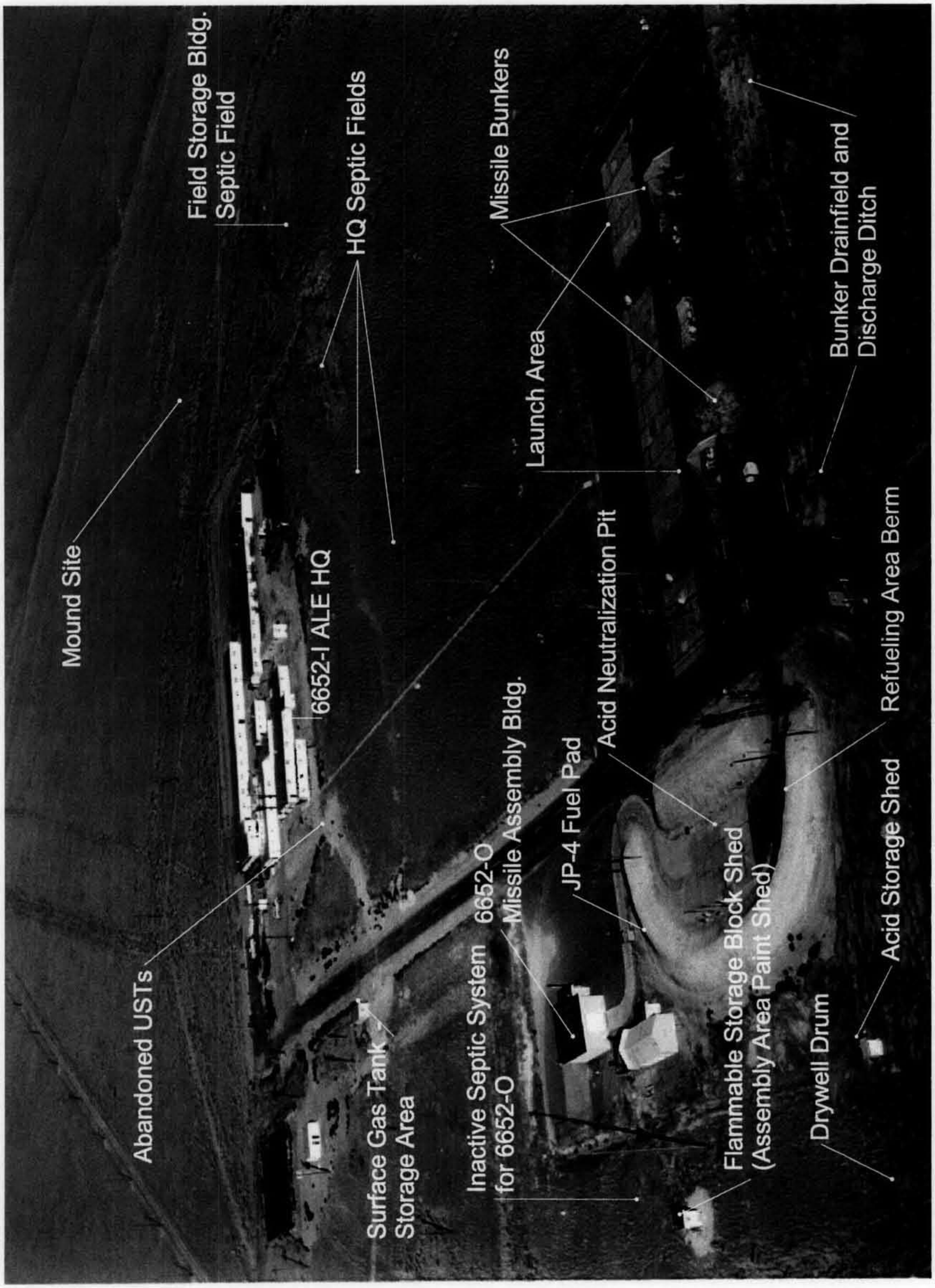


Figure 9. Nike Missile Launch Site.



The dominant native plant community surrounding the ALE Nike Missile Launch facilities consists of a big sagebrush and bluebunch wheatgrass association. Other dominant species throughout the community type include longleaf phlox (*Phlox longifolia*), Sandberg's bluegrass, Thurber's needle and threadgrass (*Stipa thurberiana*), bottlebrush squirreltail, slender hawksbeard (*Crepis atribarba*), low pussytoes (*Antennaria dimorpha*), yarrow (*Achillea millefolium*), sulfur lupine (*Lupinus sulphureus*), velvet lupine (*L. leucophyllus*), Spalding's milkvetch (*Astragalus spaldingii*), buckwheat milkvetch (*Astragalus caricinus*), and Carey's balsamroot (*Balsamorhiza careyana*) (Wilderman 1994). The areas surrounding the Nike facilities are heavily disturbed and are comprised mainly of nonnative plant species. Crested wheatgrass (*Agropyron cristatum*) was planted in the previously disturbed field between the ALE headquarter buildings and the Nike Missile Launch site.

Approximately 34 species of birds are commonly associated with the shrub-steppe habitat near Richland and on the ALE Reserve. Passerine birds are probably the most common. The western meadowlark, horned lark, and sage sparrow (*Amphispiza belli*) regularly nest on the ALE Reserve. Other nesting birds include Brewers sparrow (*Spizella pallida*) and vesper sparrows (*Poocetes gramineus*). Beck et al. (1994) also reported breeding populations of burrowing owl (*Athene cunicularia*), loggerhead shrike (*Lanius ludovicianus*), sage thrasher (*Oreoscoptes montanus*), and grasshopper sparrow (*Ammodramus savannarum*) in the shrub-steppe habitat. California quail (*Callipepla californica*) were reported as numerous near the landfills on the ALE Reserve during recent surveys (Richard Roy, USFWS, personal communication).

Beck et al. (1994) conducted a large-scale biodiversity study of insects on the ALE Reserve, and more than 500 species were identified, with 300 to 400 species awaiting identification. The report estimated 900 species represented only 25% of the total insect species. As for reptiles and amphibians, the western rattlesnake (*Crotalus viridus*), gopher snakes (*Pituophis melanoleucus*), yellow-bellied racers (*Caliber constrictor mormon*), side-blotched lizard (*Uta stansburiana*), and the short-horned lizard (*Phrynosoma douglassi*) are present. These species are important food sources for nesting raptors, particularly Swainson's hawks.

Rattlesnake Mountain and its southeast extension to the Yakima River is an anticlinal ridge characteristic of the Yakima Fold Belt; it is asymmetrical with a faulted north limb. The Pomona Member of the Saddle Mountain Basalt Formation underlies the Nike Control Center on the crest of Rattlesnake Mountain. This member varies in thickness from approximately 15 to 53 m (50 to 73 ft), with less than 0.3 m (1 ft) of eolian sediments and weathered rock fragments overlying the bedrock. The stratigraphy near the Nike Launch Site has not been well documented. It is assumed that bedrock is less than 7 m (25 ft) below the existing ground surface overlain by fine-grained sands and silts of the Hanford Formation and surface eolian deposits of silt and sand (DOE-RL 1992c).

Groundwater flow beneath the crest of Rattlesnake Mountain occurs entirely within the basalt bedrock. The depth to groundwater at the crest of the Mountain is between 300 to 450 m (990 to 1,500 ft) below the ground surface. Within the unsaturated basalt zone, numerous perched aquifers are anticipated, which likely result in the numerous springs along the slope of Rattlesnake Mountain (DOE-RL 1992c).

In the late 1960s, select buildings within the Nike Missile Launch Site were converted into the headquarters of the ALE Laboratory, managed by the Pacific Northwest National Laboratory. The laboratory facilities were abandoned in 1995. The remaining buildings within the Nike Missile Launch Site have not been used for any significant waste-producing activities since the Nike operations stopped in the late 1960s; the facilities are intact, but abandoned. Activities at 1100-IU-1 included maintenance of the missile batteries in combat-ready status requiring the storage, handling, and disposal of missile components as well as solvents, fuels, hydraulic fluids, paints, and other materials. Typical chemicals used at 1100-IU-1 included aniline, petroleum distillates, and chlorinated solvents (i.e., CCl_4, TCE, TCA, PCE, chromium oxides, acetone, paints containing chromium and lead, tricresyl phosphate, ethylene glycol, pesticides, herbicides, PCBs, and hydraulic fluid) (DOE-RL 1992b). Areas of concern at 1100-IU-1 include former septic fields that may have been used for solvent disposal, storage tanks, disposal sites, and landfills.

Initial investigations at 1100-IU-1 were conducted during the LFI/FFS process between October 1992 and January 1993. Initially, the WIDS was reviewed for data on waste types, handling practices, or known soil or groundwater contamination. Historical information, including aerial photographs and as-built construction drawings, was also reviewed. Each site was inspected and, whenever possible, knowledgeable personnel were interviewed (EPA 1993). Investigations identified 30 sites within 1100-IU-1 that required detailed investigation and/or remediation (DOE-RL 1994d). These sites are discussed later in more detail.

Little groundwater sampling information exists for the 1100-IU-1. Data collected from eight groundwater monitoring wells on ALE demonstrated that "no significant amounts of contamination was present" (DOE-RL 1994a). Groundwater data were not included in that document. Reportedly, the eight monitoring wells did not meet the existing state standards for groundwater monitoring well construction. Because less rigorous standards were used during construction, there was a potential for cross-aquifer contamination (DOE-RL 1994a). Groundwater information was not reported in the LFI\FFS or the ROD for the 1100-IU-1. Therefore, this PAS does not include any groundwater data for the 1100-IU-1. A discussion of the sites within 1100-IU-1 that were investigated follows.

1.1.4.1 6652-C SSL Active Septic System. This septic system was reported to discharge its contents over a slope northeast of the administrative building (Figure 8). The estimated area covered by the septic system field is approximately 11 by 2 m. In addition, a 9,500-L septic tank is associated with this septic system. Solvents were regularly used in site processes and are thought to have been discharged into the septic systems for disposal; therefore, potential contaminants may include chlorinated and non-chlorinated solvents (DOE-RL 1994d).

Geophysical and soil-gas surveys were not performed. Soil sampling was conducted in July 1994 to determine if any VOCs were present in the soils at the end of the septic system discharge pipe. Onsite laboratory equipment was used to analyze the samples collected for selected VOCs. VOCs were not detected in the soil samples; therefore, according to the sampling program decision process outlined in DOE-RL (1994a), remedial action was not required (DOE-RL 1994d).

1.1.4.2 6652-C SSL Inactive Septic System. This area required investigation because solvents and other waste were potentially disposed in septic systems. The estimated area covered by the septic system field is 9 by 92 m (Figure 8). In addition, a 9,375-L septic tank is associated with this septic system. Potential contaminants include chlorinated and nonchlorinated solvents (DOE-RL 1994b). A decision was made not to sample due to a lack of soil (USFWS 1996). Therefore, information regarding the type and extent of contamination is not available.

1.1.4.3 Radar Berms and Pads. Large amounts of hydraulic fluid were used in these areas to rotate radar tracking equipment. There are three radar pads, each of which is 5 by 5 m (Figure 8). Visible contamination has not been observed on the pads or surrounding berms. Potential contaminants include petroleum hydrocarbons, specifically hydraulic fluid (DOE-RL 1994d).

Geophysical and soil-gas surveys were not performed. Soil sampling was conducted in July 1994 to determine if any petroleum hydrocarbons existed. Only two of the three pads were sampled due to large cobble- to boulder-size fill material at the third pad. TPH tests were performed in July 1994 by immunoassay analysis using a field test kit. Petroleum hydrocarbons were not detected in the soil samples; therefore, according to the sampling program decision process, remedial action was not required (DOE-RL 1994d).

1.1.4.4 H-52-C Surface Gas Tank Area. Investigations have identified two 1,805-L surface gasoline tanks in this area (Figure 8). Interviews with former site personnel indicated that this area was also used to clean paintbrushes and other items. Visible surface stains were not observed within the site. The estimated area covered by the tanks and the cleaning area is 6 by 6 m. Potential contaminants include petroleum hydrocarbons (gasoline) from the gas storage tanks, solvents (chlorinated and nonchlorinated), and metals from the cleaning activities (DOE-RL 1994d).

Geophysical and soil-gas surveys were not performed. Subsurface soil samples were collected in July 1994 to determine if any VOCs, metals, or petroleum hydrocarbons were present in the soil in the former storage tank area. Onsite laboratory equipment was used to analyze the samples for various VOCs. Additional TPH tests were performed using an immunoassay field test kit. Metals, VOCs, and petroleum hydrocarbons were not detected in the soil samples; therefore, according to the sampling program decision process outlined in DOE-RL (1994b), remedial action was not required (DOE-RL 1994d).

1.1.4.5 Control Center Disposal Pits. This site is composed of five individual pits that appear to have been used to burn refuse (Figure 8). Each pit is approximately 1 by 2 m in diameter. The pits contained glass, metal, ashes, and pieces of wood. Soil samples were only taken from four pits due to rosy balsam root surrounding Pit #4. Geophysical or soil-gas surveys were not performed. Potential contaminants may include chlorinated solvents, petroleum hydrocarbons, acids, and metals (DOE-RL 1994d).

Subsurface soil sampling was conducted in July 1994 to determine if any SVOC, VOCs, metals or PCBs were present in the pits. One sample from the center of each of the four pits was collected. An onsite laboratory analyzed VOCs while an offsite laboratory analyzed SVOCs and metals. PCB analysis was performed on site using an immunoassay field test kit. Lead was the only contaminant detected in the soil samples above the ROD soil cleanup levels (250 ppm). Lead was detected in Pits #1 (1,450 mg/kg) and #3 (1,240 mg/kg) (DOE-RL 1994d). Because of concern for cultural and ecological resources, RL proposed that a concrete cap be placed over the two burn pits. Ecology and EPA concurred with this proposal (DOE-RL 1994c). Concrete caps were poured over the two pits. Table 3 identifies the hazardous substances at this site.

1.1.4.6 Building 6652-C Abandoned USTs. Six USTs (Figure 8) have been associated with this site. Interviews with site personnel have identified four 3,800-L fuel oil USTs (labeled as 6B) in the building, one UST (labeled as 6A) on the northeast corner of the building (reportedly removed), and one UST (labeled as 6C) on the southeast corner (Figure 8). Potential contaminants included petroleum hydrocarbons, fuel oil, and diesel (DOE-RL 1994d).

Geophysical surveys detected one UST-like object (site 6C) adjacent to the south side of the 6652-C Building. No USTs were detected via the geophysical surveys for sites 6A and 6B. A soil-gas survey was conducted in July 1994 to determine if any VOCs were present at the 6A UST site. Soil-gas samples were analyzed for select VOCs using onsite laboratory equipment. No VOCs were detected; therefore, the sampling program decision process determined that remedial action was not required. Because the UST was present at site 6C, the decision process described in DOE-RL (1994b) indicated that the tank and ancillary piping should be removed (DOE-RL 1994d).

Seven soil samples were collected: three from around the tank, three from the excavated and stockpiled soil, and one from the fill pipe area. Two samples contained gasoline below the cleanup goals. It was determined that the tank would be decommissioned in place. One soil sample was taken from below the tank; no petroleum hydrocarbons were detected. The tank was filled with sand and topped with grout. The stockpiled soil was returned to the excavation (USFWS 1996).

One personal communication, two weekly status reports, and a letter report all confirm that UST 6C was closed in place. The EPA Project Manager for the 1100 Area stated that the UST on top of Rattlesnake Mountain was closed in place in lieu of excavation and removal (Ecology et al. 1998). "The plans for removing underground (UST) 6652-C on top of Rattlesnake Mountain have been disapproved by the Indian Nations. This UST cannot be removed. The U.S. Army Corps of Engineers (USACE) is now working with the regulators to determine if it would be acceptable to backfill the UST with slurry" (Ecology et al. 1998). "Plans to slurry backfill the 6652-C1 UST are on hold until October 14, pending resolution of how to dispose of the 6,000 gallons of unleaded gasoline in the tank" (Ecology et al. 1998). Ecology has reviewed all closure documentation for tank #6652-C and concurs that closing in place was appropriate and at this time requires no further action (Ecology et al. 1998).

1.1.4.7 Pumphouse Disposal Slope. Investigations confirmed that solid waste had been disposed of on a slope by the pumphouse (Figure 8). A small pile of debris was observed at the top, with piles of concrete on the slope. The estimated volumes of the debris and concrete piles are 1.5 by 1.5 by 0.6 m, and 26 by 3 by 0.3 m, respectively. Sampling was not conducted; therefore, information regarding the type and extent of any potential contamination is not available (DOE-RL 1994d).

1.1.4.8 Pumphouse Latrine 1,500-Gallon Fuel Oil Storage Tank. This site once contained the Pumphouse Latrine storage tank. Two concrete saddle supports now remain (Figure 8). The potential contaminant was fuel oil from the storage tank (DOE-RL 1994d).

Geophysical and soil-gas surveys were not performed. Soil sampling was conducted in July 1994 to determine if any VOCs or petroleum hydrocarbons were present. Onsite laboratory equipment was used to analyze the samples collected for select VOCs. Additional TPH analyses were performed using an immunoassay field test kit. TPH was detected in the surface soil at 420 ppm, which exceeded the ROD cleanup level of 250 ppm for TPH. Excavation was guided by field-screening methods specific to petroleum hydrocarbons and was stopped when field screening indicated that ROD levels were achieved. Because soil was removed down to bedrock, offsite laboratory confirmatory sampling was not performed (DOE-RL 1994c).

1.1.4.9 Pumphouse Latrine 275-Gallon Fuel Oil Storage Tank. This site once contained an above-ground fuel oil storage tank. Two concrete saddle supports now remain (Figure 8). The potential contaminant at this site was fuel oil from the storage tank (DOE-RL 1994d).

Geophysical and soil-gas surveys were not performed. Soil sampling was conducted in July 1994 to determine if any VOCs or petroleum hydrocarbon were present. Onsite laboratory equipment was used to analyze the samples collected for select VOCs. Additional TPH analyses were performed using an immunoassay field test kit. VOCs and TPHs were not detected in the soil samples; therefore, according to the sampling program decision process outlined in DOE-RL (1994b), remedial action was not required (DOE-RL 1994d).

1.1.4.10 ALE Field Storage Building Septic System. This septic system was identified as a waste-management unit because solvents and other waste were potentially disposed of in septic systems (Figure 9). The estimated area covered by the septic system field is 61 by 12 m. In addition, a 15,200-L septic tank is associated with this septic system. Potential contaminants included chlorinated and nonchlorinated solvents (DOE-RL 1994d).

A geophysical survey was conducted in June 1994 to locate the edges of the septic tank. The tank was located approximately 30 cm below ground surface. A soil-gas survey was conducted in June 1994 to determine if any VOCs were in the soil. Nine samples were collected at a depth of 1 m around the perimeter of the tank. Samples were analyzed for select VOCs at an onsite laboratory. Because VOCs were not detected from the soil-gas survey, soil sampling was not conducted, and remedial action was not required (DOE-RL 1994d).

1.1.4.11 Mound Site Northwest of Building 6652-G. This site is of unknown origin, but appears to be a windbreak or the location of a soil research project near the ALE laboratory (Figure 9). This site could be better described as a berm, approximately 55 by 3 m. Potential contaminants were not identified (DOE-RL 1994d).

A geophysical survey was conducted in July 1994 to identify any concentrations of debris in or around the mound; no debris was found. Soil-gas surveys were not performed. Four subsurface soil samples were analyzed for SVOCs, VOCs, metals, and PCBs. Onsite laboratory facilities were used for select VOC analysis. PCB tests were performed on site using an immunoassay field test kit. VOCs, SVOCs, and metals were not detected, and PCBs were detected below ROD cleanup goals. Consequently, remedial action was not required (DOE-RL 1994d).

1.1.4.12 6652-I ALE Headquarters Septic System. The septic field for this system includes three separate drainfields and a 22,710-L septic tank (Figure 9). Of the three septic fields, one measures 4.6 by 46 m and two measure 21 by 30 m. Potential contaminants included chlorinated and nonchlorinated solvents that may have been discharged into the septic system (DOE-RL 1994d).

A geophysical survey was conducted in June 1994 to locate the edges of the septic tank and the drainfields. A soil-gas survey was conducted in June 1994 to determine if VOCs were present in the soil. Seventeen soil-gas samples were collected. Samples were taken at each end of the septic tank and throughout each drainfield. Samples were analyzed for select VOCs with onsite laboratory equipment. Because no VOCs were detected from the soil-gas survey, soil sampling was not conducted and remedial action was not required (DOE-RL 1994d).

1.1.4.13 Abandoned Underground Storage Tanks. This site is comprised of six USTs, ranging in size from 1,045 to 7,600 L. The tanks are located at the ALE Headquarters and associated buildings (Figure 9). Potential contaminants included fuel oil from the storage tanks (DOE-RL 1994d).

A geophysical survey was conducted in July 1994 to locate the suspected USTs. UST-like objects were detected at two of the six sites. Soil-gas surveys were conducted in July 1994 to determine if any VOCs were present at the four sites where USTs were not detected. Soil-gas samples were analyzed for VOCs using onsite laboratory equipment. VOCs were not detected from the soil-gas samples taken at the four tank sites; therefore, soil sampling was not performed, and remedial action was not required. Because the geophysical survey identified tanks present at sites 13E and 13F, these tanks and ancillary piping were required to be removed (DOE-RL 1994d).

A letter report and the ALE Close-Out Report (DOE-RL 1994d) support that tanks 13E and 13F were removed. The locations of tanks 13E and 13F correspond to tanks 6652-HJ and 6652-G, respectively, as identified in a letter report from Thompson (Ecology et al. 1998). The letter report describes tank 6652-HJ as a "2,000-gallon UST westerly side (north end) of Building 6652-H." Tank 6652-G is described as a "2,000-gallon UST northeast corner of Building 6652-G." These two tanks were slated for removal in the letter report. The 6652-H and 6652-G were removed on September 28-29, 1994 (Ecology et al. 1998). The ALE Close-Out Report (DOE-RL 1994d) also identifies the two tank removals as follows: Two 7,600-L fuel tanks associated with Buildings 6652-G and 6652-H were discovered and removed. Soils from beneath these tanks were sampled and sent off site for analysis. Laboratory results indicated that these soils were clean and that no further actions were required.

1.1.4.14 Missile Bunker Sump. This site is in the missile bunker (Figure 9) and is comprised of two areas: the north and the south missile bunker sumps. These sumps were originally used to store missiles when the Nike base was active from approximately 1952 to 1962. The original descriptions of this site indicated that debris (batteries, transformers and asbestos) existed in this area. The sump area was found to be clear of this debris; therefore, sampling was not conducted for asbestos. Geophysical and soil-gas surveys were not conducted. PCB wipe samples of the missile bunker sumps, the hydraulic lift "wells," and the north missile bunker sump hydraulic jacks were collected in July 1994. These samples were submitted to an onsite laboratory for PCB screening. The sump-wipe samples were collected from the interior walls of the sumps. The hydraulic lift well samples were collected from the interior of the wells. The auxiliary jack samples were collected from the tops of the jacks (CDM 1995a). PCB Aroclor-1254 was detected at 32 μg/100 cm^2 wipe for the auxiliary jacks, and 34 and 150 μg/wipe for the north and south missile bunker sumps, respectively. Because the investigations were conducted in accordance with approved plans and procedures, remedial action was required. Remedial action should include decontaminating all PCB-contaminated surfaces to less than the EPA required cleanup level of 10 μg/100 cm^2 wipe (DOE-RL 1994d). PCBs were the only hazardous substances detected, but no PCBs were released to the environment.

In a fax transmittal sheet to RL, USACE stated that these actions were not a part of the ALE field report because they were outside of CERCLA (not a release to the environment). However, it was agreed that the bunker would be remediated. Removal and disposal of hydraulic fluids in the bunker lift wells, sump decontamination, and PCB wipe sampling was accomplished on July 25-26, 1995. Approximately 480 L of hydraulic fluid were removed from both bunker lift wells. Approximately 770 L of water were removed from the south bunker lift well. Sump and sump pump decontamination at both bunkers took place on July 25-26, 1995. Decontamination proceeded until the regulatory criterion for surficial PCB contamination of 10 μg/100 cm^2 was achieved (CDM 1995a).

1.1.4.15 Missile Bunker Landfill. This site is an inactive landfill located approximately 91 m northwest of the missile bunker area. This landfill was used to dispose construction and demolition debris (DOE-RL 1994d).

A geophysical survey was conducted in July 1994 to identify the extent of the landfill and locate concentrations of debris. The surveys found buried metallic debris, surface metal, and concrete debris with rebar. A soil-gas survey was also conducted in July 1994 to determine if any VOCs were present in the soil. Soil-gas samples were analyzed for selected VOCs using onsite laboratory equipment. VOCs were not detected from the soil-gas survey; therefore, soil samples were not taken, and remedial action was not required (DOE-RL 1994d).

During a NRTC site tour in October 1997, debris was found among the well-developed sagebrush stand at the site (CTUIR 1998). Asbestos-like material and open paint cans were noted as part of the debris. However, asbestos was not found during the site investigations.

1.1.4.16 Missile Refueling Area Berm. This area consists of two berms (Figure 9). Potential historical use of herbicide and/or defoliant on these berms was identified. The estimated total volume of the berms is 459 m^3.

Geophysical and soil-gas surveys were not performed. Soil sampling was conducted in June 1994 to determine if any pesticides or herbicides were present. Two composite soil samples, one from each berm, were collected. The composite samples consisted of six sample locations on each berm, for a total of 12 samples collected. Soil samples were sent to an offsite laboratory for analysis. Neither pesticides nor herbicides were detected in the soils; therefore, remedial action was not required (DOE-RL 1994d).

1.1.4.17 Acid Neutralization Pit. This site is a concrete drainage pit filled with soil and gravel and covered with vegetation (Figure 9). The pit is approximately 12 by 1.5 m. Jet propellant (JP-4) from a nearby refueling area is thought to have drained into the pit (DOE-RL 1994d).

Geophysical and soil-gas surveys were not performed. Soil sampling was conducted in June 1994 to determine if any metals or petroleum hydrocarbons were present. Samples were screened for TPH using an onsite laboratory, and metal were analyzed off site. Petroleum hydrocarbons and metals were not detected from the soil samples; therefore, remedial action was not required (DOE-RL 1994d).

1.1.4.18 Missile Assembly and Test Building (6652-0) Inactive Septic System. The 6652-0 Building, which is connected to the septic system, was the location of the electrical parts cleaning operation (Figure 9). The estimated area covered by the septic system field is 30 by 3 m. A 3,785-L septic tank is associated with this system (DOE-RL 1994d).

A geophysical survey was conducted in June 1994 to locate the septic tank and associated drain field. A utility location survey was also conducted to locate an underground cable northwest of the tank-like object. The interpreted locations of the septic tank, drainfield, and detected utilities were used to guide the location of soil-gas probes. A soil-gas survey was conducted in June 1994 to determine if any VOCs were present. Samples were submitted to an onsite laboratory for VOC analysis (DOE-RL 1994d). PCE was the only hazardous substance detected (estimated concentration 0.4 mg/kg). Because only a trace amount of PCE was detected from the soil-gas survey, additional sampling was not conducted and remedial action was not required (DOE-RL 1994d).

1.1.4.19 Missile Maintenance and Assembly Area Acid Storage Shed. Investigations identified discolored soil and stressed vegetation in the area of this 5 by 5-m shed (Figure 9). In addition, a drainage ditch that runs near the shed was observed to contain discolored soil.

Geophysical and soil-gas surveys were not conducted. One sample was collected from the eastside of the storage site and analyzed for SVOCs, VOCs, metals, and PCBs. The sample was submitted to an onsite laboratory for VOC analysis and PCB screening, and to an offsite laboratory for SVOC and metals analysis. Because VOCs, SVOC, metals, and PCBs were not found in the soil, remedial action was not required (DOE-RL 1994d).

1.1.4.20 JP-4 Fuel Pad. This site was identified as a 3 by 3-m concrete pad, where fueling operations took place (Figure 9). No evidence of spills or staining was observed on the pad. Based on past use of the pad, potential contaminants included petroleum hydrocarbons (DOE-RL 1994d).

Geophysical and soil-gas surveys were not conducted. Soil sampling was conducted in June 1994 to determine if any petroleum hydrocarbons were present. Two soil samples were collected: one on the northwest and the other on the southeast side of the fuel pad. The samples were submitted to an onsite laboratory for TPH screening. Because TPH was not detected in the soil samples, remedial action was not required (DOE-RL 1994d).

1.1.4.21 Missile Bunker Drainfield. The estimated area covered by this drainfield is approximately 5 by 15 m (Figure 9). Potential contaminants included chlorinated and nonchlorinated solvents that may have been discharged into the septic system disposal (DOE-RL 1994b).

A geophysical survey was conducted in June 1994 to locate the septic tank and associated drain field. A utility location survey was also conducted to locate an underground cable. The interpreted locations of the septic tank, drain field, and detected utilities were used to determine locations of soil-gas sampling. Two soil-gas samples were collected in June 1994 and submitted to an onsite laboratory for VOC analysis. Because VOCs were not detected in soil-gas samples, soil samples were not collected, and remedial action was not required (DOE-RL 1994d).

1.1.4.22 Missile Bunker Discharge Ditch. This site is comprised of three discharge pipes that originate from the missile bunkers (Figure 9). Two of these discharge pipes were thought to connect to the missile bunker sumps and are buried. The third pipe has been seen discharging liquid and was thought to connect to a water tank located on the south bunker berm.

A geophysical survey was conducted in June 1994 to locate two discharge ditches at the end points of two clay discharge pipes east of the missile bunker. A utility location survey was also performed to locate the underground utilities. A soil-gas survey was not performed. Soil sampling was conducted at the discharge pipes in July 1994 to determine if any SVOCs, VOCs, metals, or PCBs were present. Four soil samples were collected, one from each discharge pipe area and one from the northern discharge pipe. The samples were submitted to an onsite laboratory for VOC analysis and to an offsite laboratory for SVOC and metals analysis. PCB screening was performed on site using a field test kit. VOCs, SVOCs, and metals were not detected. PCBs were detected in two of the soil samples in concentrations ranging from >1 ppm to <10 ppm. Confirmatory PCB sample analysis was performed by an offsite laboratory. Because the confirmatory analysis did not detect PCBs, remedial action was not required.

1.1.4.23 H-52-L Surface Gas Tank Storage Area. Investigations identified two 1,805-L surface gasoline tanks in this area (Figure 9). Interviews with former site employees indicated that this area was also used to clean paint brushes and other items (DOE-RL 1994b).

A geophysical survey was conducted in July 1994 to locate any underground utilities before intrusive sampling; underground utilities were not detected. Soil-gas surveys were conducted in June and July 1994 to determine if any VOCs were present. Three soil-gas samples were collected and submitted to an onsite laboratory for analysis of select VOCs. Because VOCs were not detected from the soil-gas surveys, soil samples were not collected and remedial action was not required (DOE-RL 1994d).

1.1.4.24 Horseshoe Landfill Site. This site is an inactive landfill located 183 m northwest of the missile bunker area beyond the missile bunker landfill (Figure 10). This site was identified as a possible waste-management unit because of debris observed at the surface. This site is approximately 2.79 hectares

A geophysical survey was conducted in July 1994 to identify the extent of the landfill and locate debris. The geophysical survey results were used to determine the location of soil-gas sampling and geophysical anomalies. A soil-gas survey was conducted in July 1994 to determine if VOCs were present. Fifty-two soil-gas samples were collected and submitted to an onsite laboratory (DOE-RL 1994d). Based on findings from similar landfills on the North Slope of the Hanford Site, EPA and Ecology required limited additional characterization of the landfill.

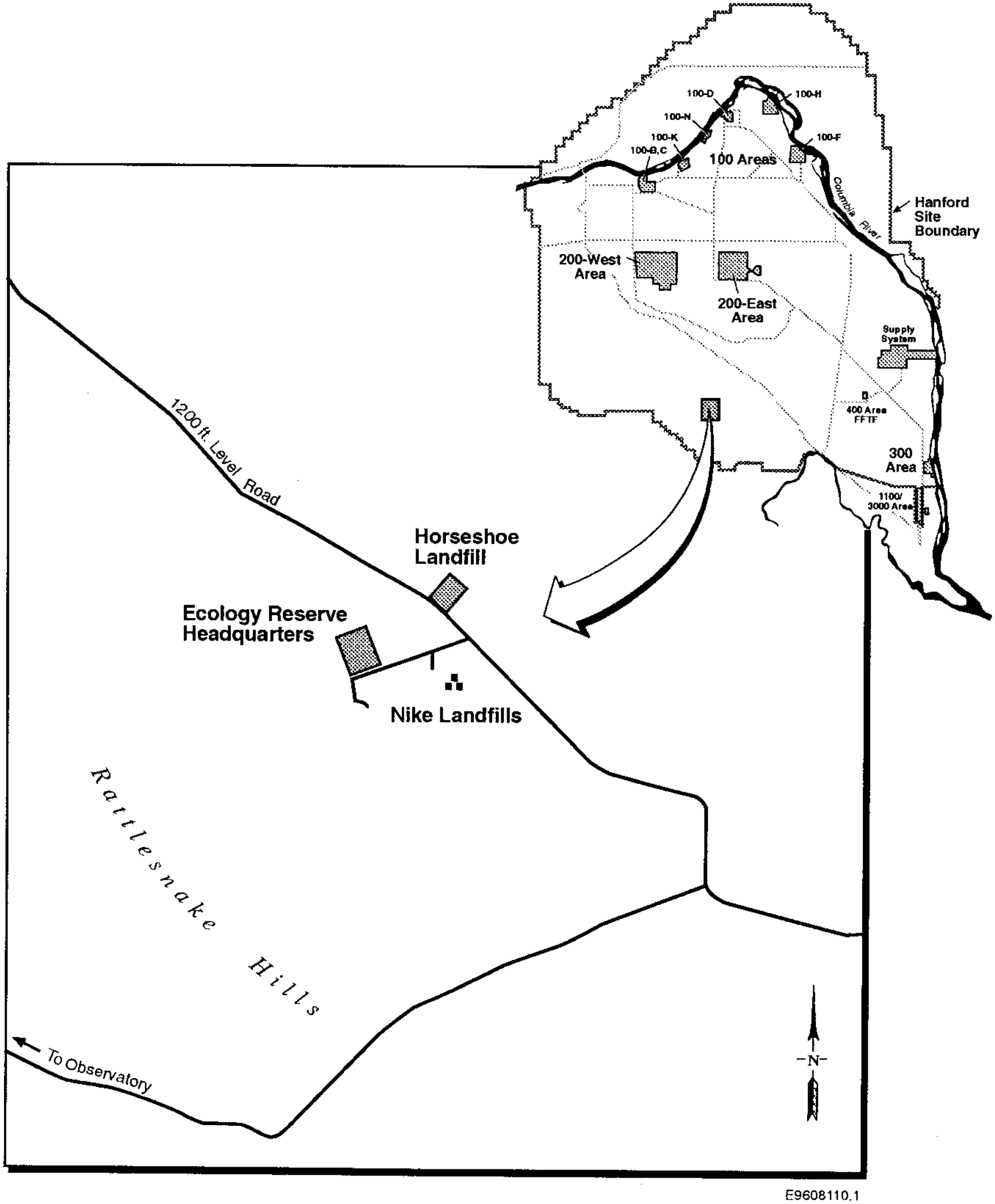
Six anomalies were excavated at the Horseshoe Landfill. Activities consisted of field screening of buried waste, sampling and analysis of suspect waste, and segregation of confirmed hazardous or contaminated materials. Waste was field screened using several criteria, including visual observation, direct-reading instruments, and analyte-specific field analysis kits. Suspect waste was sampled and characterized by an offsite laboratory. Soil and wastes were analyzed for VOCs, SVOCs, pesticides, PCBs, the eight RCRA metals, and TPH. Eighteen soil/debris samples (including three duplicate samples) and one aqueous sample (trip blank) were collected. The aqueous sample was analyzed for VOCs.

Anomalies 1, 2, and 3 were all medium anomalies with no evidence of buried wastes. A single composite soil sample was collected from the base of the excavated trenches, and no contaminants above cleanup levels were detected. DDT, DDD, and DDE concentrations were nondetect (ND), <1 ppm (9.00 ppb), and <1 ppm (6.60 ppb), respectively (DOE-RL 1994c; CDM 1995b).

Anomalies 4 and 5 were medium and medium/high, respectively. The single trench in anomaly 4 uncovered rusted metal debris, car parts, and seven empty 209-L drums that were ripped open and partially collapsed. Two trenches were excavated in anomaly 5 that uncovered bottles, a few pieces of rusted metal, and a few animal bones. A single composite soil sample was collected from the base of the excavations in the two anomalies. No contaminants were detected above cleanup levels. DDT, DDD, and DDE concentrations were ND, <1 ppm (6.07 ppb), and ND, respectively (DOE-RL 1994c; CDM 1995b).

Five trenches were excavated from anomaly 6. The first three trenches showed no evidence of buried wastes or disturbed soil on the west side of the anomaly, except for copper grounding wire. Sheet metal scrap, fence posts, wood debris, and a washtub were excavated from the fourth trench. Cable, cement blocks, scrap metal, three ripped and partially collapsed 209-L drums, plastic and metal parts, and four 25.4-cm battery-type containers with screens were excavated from the fifth trench.

Figure 10. Horseshoe and Nike Landfills.



While excavating anomaly 6, the crew noted an insecticide-like odor from one of the excavated soil piles. Four soil samples from the pile all indicated DDT concentrations greater than 10 ppm from field test kits. A grab soil sample was collected from the area of the highest DDT reading from the field screen. An offsite laboratory analyzed the grab sample; DDT, DDD, and DDE concentrations were 945, 360, and 27 ppm, respectively. Five more soil samples were taken from the other excavated soil piles. These samples were screened using test kits, with all five samples indicating DDT greater than 10 ppm. These levels exceeded Ecology's established action levels of 1 ppm to remove DDT-contaminated soil.

Soil excavation and field screening continued. The trench was then split into four sections, and four composite soil samples were taken from the four trench sections. In addition, two grab samples were taken from the trench where field test kits indicated DDT greater than 10 ppm, and three composite samples were collected from the excavated soil piles. All samples were sent to an offsite laboratory for analysis.

DDT concentrations were <1 ppm in all four composite samples (DOE-RL 1994d). However, the grab samples ranged from 4.7 to 34.1 ppm. After further excavation of the A6 anomaly, three final soil samples were collected with DDT concentrations of <1 ppm, <1 ppm, and 1.7 ppm. All three samples had DDE and DDD concentrations of <1 ppm (CDM 1995b). Excavations were backfilled and compacted using clean fill and graded to original conditions. Approximately 1,836 m^3 of soil were shipped off site to a hazardous waste landfill (CDM 1995b).

From November 1995 to December 1995, the site was revegetated by transplanting bunchgrasses from other ALE locations. The revegetated area of the landfill measures approximately 35 by 70 m. The exceptionally wet year of 1995 allowed backfilled sagebrush seeds to grow and become established. Vegetation growth on the landfill was measured for percent canopy cover and percent frequency in June 1996 and 1997. The survival of transplanted bunchgrasses has been good with 68% survival in 1997 and a canopy cover of 3.7%. The canopy coverage of the volunteer sagebrush was 5.5% (Gano et al. 1997).

1.1.4.25 Elevator Doors. This site consists of elevator doors in the north and south missile bunkers (Figure 9). Included in this area are two 4 by 10-m launch pads and the elevator doors. A tar-like sealant that may contain PCBs was observed around the launch pads and elevator doors (DOE-RL 1994d).

Geophysical and soil-gas surveys were not conducted. PCB wipe samples were taken from the northern elevator door concrete firing area sealant and the northern elevator door hydraulic line in July 1994. Samples were submitted to an onsite laboratory for PCB screening (DOE-RL 1994d). PCBs were detected from the wipe samples at the missile bunker elevator door hydraulic line. The PCB Aroclor-1254 was present at a concentration of 330 μg/wipe. PCBs were the only hazardous substances detected, but no PCBs were released to the environment.

The elevated PCB concentrations confirmed that remedial action was needed. "The first action should be to submit samples of the PCB containing fluids for analysis before the appropriate remedial action is decided. Remedial action should include removal and disposal of any

PCB-contaminated fluids and decontamination surfaces to less than the EPA required cleanup level of 10 μg/100 cm^2 wipe" (DOE-RL 1994d). Remedial action has not yet been performed since it was planned to occur during the decommissioning of the missile bunkers (pers. comm. Randy Chong 12/97).

1.1.4.26 Flammable Storage Block Shed. The storage block shed is located where the former Missile Maintenance and Assembly Area Paint Shed was located (Figure 9). Discolored soil and stressed vegetation have been observed around this shed. A utility location survey was conducted in June 1994 to locate any underground utilities before sampling. Underground cables and pipes were not detected, and a soil-gas survey was not performed. Soil sampling was conducted in June 1994 to determine if any SVOCs, VOCs, metals, or PCBs were present. Four soil samples were collected from two hand-augered borings. Soil samples were submitted to an onsite laboratory for VOC analysis and PCB screening, and to an offsite laboratory for SVOC and metals analysis (DOE-RL 1994d). Contaminants were not detected in the samples; therefore, remediation was not required.

1.1.4.27 Missile Maintenance and Assembly Area Paint Shed. This 3 by 3-m shed was removed and may have been replaced with the Flammable Storage Block Shed (Figure 9). No visible stains, stressed vegetation, and discolored soils were observed in the area (DOE-RL 1994b).

1.1.4.28 Missile Maintenance and Assemble Area Dry Well Drum. A 209-L (55-gal) drum was observed buried in the ground (Figure 9). Another 209-L drum, labeled "Dry Cleaning Solution" was observed laying on its side near the buried drum. This area is about 1.5 by 1.5 m, with scarce vegetation.

Geophysical and soil-gas sampling were not conducted. Soil sampling was conducted in June and July 1994 to determine if any VOCs were present. Three samples were collected: one inside and two outside the dry well drum. Soil samples were submitted to an on-site laboratory for VOC analysis. Because VOCs were not detected, remedial action was not required.

1.1.4.29 H-52-L Nike Base Landfill. This site is an inactive landfill located approximately 91 m southeast of the main missile base (Figure 10). Interviews with former site personnel have indicated that everything used in base operations was disposed in a landfill close to the base. Various types of debris were observed at the surface. Areas of discolored soil and stressed vegetation have also been observed on the surface of the landfill. The site is approximately 1.86 hectares. Potential contaminants included solvents (chlorinated and nonchlorinated), discarded missile fuel (which contains refuming nitric acid, aniline, furfuryl alcohol, JP-3/JP-4, and hydrazine), petroleum hydrocarbons (fuels, waste oil, hydraulic fluid), acids, and metals (DOE-RL 1994d).

A geophysical survey was conducted in July 1994 to identify the extent of the landfill and locate concentrations of debris. The geophysical survey results were used to guide the location of soil-gas sampling. A soil-gas survey was conducted in July 1994 to determine if VOCs were present at the site. Thirty-three soil-gas samples were submitted to an onsite laboratory for VOC analysis. VOCs were not found in the soil-gas samples (DOE-RL 1994d). Three geophysical anomaly sites were excavated in August 1994. The waste inventory removed from the site included concrete blocks, bottles, wood, and metal debris.

One composite soil sample was collected from the base of the three anomalies. An aliquot was taken from each anomaly except for the VOC sample, which was taken from anomaly 1. The one soil sample was analyzed for VOCs, SVOCs, pesticides/PCBs, eight RCRA metals, and TPH. The one aqueous sample was analyzed for SVOCs, pesticides/PCBs, eight RCRA metals, and TPH (DOE-RL 1994c). The samples were sent to a USACE certified laboratory (Environmental Science and Engineering) for analysis and reporting according to EPA QC Level III data. The composite soil sample had DDT, DDD, and DDE concentrations of <1 ppm (4.24 ppb), ND, and <1 ppm (1.89 ppb), respectively. The aqueous sample had DDT, DDD, and DDE concentrations of 3.84 ppb, 1.38 ppb, and <0.026 ppb, respectively (CDM 1995b).

Revegetation work at the three excavated sites was conducted in November and December 1995. The sites, which were revegetated with bunchgrass, measure approximately 6 by 9 m, 4 by 9 m, and 4 by 23 m. In June 1996 and 1997, the survival of the bunchgrasses was measured and ranged from 61.4 to 88.2% in 1996 (Henckel 1996).

1.1.4.30 Gravel Driveway Area. This site was identified during investigations at the H-52-C Surface Gas Tank Area (Figure 8) and is approximately 76 m south of the 6652-C Building. Asphalt-like material, mixed with limestone gravel, was observed at this site. The potential contaminant was TPH.

Geophysical and soil-gas surveys were not conducted. A surface sample of degrading asphalt was collected in July 1994 to determine if any petroleum hydrocarbons were present in the asphalt. The sample was analyzed using an immunoassay field test kit. Because significant levels of TPH were not detected, remedial action was not required (DOE-RL 1994d).

1.2 Summary of the Hazardous Substances Released

Table 3 summarizes all of the hazardous substances released in the 1100 Area above background concentrations. The table also includes information on the concentrations of the releases, the cleanup levels, post-cleanup residual concentrations of the releases, and an estimate of the excavated soil volumes.

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