Environmental Restoration Program
Final Record of Decision

142nd Fighter Wing
Portland Air National Guard Station
Portland International Airport
Portland, Oregon

January 2004

Air National Guard
Andrews AFB, Maryland

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Prepared For:

Air National Guard
Andrews AFB, Maryland
Contract No. GS-10F-0225L
Client Order 9T1N080PG

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LIST OF ACRONYMS/ABBREVIATIONS

Acronym/ Abbreviation	Definition
ANG	Air National Guard
ANGB	Air National Guard Base
ARAR	Applicable or relevant and appropriate requirement
AST	Aboveground storage tank
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of concern
CRSA	Columbia River Sand Aquifer
CSM	Conceptual site model
DNAPL	Dense non-aqueous phase liquid
ERM	Environmental Resources Management
ERP	Environmental Restoration Program
FS	Feasibility Study
FW	Fighter Wing
IRA	Interim remedial action
µg/L	Micrograms per liter
MNA	Monitored natural attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	Operation and maintenance
OAR	Oregon Administrative Rules
ODEQ	Oregon Department of Environmental Quality
PA	Preliminary Assessment
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PIA	Portland International Airport
POL	Petroleum, oil, and lubricants
RAB	Restoration Advisory Board
RAO	Remedial action objective
RI	Remedial Investigation
ROD	Record of Decision
SVE	Soil vapor extraction
SVOC	Semivolatile organic compound
TCE	Trichloroethene
TMV	Toxicity, mobility, or volume
TPH	Total petroleum hydrocarbons

LIST OF ACRONYMS/ABBREVIATIONS

Acronym/ Abbreviation	Definition
U.S.	United States
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
VOC	Volatile organic compound

SECTION 1.0

DECLARATION

1.1 Site Name and Location

Portland Air National Guard Base (Portland ANGB), 6801 NE Cornfoot Road, Portland, Oregon.

1.2 Statement of Basis and Purpose

This decision document presents the Selected Remedies for areas of the Portland ANGB that present unacceptable risks to human health or the environment due to past releases of hazardous substances at the Base. The remedies were chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (as amended by the Superfund Amendments and Reauthorization Act of 1986), the Oregon Environmental Cleanup Law of 1987, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for the Portland ANGB.

The Oregon Department of Environmental Quality (ODEQ) concurs with the Selected Remedies.

1.3 Assessment of Site

The response actions selected in this Record of Decision (ROD) are necessary to protect the public health or welfare or the environment from past releases of hazardous substances into the environment.

1.4 Description of Selected Remedies

Based on human health and ecological risk assessments conducted at the Portland ANGB, six sites have been identified as having hazardous substances present in groundwater or sediment at concentrations that pose unacceptable risks to human health or the environment (ERM 2001a, 2002a). These sites are designated as Environmental Restoration Program (ERP) Sites 1, 2, 3, 4, 9, and 11. Four other sites that were investigated, ERP Sites 5, 7, 8, and 10, were determined to pose no unacceptable risks (ERM 2001a). Response actions will be implemented at ERP Sites 2, 4, 9, and 11. Groundwater contamination at ERP Sites 1 and 3 will be addressed as part of the ERP Site 2 remedy, as Site 2 is the presumed source of the groundwater contamination at Sites 1 and 3. No further action is recommended at ERP Sites 5, 7, 8, and 10.

The Selected Remedies for the Portland ANGB ERP sites are:

- ERP Site 1 (Central Hazardous Waste Storage Area): In Situ Oxidation – Potassium Permanganate Injection with Monitored Natural Attenuation (MNA) (Site 1 will be addressed as part of the Site 2 remedy);
- ERP Site 2 (Civil Engineering Hazardous Material Storage Area): In Situ Oxidation – Potassium Permanganate Injection with MNA;
- ERP Site 3 (Hush House Area): In Situ Oxidation – Potassium Permanganate Injection with MNA (Site 3 will be addressed as part of the Site 2 remedy);
- ERP Site 4 (Main Drainage Ditch): Ditch Filling/Sediment Capping;
- ERP Site 5 (Aerospace Ground Equipment Maintenance Shop): No Further Action;
- ERP Site 7 (Burn Pit Area): No Further Action;
- ERP Site 8 (Sanitary Landfill): No Further Action;
- ERP Site 9 (Petroleum, Oil, and Lubricants Facility): In Situ Oxidation – Sodium Persulfate Injection with MNA;
- ERP Site 10 (Equipment Washrack): No Further Action; and

- ERP Site 11 (Washrack West of Building 250): In Situ Oxidation – Potassium Permanganate Injection with MNA.

The remedy for ERP Sites 2, 9, and 11 utilizes in situ chemical oxidation and MNA to treat dissolved volatile organic compounds (VOCs) in groundwater. The contaminants of concern (COCs) at Sites 1, 2, 3, and 11 consist of chlorinated VOCs such as trichloroethene (TCE), 1,2-dichloroethane, cis-1,2-dichloroethene, and vinyl chloride. The primary COC at Site 9 is benzene, although isolated detections of polynuclear aromatic hydrocarbons (PAHs) have also been reported at trace levels that exceed acceptable risk-based concentrations. The major components of the remedy for ERP Sites 2, 9, and 11 include:

- Injecting an aqueous solution of potassium permanganate (Sites 2 and 11) or sodium persulfate (Site 9) through the lateral and vertical extent of groundwater impacted by COC concentrations exceeding ODEQ hot spot criteria; and

- Monitoring concentrations of COCs and natural attenuation parameters in groundwater to verify compliance with site-specific remedial action objectives (RAOs).

The remedy for ERP Site 4 (Main Drainage Ditch) utilizes ditch filling/sediment capping to eliminate potential ecological risks posed by COCs identified in ditch sediments (primarily metals, PAHs, and polychlorinated biphenyls [PCBs]). Unlike the remedy for ERP Sites 2, 9, and 11, the Site 4 remedy was not selected through the normal remedy selection process. As discussed in Sections 1.6 and 2.12.2, the Site 4 remedy is a byproduct of a planned stormwater improvement project at the Base.

Upon successful completion of the response actions at ERP Sites 2, 4, 9, and 11, the Air National Guard (ANG) will seek a No Further Action decision from the ODEQ for the Portland ANGB.

1.5 Statutory Determinations

The Selected Remedies for ERP Sites 2, 4, 9, and 11 are protective of human health and the environment, comply with Federal and State requirements that are applicable or relevant and appropriate to the response actions, are cost-effective, and utilize permanent solutions to the maximum extent practicable. In addition, the remedy for ERP Sites 2, 9,

and 11 utilizes alternative treatment technologies to the maximum extent practicable, and satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume [TMV] of hazardous substances as a principal element through treatment).

The Selected Remedy for ERP Sites 2, 9, and 11 is not expected to result in hazardous substances remaining in groundwater above levels that allow for unlimited use and unrestricted exposure. However, it may take longer than 5 years to achieve target cleanup levels and meet site RAOs. Therefore, a policy review may be conducted within 5 years of construction completion to ensure that the remedy for ERP Sites 2, 9, and 11 is, or will be, protective of human health and the environment.

1.6 ROD Data Certification Checklist

The following information is included in the Decision Summary section of this ROD (Section 2.0). Additional information can be found in the Administrative Record for the Portland ANGB.

- COCs and their respective concentrations;
- Baseline risks represented by the COCs;
- Cleanup levels established for the COCs and the basis for these levels;
- How source materials constituting principal threats are addressed;
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD;
- Potential land and groundwater use that will be available at the Base as a result of the Selected Remedies;
- Cost estimates for implementing the Selected Remedies (ERP Sites 2, 9, and 11 only – see below); and
- Key factors that led to selecting the remedies.

The Portland ANGB intends to install stormwater drainage piping and clean fill material in the Main Drainage Ditch (ERP Site 4) in fiscal year 2005 as part of a facility stormwater improvement project. This action will

eliminate potential ecological risks posed by contaminants in the ditch sediments. The work will be paid for with both Base O&M and ERP funds; however, the project will be contracted and managed by the Base rather than the ANG ERP Branch. Consequently, cost estimates for the ditch filling project were not developed as part of the ERP and are not included in this ROD.

1.7 Authorizing Signature

The signature below indicates the ANG's authorization of this ROD.

DAVID C. VAN GASBECK
Chief, Environmental Division
Civil Engineer Directorate

7 Jan 04
Date

SECTION 2.0

DECISION SUMMARY

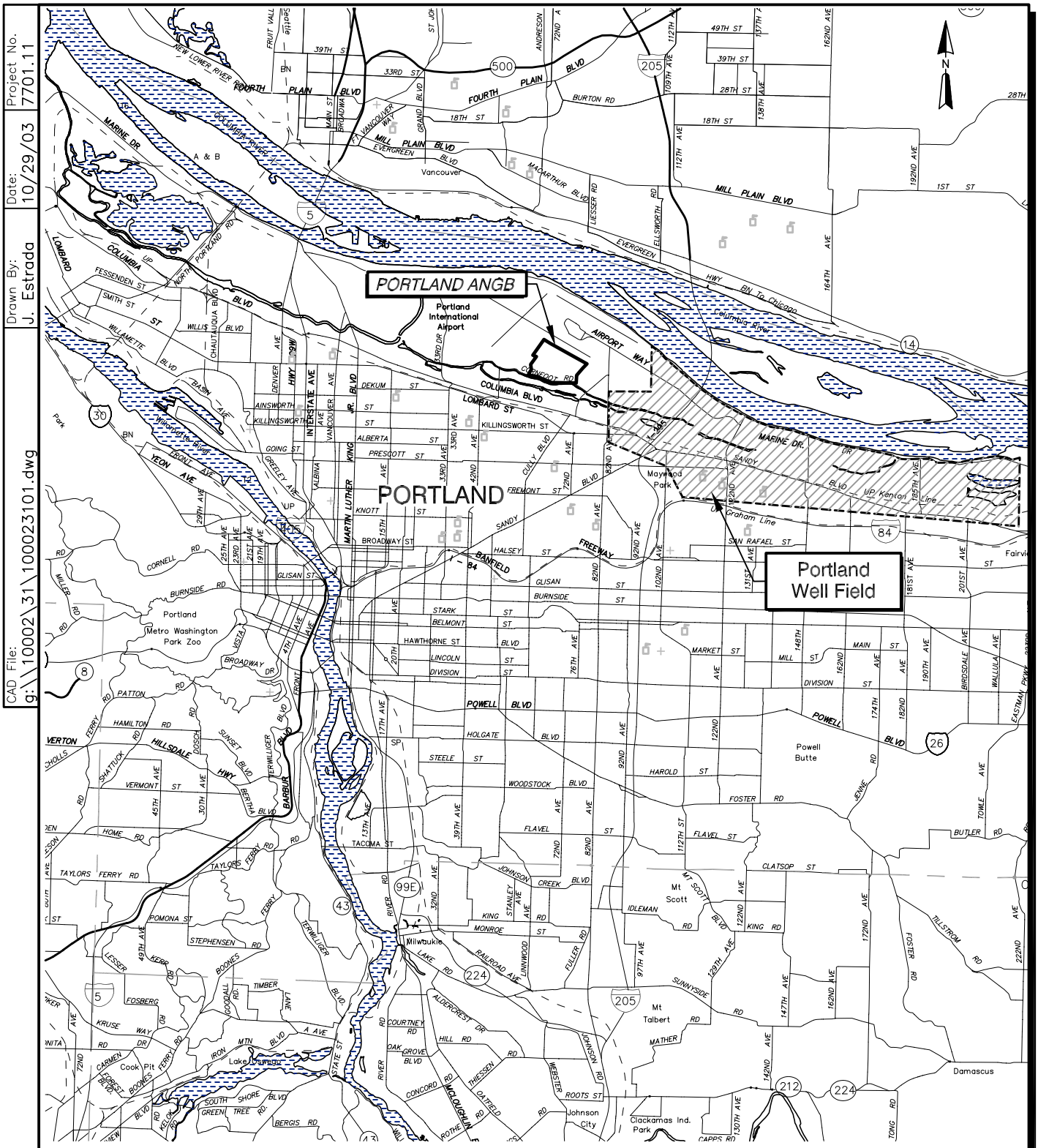
This section provides an overview of the site characteristics, the remedial alternatives evaluated, and the analysis of those alternatives. It also identifies the Selected Remedies and explains how the remedies fulfill statutory and regulatory requirements.

2.1 Site Name, Location, and Description

The Portland ANGB is located at 6801 NE Cornfoot Road in Portland, Oregon. The Base occupies approximately 245 acres immediately south of the Portland International Airport (PIA), between the Columbia River to the north and the Columbia Slough to the south (Figure 2-1). The ANG leases the Base property from the Port of Portland.

The Portland ANGB is the home of the Oregon ANG 142nd Fighter Wing (FW). The 142nd FW is an active unit with a full-time contingent of F-15 fighter planes, crews, and support units, including active-duty ANG personnel. The Base facility comprises flight aprons and taxiways, paved roads, and approximately 72 buildings used for operations support and maintenance. The major support operations at the Portland ANGB that use and dispose of hazardous substances include aircraft, vehicle, and equipment maintenance; facilities maintenance; and petroleum, oil, and lubricants (POL) management. These activities generate varying quantities of waste oils, recovered fuels, and spent cleaners, solvents, and acids.

A map of the Base showing the locations of the sites investigated as part of the ERP is shown in Figure 2-2. The ERP site boundaries shown in Figure 2-2 were established early in the investigation based on the locations of historical facilities and/or activities that were known or suspected to have released hazardous substances to the environment. These site boundaries do not represent the extent of contamination delineated during the Remedial Investigation (RI).



Source: Portland Air National Guard Base Masterplan, May 1997

Figure 2-1

Location of Portland Air National Guard Base

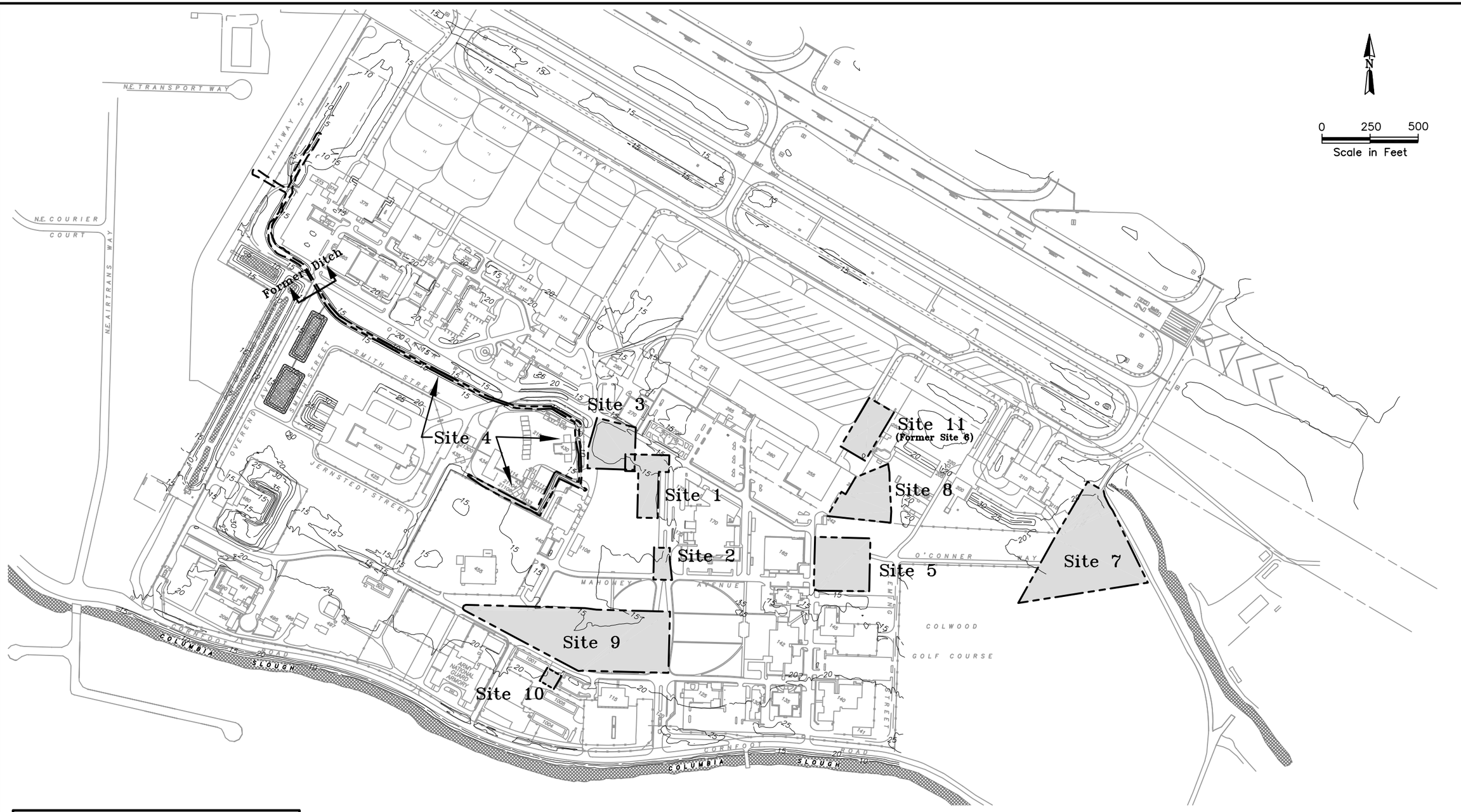
142nd FW, Portland ANGB

Portland International Airport

Portland, Oregon

ERM 10/03

CAD File: G:_10002_31_100023102.dwg
Drawn By: J. Estrada
Date: 10/29/03
Project No. 10002.31



LEGEND

- ERP Site Boundary
- 270 Building ID
- 15 Ground Surface Elevation Contour (ft amsl)

Figure 2-2
ERP Site Location Map
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon

ERM 10/03

The lead agency for the cleanup activities at the Portland ANGB is the ANG; the support agency is the ODEQ. The ANG is performing the work as a voluntary cleanup with ODEQ oversight. The work is part of the ANG's ERP, and is funded by the National Guard Bureau. Currently, the Port of Portland is paying ODEQ's oversight costs.

2.2 Site History and Enforcement Activities

This section discusses site development and waste disposal history, previous investigations, and regulatory enforcement actions.

2.2.1 Site Development History

Development of the Portland ANGB site began in 1936 with the placement of a large quantity of dredge material as fill. Additional filling of land occurred in 1970. The 142nd FW began operations at the Base in 1941, and the facility operated as an Army Air Corps Base until 1945. In approximately 1947, the Base was converted to an ANG facility and in 1950 it was converted to a United States Air Force Base. Control of the Base reverted to the ANG in 1964, and the Base has maintained this status to the present time.

2.2.2 Waste Disposal History

This section summarizes the waste disposal histories of the sites where response actions will be implemented: ERP Sites 2, 4, 9, and 11. Historical information for the ERP sites where no further action is planned (i.e., Sites 5, 7, 8, and 10) is provided in the Final RI Report (ERM 2001a).

2.2.2.1 ERP Site 2 - Civil Engineering Hazardous Material Storage Area

ERP Site 2 is the former Civil Engineering Hazardous Material Storage Area. The site includes the former locations of a solvent storage shed and a paint storage building. Drums containing solvents, degreasers, and paint thinners were stored on wooden pallets and drum cradles in or near the solvent storage shed; paint was stored in the paint storage building. There are no historical records of waste disposal activities at Site 2.

2.2.2.2 ERP Site 4 - Main Drainage Ditch

ERP Site 4 is the Main Drainage Ditch, a linear constructed channel that originates in the central portion of the Portland ANGB, south of the jet fuel storage area (Figure 2-2). The ANG has defined ERP Site 4 as the aquatic portion of the channel. This portion of the channel is roughly 8 feet wide and 10 feet deep with steep banks, and encompasses approximately 76,250 square feet (1.8 acre). The Main Drainage Ditch receives stormwater runoff from most areas of the Base and conveys it to two retention ponds at the western end of the ditch. Water in the retention ponds is pumped into a nearby Port of Portland stormwater drainage channel that discharges to the Columbia Slough.

During initial field surveillance activities and sampling in the late 1980s, petroleum hydrocarbons were reportedly observed in the Main Drainage Ditch downstream of a flight apron area drain outfall. Accidental spills, indirect discharge, and wash water containing residual contaminants from adjacent facilities may have impacted the ditch in the past. There are no records of wastes being intentionally disposed of in the ditch.

2.2.2.3 ERP Site 9 - Petroleum, Oil, and Lubricants Facility

ERP Site 9 is the former POL Facility. The site contained twelve 25,000-gallon jet fuel underground storage tanks (USTs), one waste oil UST, two diesel aboveground storage tanks (ASTs), and dispensing stations. Refueler trucks were used to transfer fuel from the POL Facility to the flight apron area. The 13 USTs were removed in March 1994. The diesel ASTs and dispensing stations were removed prior to the RI.

There are no records of historical waste disposal or storage activities at ERP Site 9. During site construction activities in 1991, ANG personnel discovered petroleum contamination in soil at the site. Fuel inventories and tank tightness tests did not indicate leaks in the tanks or associated piping.

2.2.2.4 ERP Site 11 - Washrack West of Building 250

ERP Site 11 is the former Washrack West of Building 250. The washrack consisted of a 60-foot by 80-foot concrete pad and an oil/water separator, and was used for washing aircraft. Solvents and degreasers were sometimes applied to the aircraft before they were washed with a soap and water mixture. The ANG removed the washrack and oil/water separator in September 1999 as part of a non-time-critical removal action.

The oil/water separator was a three-stage, concrete, gravity-type separator. It discharged to the storm sewer prior to 1984 and to the sanitary sewer after 1984. The separator was removed from service in 1989 after cracks were discovered in the center stage.

2.2.3 Previous Investigations

ERP investigations were initiated at the Portland ANGB in 1987. The purpose of these investigations was to: (1) determine whether contamination is present in soil, sediment, groundwater, and/or surface water as a result of past hazardous material handling and disposal practices; (2) characterize the nature and extent of contamination discovered; (3) evaluate the associated risks to human health and the environment; and (4) develop and evaluate remedial alternatives for ERP sites requiring further action to mitigate risks. Table 2-1 summarizes the major steps in the ERP process at the Portland ANGB.

The ERP investigations began with a Phase I Records Search (Preliminary Assessment [PA]) in 1987. Since the PA was completed, there have been two major site characterization phases: a Site Investigation completed in 1991, and an RI completed in 2000. The majority of the site characterization and data analysis work was completed during the RI. The RI consisted of several distinct field investigations and data evaluation studies. Each successive investigation built upon and supplemented the information obtained during previous investigations. The Final RI Report (ERM 2001a) represents the culmination of the site-characterization effort. Quarterly groundwater monitoring has been performed at the Base since January 1997.

Initial field sampling activities for the RI were completed in 1996. A draft RI report was prepared following this initial sampling effort (Operational Technologies Corporation 1996), and data gaps in the site characterization were identified. These data gaps were addressed through additional sampling performed in 1997 as part of a Remedial Investigation/Data Gap Evaluation, and in 1998 through 2000 as part of a second basewide RI phase and an Engineering Evaluation/Cost Analysis (EE/CA) for ERP Site 11. The initial RI work that was completed in 1996 was subsequently designated as the Phase I RI; the RI work conducted between 1998 and 2000 is known as the Phase II RI.

The Phase II RI field work was completed in two stages. The first stage was conducted between January and April 1998. Several data gaps were identified after the first stage was completed. These data gaps were

TABLE 2-1

Major Steps in Environmental Restoration Program Process
142nd FW, Portland ANGB, Portland, Oregon

Preliminary Assessment 1987	Site Investigation 1989-1991	Phase I RI 1995-1996	RI/DGE 1997	Site 11 Soil EE/CA and IRA 1998-2000	Phase II RI and Site 4 Ecological Risk Assessment 1998-2002
Objective: Identify potentially contaminated sites based on a review of existing information.	**Objective:** Determine whether contamination is present in soil, groundwater, sediment, and/or surface water at the ERP sites identified during the Preliminary Assessment.	**Objective:** Characterize the nature and extent of contamination at ERP Sites 1 through 5 and 7 through 11. Evaluate risks to human health and the environment.	**Objective:** Address selected data gaps identified as the result of the Phase I RI, including contaminant distribution and site hydrogeology. Determine the extent of further investigation needed to address remaining data gaps during a second RI phase.	**Objective:** Characterize and remediate contaminated soil in the ERP Site 11 source area to reduce human health risks and leaching of contaminants to groundwater.	**Objective:** Complete the characterization of contaminated sites and the evaluation of risks. Develop recommendations for addressing sites that pose unacceptable risks.
Scope: Interviewed past and present Base employees, reviewed information regarding hazardous materials handling and disposal practices, and evaluated available information on site conditions.	**Scope:** Investigation at ERP Sites 1, 2, 3, 5, 7, and 8 included one or more of the following: geophysical surveying, soil gas sampling, soil sampling (test pits and borings), and groundwater monitoring well installation/ sampling. Sediment samples were collected at ERP Site 4. Background soil samples were also collected. ERP Site 9 was not investigated.	**Scope:** Investigation at ERP Sites 1, 2, 3, 5, and 7 through 11 included one or more of the following: geophysical surveying, soil gas sampling, surface and subsurface soil sampling, direct-push groundwater sampling, and groundwater monitoring well installation/ sampling. Sediment and surface water samples were collected at ERP Site 4. Additionally, background soil and groundwater samples were collected, aquifer slug tests were performed, and human health and ecological risks were evaluated.	**Scope:** Investigation at ERP Sites 1, 2, 5, 7, 11, and background locations included one or more of the following: subsurface soil sampling, direct-push groundwater sampling, and groundwater monitoring well installation/sampling.	**Scope:** Collected direct-push soil and groundwater samples at ERP Site 11 to delineate the extent of soil contamination in the area of the former washrack and oil/water separator. Excavated contaminated soil above the water table as part of a non-time-critical removal action. Collected confirmation soil samples from the excavation limits and restored the site.	**Scope:** Investigation at ERP Sites 1, 2, 3, 5, 7, 9, 10, 11, and background locations included one or more of the following: surface and subsurface soil sampling, direct-push groundwater sampling, and groundwater monitoring well installation/ sampling. Sediment and surface water samples were collected at ERP Site 4. Additional tasks included risk assessment, aquifer testing, a natural attenuation evaluation, groundwater flow modeling, and a pilot test of in-well aeration technology for groundwater treatment.
Results: ERP Sites 1 through 8 were established. No Further Action was recommended for ERP Site 6.	**Results:** Contamination above applicable regulatory levels was confirmed at ERP Sites 2, 4, and 5. Contaminants also were detected at ERP Sites 1, 3, and 7. Geophysical anomalies, possibly indicating disturbed soil, were detected at ERP Site 8; no samples were collected at Site 8.	**Results:** A preliminary site characterization (nature and extent of contamination) was developed for ERP Sites 1 through 5, 7, 9, 10, and 11. Unacceptable risks were identified at several ERP sites. No Further Action was recommended for soil and groundwater at ERP Site 8 and for groundwater at ERP Site 10.	**Results:** Contaminants were detected above project screening goals at ERP Sites 1, 2, and 11. Areas requiring additional investigation to define the extent of contamination were identified. A conceptual model of the relationship between water-bearing zones at the site was established.	**Results:** Approximately 260 cubic yards of soil containing VOCs and petroleum compounds were removed in September 1999 and treated off site by thermal desorption. Confirmation samples indicate contamination remains in soil at the excavation limits. SVE piping was installed in the excavation backfill material to address this residual contamination.	**Results:** Unacceptable human health risks were identified at ERP Sites 1, 2, 3, 9, and 11. The unacceptable risks are primarily due to VOC contamination in groundwater. An FS was recommended to establish remedial action objectives and develop remedial alternatives for these sites. Potential ecological risks were identified at ERP Site 4.
Data Gaps: Further investigation needed at ERP Sites 1, 2, 3, 4, 5, 7, and 8 to determine whether contamination is present.	**Data Gaps:** Further investigation needed at ERP Sites 1, 2, 3, 4, 5, 7, and 9 to determine the nature and extent of contamination. Sampling needed at ERP Site 8 to determine whether contamination is present in the area of the geophysical anomalies.	**Data Gaps:** Further investigation needed to define nature and extent of contamination in soil and/or groundwater at Sites 1, 2, 3, 5, 7, 9, 10, and 11. Additional surface water sampling needed at ERP Site 4. Additional site hydrogeologic characterization required.	**Data Gaps:** Further investigation needed to define nature and extent of contamination in soil and/or groundwater at Sites 1, 2, 3, 5, 7, 9, 10, and 11. Additional surface water sampling needed at ERP Site 4 to assess impacts from contaminated groundwater at Sites 1, 2, and 3. Additional site hydrogeologic characterization required.	**Data Gaps:** None identified.	**Data Gaps:** No data gaps were identified that preclude completion of an FS.
Comments: ERP Site 9 was established after a petroleum release was reported to the ODEQ in 1988.	**Comments:** Following the SI, ERP Sites 10 and 11 were established based on analytical results from samples collected by ANG personnel.	**Comments:** Plans for an RI/DGE were developed following the Phase I RI. The RI/DGE would determine the extent of further investigation needed to address data gaps during a second RI phase.	**Comments:** A Restoration Advisory Board (RAB) was established and meetings initiated.	**Comments:** The residual soil contamination at the excavation limits is a potential continuing source of groundwater contamination.	**Comments:** ODEQ entered into an agreement with the Port of Portland to review and provide comments on ERP work at the Base.

Notes:
ANG = Air National Guard
EE/CA = Engineering Evaluation/Cost Analysis
FS = Feasibility Study
IRA = Interim Remedial Action
ERP = Environmental Restoration Program
ODEQ = Oregon Department of Environmental Quality
RI = Remedial Investigation
RI/DGE = Remedial Investigation/Data Gap Evaluation
SI = Site Investigation
SVE = Soil vapor extraction
USEPA = United States Environmental Protection Agency
VOC = Volatile organic compound

TABLE 2-1

Major Steps in Environmental Restoration Program Process
142nd FW, Portland ANGB, Portland, Oregon

Feasibility Study 2000-2001	Site 2 Groundwater IRA 2000-2003	Site 11 Groundwater EE/CA and IRA 2001-Present
Objective: Develop and evaluate remedial alternatives for contaminated groundwater at ERP Sites 2, 9, and 11. Select a preferred alternative for each site based on USEPA and ODEQ evaluation criteria.	**Objective:** Conduct pilot tests and a full-scale technology demonstration of remedial technologies for reducing VOC concentrations in groundwater at ERP Site 2.	**Objective:** Develop and evaluate IRA alternatives for addressing contaminated groundwater and residual soil contamination at ERP Site 11. Select a preferred IRA, prepare remedial designs, and implement the IRA.
Scope: Remedial alternatives for addressing VOC contamination in groundwater at ERP Sites 2, 9, and 11 were developed, screened, and evaluated. The most technically appropriate and cost effective alternatives that adequately protect human health and welfare and the environment were identified.	**Scope:** Three remedial technologies (ozone sparging, enhanced aerobic bioremediation, and potassium permanganate injection) were tested to evaluate their effectiveness. Based on the pilot test results, potassium permanganate injection was selected for a full-scale technology demonstration.	**Scope:** Several IRA alternatives for groundwater were developed and evaluated. The most technically appropriate and cost effective alternative that adequately protects human health and welfare and the environment was identified. The EE/CA also evaluated SVE and enhanced aerobic bioremediation for treatment of residual soil contamination in the source area. Remedial design documents were prepared and the preferred IRA was implemented.
Results: In situ chemical oxidation using potassium permanganate was selected as the preferred alternative for ERP Sites 2 and 11. In situ chemical oxidation using sodium persulfate was selected as the preferred alternative for ERP Site 9.	**Results:** Pilot tests indicated that of the three technologies tested, potassium permanganate injection had the largest radius of influence and produced the most significant and longest-lasting reductions in contaminant concentrations. Effectiveness and implementability of this technology was confirmed by the full-scale technology demonstration.	**Results:** The preferred IRA consists of in situ chemical oxidation using potassium permanganate. The permanganate is injected through horizontal wells installed under the concrete flight apron. Residual soil contamination in the source area is being treated by SVE and enhanced bioremediation (injection of oxygen releasing material).
Data Gaps: None identified.	**Data Gaps:** VOC concentrations in groundwater immediately northeast of Site 2 (near Building 170) require further characterization to assess the extent of the area needing treatment.	**Data Gaps:** None identified.
Comments: The FS methods and results are summarized in the Proposed Plan.	**Comments:** Results of the Site 2 IRA will support the design of the Selected Remedy during the remedial design process.	**Comments:** The IRA constitutes the first phase of the Site 11 remedy. If unacceptable risks remain after the IRA, they will be addressed during the final remedy.

Notes:
ANG = Air National Guard
EE/CA = Engineering Evaluation/Cost Analysis
FS = Feasibility Study
IRA = Interim Remedial Action
ERP = Environmental Restoration Program
ODEQ = Oregon Department of Environmental Quality
RI = Remedial Investigation
RI/DGE = Remedial Investigation/Data Gap Evaluation
SI = Site Investigation
SVE = Soil vapor extraction
USEPA = United States Environmental Protection Agency
VOC = Volatile organic compound

addressed during the second stage of field work, performed between September and November 1999.

The following sites were investigated during the RI:

- ERP Site 1 - Central Hazardous Waste Storage Area;
- ERP Site 2 - Civil Engineering Hazardous Material Storage Area;
- ERP Site 3 - Hush House Area;
- ERP Site 4 - Main Drainage Ditch;
- ERP Site 5 - Aerospace Ground Equipment Maintenance Shop;
- ERP Site 7 - Burn Pit Area;
- ERP Site 8 – Sanitary Landfill;
- ERP Site 9 – Petroleum, Oil, and Lubricants Facility;
- ERP Site 10 - Equipment Washrack; and
- ERP Site 11 (former ERP Site 6) - Washrack West of Building 250.

The locations of the ERP sites are shown in Figure 2-2. ERP Site 11 was originally identified as Site 6 in the PA report (Hazardous Materials Training Center 1987). ERP Site 6 was subsequently designated as ERP Site 11 during the Phase I RI (Operational Technologies Corporation 1996). All of the ERP sites are within the Portland ANGB boundary except ERP Site 7 (Burn Pit Area), which straddles the eastern Base boundary.

The RI provided recommendations for each ERP site based on the contaminant concentrations detected in various media and the associated risks. Table 2-2 presents a summary of the investigation findings at each of the ERP sites and the recommendations for each site. The recommendations shown in Table 2-2 for ERP Sites 2, 9, and 11 formed the basis for the development and evaluation or remedial alternatives in the Feasibility Study (FS), which was completed in 2001 (ERM 2001b). At the time the FS was prepared, the potential ecological risks associated with ERP Site 4 were still being assessed. The Site 4 ecological risk assessment was completed in 2002; the results are reported in the *Final Site Ecology Screening Report for Environmental Restoration Program Site 4* (ERM 2002a).

TABLE 2-2

Summary of Investigation Findings and Recommendations
142nd FW, Portland ANGB, Portland, Oregon

ERP Site	Site Name	Waste Disposal History	Nature and Extent of Contamination	Risk Assessment Results	Recommendation
1	Central Hazardous Waste Storage Area	Waste storage area for misc. wastes incl. waste oil, solvents, fuels, shop wastes, electrical transformers, and capacitors.	Low levels of TCE, PCE, and cis-1,2-DCE in Shallow Zone groundwater. Likely primary source is ERP Site 2.	Unacceptable total carcinogenic risk and noncarcinogenic hazard for hypothetical on-site residential exposure to groundwater (primarily vinyl chloride).	Soil: No further action. Groundwater: Remedial measures to prevent off-site migration and on-site exposure to groundwater with unacceptable concentrations.
2	Civil Engineering Hazardous Material Storage Area	Solvents, paint thinners, and MEK were stored in or near solvent storage shed; paint was stored in Building 1123.	VOCs not detected in soil samples. Chlorinated VOCs detected in Shallow Zone and Deep Zone groundwater. Dissolved VOC plume extends approx. 750 feet to northwest and is approximately 400 feet wide.	Unacceptable total carcinogenic risk and noncarcinogenic hazard for hypothetical on-site residential exposure to groundwater (primarily vinyl chloride).	Soil: No further action. Groundwater: Remedial measures to prevent off-site migration and on-site exposure to groundwater with unacceptable concentrations.
3	Hush House Area	Waste oil, fuel, and solvents were stored at the Hush House on unpaved surface.	Area B: Benzene, SVOCs, TPH, and metals detected in shallow soil above PSGs near former oil/water separator. Naphthalene, benzene, and vinyl chloride detected in groundwater above PSGs. Area C: TPH detected in shallow soils.	Unacceptable total carcinogenic risk for hypothetical on-site residential exposure to soil (primarily benzo[a]pyrene and dibenz[a,h]anthracene) and groundwater (primarily benzene and vinyl chloride).	Soil: No further action; residential soil scenario not applicable due to industrial zoning/land use of property. Groundwater: Remedial measures to prevent off-site migration and on-site exposure to groundwater with unacceptable concentrations.
4	Main Drainage Ditch	Petroleum and oil were reported in the Main Drainage Ditch downstream from the flight apron outfall in 1987. Ditch receives surface water runoff from adjacent facilities. No records of wastes being intentionally disposed of in the ditch.	SVOCs, TPH, and metals detected in sediment in Main Drainage Ditch above PSGs. Bromodichloromethane, antimony, cadmium, copper, lead, zinc, and cis-1,2-DCE detected in surface water above PSGs.	No unacceptable human health risks. Contaminants present in sediment (primarily PAHs, PCBs, and metals) exceed Oregon screening values for ecological risk.	Surface water: No further action. Sediment: Remedial measures to mitigate potential ecological risks.
5	Aerospace Ground Equipment (AGE) Maintenance Shop	Spent battery acid, solvents, lubricants, antifreeze, cleaning solutions, and automobile fluids were generated at Maintenance Shop. Wastes may have been disposed of along the northern and southern fence lines. Former LUST contained heating oil.	Area A: Chloroform, 1,2-dichlorobenzene, TCE, toluene, and xylene detected in groundwater at low concentrations. Area B: 1,2-DCA, TCE, and metals detected above PSGs in surface and subsurface soil.	No unacceptable risks. One soil sample exceeded the USEPA screening level for lead for an unrestricted use (residential) scenario.	No further action; residential soil scenario not applicable due to industrial zoning/land use of property.
7	Burn Pit Area	Flammable liquids incl. waste oil, JP-4 jet fuel, and solvents were reportedly burned in the pit as part of fire training exercises.	BTEX, SVOCs, and TPH detected in soil in the burn pit area above PSGs. Benzene, PCE, and TPH detected in groundwater.	Unacceptable carcinogenic risk for hypothetical on-site residential exposure to soil (benzo[a]pyrene).	No further action; residential soil scenario not applicable due to industrial zoning/land use of property.
8	Sanitary Landfill	Wastes incl. ordinary shop and building refuse, paint cans, oil and paint residue, batteries, and broken equipment and parts were reportedly disposed of in trenches and buried.	Soil not sampled; evidence of landfilling not confirmed. No confirmed detections of PCBs, VOCs, SVOCs, or metals in groundwater above PSGs.	No unacceptable risks.	No further action.
9	Petroleum, Oil, and Lubricants (POL) Facility	Site consisted of 12 JP-4 jet fuel USTs, 2 diesel ASTs, 1 waste oil UST, and filling stations.	Petroleum hydrocarbons and trace levels of PAHs detected in Shallow Zone groundwater.	Unacceptable total carcinogenic risk for hypothetical on-site residential exposure to soil (benzo[a]pyrene) and groundwater (primarily benzene and PAHs). Unacceptable noncarcinogenic hazard for hypothetical on-site residential exposure to groundwater (primarily benzene).	Soil: No further action; residential soil scenario not applicable due to industrial zoning/land use of property. Groundwater: Remedial measures to prevent off-site migration and on-site exposure to groundwater with unacceptable concentrations.
10	Equipment Washrack	Liquids from equipment washing operations discharged via drain pipe to a roadside ditch.	Antimony, cadmium, lead, and selenium detected above PSGs in soil.	No unacceptable risks. One soil sample exceeded USEPA screening level for lead for an unrestricted use (residential) scenario.	No further action; residential soil scenario not applicable due to industrial zoning/land use of property.
11	Washrack West of Building 250	Liquids from aircraft washing operations flowed from washrack area to the catch basin of the oil/water separator. Prior to removal, cracks were noticed in the oil/water separator.	Chlorinated VOCs, BTEX, TPH, and metals detected in soil in area of former oil/water separator. Chlorinated VOCs and benzene detected in Shallow Zone and Deep Zone groundwater.	Unacceptable total carcinogenic risk and noncarcinogenic hazard for hypothetical on-site residential exposure to groundwater (primarily benzene, 1,2-DCA, and vinyl chloride).	Soil: In-situ treatment to prevent leaching of residual contaminants to groundwater. Groundwater: Remedial measures to prevent off-site migration and on-site exposure to groundwater with unacceptable concentrations.

NOTES:

bgs - Below ground surface
ft - Feet
LUST - Leaking underground storage tank
RI - Remedial Investigation
MEK - Methyl ethyl ketone
PSG - Remedial Investigation project screening goal
UST - Underground storage tank
SVOC - Semivolatile organic compound
TPH - Total petroleum hydrocarbons
USEPA - United States Environmental Protection Agency
1,2-DCA - 1,2-Dichloroethane
AST - Aboveground storage tank
VOC - Volatile organic compound
TCE - Trichloroethene
PCB - Polychlorinated biphenyl
cis-1,2-DCE - cis-1,2-Dichloroethene
PCE - Tetrachloroethene
PAH - Polynuclear aromatic hydrocarbon
BTEX - Benzene, toluene, ethylbenzene, and xylenes

Several remediation technologies/treatment options were evaluated in the Feasibility Study report (ERM 2001b) for the ERP sites shown in blue. Groundwater contamination at ERP Sites 1 and 3 will be addressed as part of the Site 2 remedy.

The FS evaluated remedial action alternatives for each of the ERP sites requiring further action except Site 4. The Final FS Report (ERM 2001b) describes the development and evaluation of remedial alternatives, and presents the preferred alternatives for ERP Sites 2, 9, and 11. The Proposed Plan (ERM 2003a) summarizes the approach and findings of the FS. It also presents remedial alternatives and recommendations for ERP Site 4 based on the ecological risk assessment performed at this site.

2.2.4 Enforcement Actions

No regulatory enforcement actions have been reported at the Portland ANGB. The ANG's environmental work at the site is being conducted as a voluntary cleanup, with regulatory oversight by the ODEQ.

2.3 Community Participation

The ANG completed a Community Relations Plan for the Portland ANGB in February 1994. The Final RI Report was made available to the public in January 2001. The Final FS Report and Final Proposed Plan were made available to the public in July 2001 and April 2003, respectively. These and other ERP documents relevant to the environmental studies performed at the Base can be found in the Administrative Record maintained at the Base, and in the Public Information File maintained at the Multnomah County Central Library, 801 S.W. 10th Avenue, Portland. Both the Administrative Record and the Public Information file are available for public review during normal business hours. In addition, the ANG provides copies of ERP documents to the ODEQ for review and comment. The ODEQ may be contacted regarding public review of their files.

The Portland ANGB has a Restoration Advisory Board (RAB) composed of ANG, ODEQ, and Port of Portland representatives, as well as representatives from the local community. The RAB meets periodically (typically one or two times per year) to discuss issues pertaining to ERP activities at the Base. During the remedy selection process, the RAB met several times. The RAB meetings provided a forum for discussing the ANG's progress in the remedy selection process, as well as stakeholder concerns. The meetings also provided an opportunity for the public to ask questions about the remedy selection process.

A notice announcing the availability of the Final Proposed Plan was published in the Portland Oregonian newspaper on 27 April 2003. A public comment period was held from 28 April to 27 May 2003. No comments were submitted during the public comment period. In a letter to the ANG dated 27 May 2003, the ODEQ indicated that it agrees that the Final Proposed Plan meets the requirements of Oregon's cleanup laws based upon achieving the stated RAO at each site.

2.4 Scope and Role of Response Actions

The remedial actions presented in this ROD are intended to prevent exposure to contaminated groundwater and sediment at concentrations that would present an unacceptable risk. This will be accomplished through active treatment and monitoring of contaminated groundwater, and through capping of contaminated sediments. These actions are expected to meet RAOs by reducing the TMV of the COCs at each ERP site, and are thus protective of human health and the environment.

Interim remedial actions (IRAs) have been implemented at ERP Sites 2 and 11, and additional interim actions are planned. These actions are summarized below.

- A soil removal action was performed at ERP Site 11 in September 1999. Approximately 260 cubic yards of soil containing petroleum hydrocarbons and chlorinated VOCs was removed in the immediate vicinity of the former oil/water separator and hauled off-site to a thermal desorption facility. The scope and results of the 1999 soil removal action are detailed in the *Final Completion Report for Site 11 Interim Remedial Action Construction for Soils Media* (ERM 2000).

- An EE/CA that evaluated IRA alternatives for treating chlorinated VOCs in groundwater at ERP Site 11 was completed in June 2001 (ERM 2001c). The EE/CA also addressed residual soil contamination in the area of the former oil/water separator. The IRA recommended in the EE/CA consists of potassium permanganate oxidation to address contaminated groundwater, and soil vapor extraction/enhanced bioremediation to address contaminated soil. The final design document for the Site 11 IRA was completed in December 2002 (ERM 2002b). Remediation at the site was started in 2003.

- Treatability tests and a full-scale technology demonstration of in situ chemical oxidation were conducted at ERP Site 2 between 2000 and

2002. The purpose of this IRA was to evaluate the effectiveness of in situ remediation technologies for treating chlorinated VOCs in groundwater at the Base, and to begin cleanup of groundwater at ERP Site 2. The first phase of the project consisted of a 3-month treatability test performed in Fall 2000. Three in situ remediation technologies were evaluated: enhanced aerobic bioremediation, ozonation, and potassium permanganate oxidation. The treatability test results are presented in the *Interim Remedial Action Construction Phase I Interim Report* (ERM 2001d). The second phase of the project consisted of a full-scale technology demonstration of potassium permanganate oxidation. Field work for the demonstration began in April 2002 and was completed in November 2002. The methods and results of the full-scale technology demonstration are presented in the *Final Interim Remedial Action Construction Technology Demonstration Report* (ERM 2003b).

The remedy for the sites requiring further action will consist of a combination of focused IRAs to address immediate threats, and final actions to address residual and potential future threats. If no unacceptable risks remain at a site after an interim action is completed, the interim action can constitute the final remedy for the site.

2.5 Site Characteristics

This section summarizes the relevant characteristics of the Portland ANGB and the ERP sites where cleanup actions will be performed. Details regarding site characteristics are discussed in the various technical reports referenced below.

2.5.1 Overview

The Portland ANGB occupies approximately 245 acres of land immediately south of the PIA (Figure 2-1), on the Columbia River Floodplain. A site plan showing the locations of the ERP sites is presented in Figure 2-2. The Base is relatively flat and level, with a surface elevation between 10 and 20 feet above mean sea level. Buildings, asphalt/concrete pavement, and landscaped grass cover the majority of the site; raised planters containing shrubs and trees exist around buildings and parking lots. A ~2,800-foot long stormwater drainage ditch (ERP Site 4 – Main Drainage Ditch) exists near the central portion of the Base; this drainage

ditch has been designated as a jurisdictional wetland by the U.S. Army Corps of Engineers.

A chain link fence exists along the western, southern, and eastern boundaries of the Base; the Base is open to the PIA airfield on the north side. Access to the Base is controlled through several entrance gates along Cornfoot Road. The Base is bordered on the north and west by facilities of the PIA. The areas south and east of the Base are zoned for residential, industrial, and commercial use. The Columbia River, a major drainage channel and inland transportation/recreation corridor for Oregon, Idaho, and Washington, is approximately 1 mile north of the Base.

The Portland ANGB and the surrounding population obtain drinking water from the City of Portland. The city's main water supply comes from surface water in the Bull Run Watershed. This supply is supplemented as necessary by the Portland municipal well field (the Columbia South Shore Well Field), which is centered approximately 4 miles southeast of the Base (Figure 2-1). The Portland well field operates on an as-needed basis, primarily during the summer. The western boundary of the well field comes within 0.6 miles of the Portland ANGB at its closest point. The municipal water supply wells are isolated from the shallow groundwater at the Base by a 50- to 200-foot thick siltstone/claystone confining layer. There are no known private drinking water wells within 1 mile of the Base.

2.5.2 Surface and Subsurface Features

The Portland ANGB is largely developed, comprising a variety of office buildings, warehouses, maintenance and repair shops, fuel storage and distribution facilities, and aircraft hangers. There are approximately 72 buildings on the Base property interspersed among paved roads and parking areas, the flight apron, and taxiways. The utilities servicing the Base are typical of those found at industrial/commercial sites (i.e., water, power, gas, communications, sanitary sewer). The Base has its own stormwater drainage system (see below). Undeveloped portions of the Base (i.e., areas containing vegetation) are characterized by frequently mowed grassland occurring between buildings and roads and adjacent to taxiways, and small patches of wetland occurring along man-made drainage channels and in low-lying areas.

Surface water features at the Portland ANGB are limited to man-made channels that comprise the Base stormwater drainage system. Surface runoff from the majority of the Base flows into a series of storm drains

that discharge to the Main Drainage Ditch (ERP Site 4). The Main Drainage Ditch conveys the water to a series of two oil/water separators and retention ponds in the western portion of the Base (Figure 2-2). Water in the retention ponds is pumped into a nearby Port of Portland stormwater retention pond/drainage channel that discharges into the Columbia Slough. Surface runoff in the vicinity of ERP Site 7 flows into the ditch immediately east of the site (Figure 2-2), which discharges directly to the Columbia Slough.

The Portland ANGB historically utilized washracks, oil/water separators, USTs, and ASTs in several areas of the Base. Much of this equipment was removed in the 1980s and 1990s as part of ongoing compliance activities and facility improvements. Some of the equipment remains in operation or has been replaced or relocated as necessary to support the mission of the 142nd FW. The Base also had a burn pit at ERP Site 7 that was used for fire training exercises. The burn pit has been filled in, and ERP Site 7 is now an equipment storage/staging area.

2.5.3 Site Geology and Hydrogeology

The Portland ANGB is in the central portion of the Portland Basin, a northwest-southeast trending structural depression that was formed in the early Tertiary, and subsequently filled with approximately 1,800 feet of late Tertiary and Quaternary deposits of sedimentary and volcanic origin.

The near-surface geology at the Base consists of Columbia River Sand deposits and Pleistocene to Recent Alluvium. The Columbia River Sand consists predominantly of sand with a small amount of silt and gravel. The Pleistocene and Recent Alluvium sediments include terrace deposits, catastrophic flood deposits, and recent river alluvium composed of fluvial and local lacustrine sediments. The recent alluvium deposits of the Columbia River are made up of interbedded silt and sand (Hartford and McFarland 1989).

The Columbia River has been isolated from the floodplain area by a series of artificial dikes that were completed prior to the 1940s. The floodplain surface is relatively flat; at the Portland ANGB the natural land surface has been modified by using imported and local fill material to elevate portions of the Base.

A generalized hydrogeologic cross section for the Portland ANGB is shown in Figure 2-3. The unconsolidated sediments extending from the ground surface to approximately 48 to 60 feet below ground surface (bgs)

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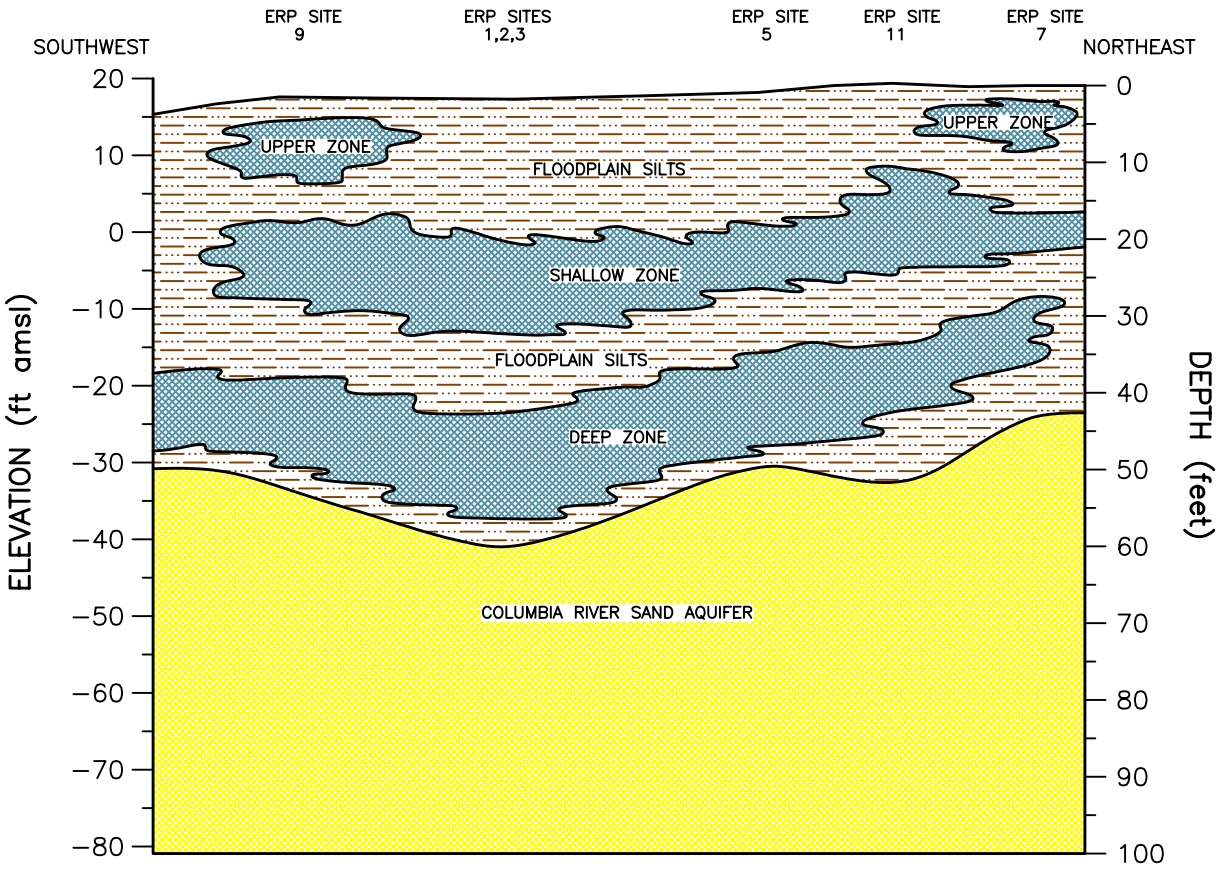

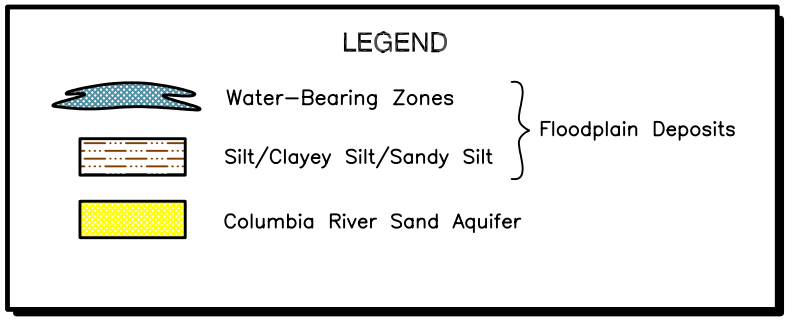

Figure 2-3
Generalized Base Hydrogeologic Cross Section
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon

ERM 10/03

consist of interbedded silt and sand layers referred to collectively as the Floodplain Deposits. Significant water-bearing zones within the Floodplain Deposits include the Shallow Zone and the Deep Zone. The Shallow Zone is a layer of fine sand and silty sand present at depths between approximately 5 and 30 feet bgs. The average thickness of the Shallow Zone is approximately 10 feet. The Deep Zone consists of fine sand present between approximately 30 and 55 feet bgs, and has an average thickness of approximately 15 feet.

The Floodplain Deposits are underlain by the Columbia River Sand Aquifer (CRSA), a silty to gravely sand aquifer. Soil samples recovered from borings drilled into the CRSA at the Base consist predominantly of fine to medium sand with abundant mica. The CRSA is interpreted as a channel fill deposit cut into the Troutdale Gravel Aquifer, which is present beneath the Portland well field and to the north and south of the Base in the same stratigraphic position as the CRSA. The CRSA is estimated to be between 150 and 225 feet thick at the Portland ANGB based on borings drilled at the PIA and the Portland well field.

The depth to groundwater in wells completed in the Floodplain Deposits and the CRSA generally ranges from 2 to 10 feet bgs, depending on the location, season, and long-term precipitation trends. The predominant groundwater flow direction in the Shallow Zone is toward the west and northwest, although the local flow direction can vary considerably. The groundwater flow directions in the Deep Zone and CRSA typically vary depending on water levels in the Columbia River. Potentiometric maps for the Shallow Zone, Deep Zone, and CRSA produced from April 2003 water level data are presented in Figures 2-4 through 2-7.

Water levels and hydraulic gradients in the Deep Zone and CRSA correlate with the Columbia River stage, suggesting that these two units are hydraulically connected to the river. Water level data from the Shallow Zone indicate that hydraulic gradients and water levels in this unit are influenced mainly by precipitation/direct infiltration. Water levels and hydraulic gradients in the Shallow Zone also are influenced by groundwater recharge/discharge through drainage ditches and the Columbia Slough. Variable static pressures in the Shallow Zone, Deep Zone, and CRSA produce measurable vertical hydraulic gradients between these units. The magnitude and direction of the vertical gradients vary both spatially and temporally as a function of recent precipitation trends and the Columbia River stage.

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See Figure 2-5
For Detail

Main Drainage Ditch

RETENTION POND #1

Site 1
Site 2
Site 3
Site 4
Site 5
Site 7
Site 8
Site 9
Site 10
Site 11

04SW-11 8.27
04SW-12 8.76
04SW-10 2.75*
04SW-6 8.97
04SW-9 9.46

MW2-9 10.29*
MW3-1 NM
MW3-2 10.56
MW1-1 10.83
MW1-2 10.52
MW1-4 10.56
MW1-3 10.73
MW2-25 10.63
MW1-6 10.71
MW2-8 9.89
MW2-27 10.75
MW2-26 11.07
MW2-5 10.32
MW2-24 10.68
MW2-28 10.48
MW2-3 10.79
MW2-23 10.79
MW2-29 10.53
MW2-30 10.60
PZ2-3 10.65
MW2-6 10.00
MW2-7 10.97
MW2-1 10.23
PZ2-1 10.70
MW2-2 10.71
MW9-1 11.94
MW9-3 12.84
MW9-4 12.28
MW9-6 12.54
MW9-5 12.32
MWBG-4 14.34*
MWBG-0 13.22
MWBG-6 9.83*
CSSW-1* 6.61
MWBG-1 10.91*
MWBG-2 14.96

MW11-4 13.90
MW11-11 12.17
MW11-1 13.25
MW11-10 14.56
MW11-6 12.28
MW11-7 10.40
MW11-3 14.03
MW11-5 10.68*
MW11-9 14.82
MW11-13 11.11
MW5-1 11.58
MW5-2 11.80

MW7-3 NM
MW7-2 10.47
MW7-1 12.42
MW7-4 14.49
07SW-1 6.63

9.0
10.0
11.0
12.0
13.0
14.0

O'CONNER WAY
SMITH STREET
JERNSTEDT STREET
JOHNSON AVENUE
FLEMING AVENUE
MILITARY TAXIWAY
ARMY NATIONAL GUARD ARMORY
COLWOOD GOLF COURSE
CORNFOOT ROAD
COLUMBIA SLOUGH

N

0 150 300
Scale in Feet

LEGEND

MWBG-4	Monitoring Well, Floodplain Silt
MW7-3	Monitoring Well, Shallow Zone
04SW-11	Surface Water Sampling Location
PZ2-1	Piezometer, Shallow Zone
10.86	Groundwater Elevation Based on 21 April 2003 Data (ft amsl)
NM	Not Measured
*	Datum Not Used For Contouring
10.0	Contour of Approximate Potentiometric Surface Elevation; Dashed Where Inferred (ft amsl)
	Inferred Groundwater Flow Direction
	ERP Site Boundary

Figure 2-4
Potentiometric Surface Map - Shallow Zone
21 April 2003
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon

ERM 10/03

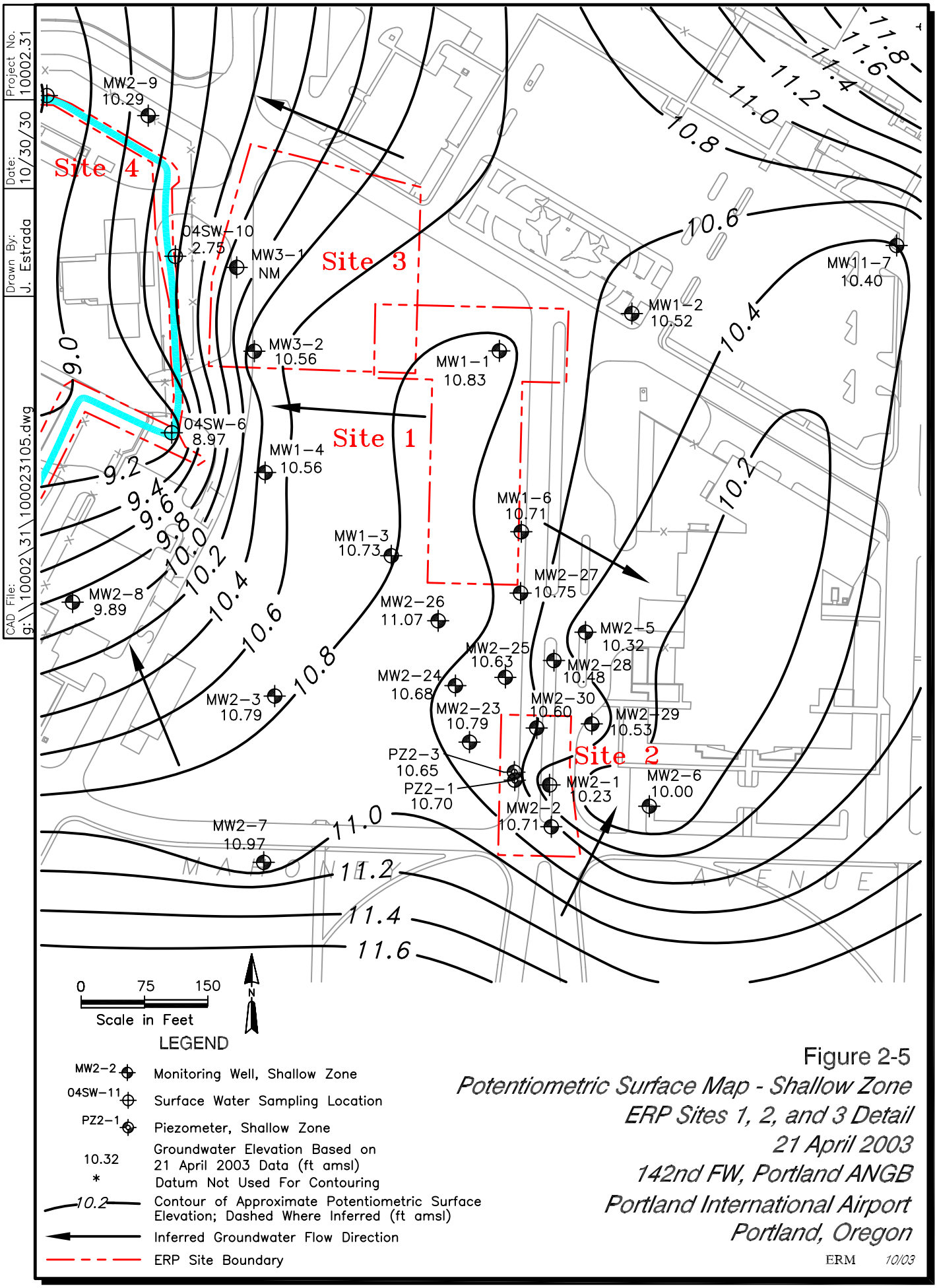

Figure 2-5

Potentiometric Surface Map - Shallow Zone

ERP Sites 1, 2, and 3 Detail

21 April 2003

142nd FW, Portland ANGB

Portland International Airport

Portland, Oregon

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Project No. 10002.31

Main Drainage Ditch
RETENTION POND #1
RETENTION POND #2
SMITH STREET
O'CONNER WAY
MILITARY TAXIWAY
MAHONEY AVENUE
JOHNSON AVENUE
COLWOOD GOLF COURSE
CORNFOOT ROAD
COLUMBIA SLOUGH
ARMY NATIONAL GUARD ARMORY
2535
1004

MW2-10 10.55
MW1-5 10.35
MW2-4 10.20
MW2-31 9.85*
MW2-22 10.19
PZ2-2 10.13
MWBG-5 10.50
MW9-2 10.09
MW11-12 7.63*
MW11-2 11.63*
MW11-15 10.73
MW11-14 10.10
MW11-8 10.59
PZ11-3 9.92*
EW11-1 10.40
MWBG-3 9.18

Site 1
Site 2
Site 3
Site 4
Site 5
Site 7
Site 8
Site 9
Site 10
Site 11

10.50
10.25
10.00
9.75
9.50
9.25

0 150 300
Scale in Feet

LEGEND

MWBG-6	Monitoring Well, Floodplain Silt
MW2-4	Monitoring Well, Deep Zone
EW11-1	Extraction Well, Deep Zone
PZ2-2	Piezometer, Deep Zone
ERP Site Boundary	
10.00	Contour of Approximate Potentiometric Surface Elevation; Dashed Where Inferred (ft amsl)
	Inferred Groundwater Flow Direction
10.13	Groundwater Elevation Based on 21 April 2003 Data (ft amsl)
*	Datum Not Used for Contouring
NM	Not Measured

Figure 2-6
Potentiometric Surface Map - Deep Zone
21 April 2003
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon
ERM 10/03

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Main Drainage Ditch

Site 1
Site 2
Site 3
Site 4
Site 5
Site 7
Site 8
Site 9
Site 10
Site 11

MW11-17 10.27
MW11-16 9.64*
MWBG-11 10.40
PZ11-5 10.40
PZ11-4 9.95*
EW11-2 10.33
MW11-18 10.13
MWBG-7 10.20
MW2-21 10.17
MWBG-10 9.68*
MW2-20 10.09
MWBG-8 10.12
MWBG-9 10.01

10.35
10.30
10.25
10.20
10.15
10.10
10.05

O'CONNER WAY
SMITH STREET
JERNSTEDT STREET
MAHONEY AVENUE
JOHNSON AVENUE
MILITARY TAXIWAY
COLWOOD GOLF COURSE
CORNFOOT ROAD
COLUMBIA SLOUGH
ARMY NATIONAL GUARD ARMORY

N

0 150 300
Scale in Feet

LEGEND

MWBG-8 ⊕	Monitoring Well, Columbia River Sand Aquifer
EW11-2 ⊕	Extraction Well, Columbia River Sand Aquifer
PZ11-2 ⊕	Piezometer, Columbia River Sand Aquifer
10.09	Groundwater Elevation Based on 21 April 2003 Data (ft amsl)
NM	Not Measured
*	Datum Not Used for Contouring
10.10	Contour of Approximate Potentiometric Surface Elevation; Dashed Where Inferred (ft amsl)
	ERP Site Boundary
	Inferred Groundwater Flow Direction

Figure 2-7
Potentiometric Surface Map - Columbia River Sand Aquifer
21 April 2003
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon

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2.5.4 Nature, Extent, and Suspected Sources of Contamination

This section describes the nature, extent, and suspected sources of contamination at ERP Sites 2, 4, 9, and 11. Site characterization information for the ERP sites where no further action is planned (i.e., Sites 5, 7, 8, and 10) is contained in the Final RI Report (ERM 2001a).

2.5.4.1 ERP Site 2 - Civil Engineering Hazardous Material Storage Area

Chlorinated VOCs (primarily TCE, cis-1,2-dichloroethene, and vinyl chloride) are present in groundwater in the Shallow and Deep Zones at ERP Site 2. In addition, isolated detections of chloromethane and/or vinyl chloride were reported in two CRSA monitoring wells in the vicinity of ERP Site 2 in November 2002 and April 2003, at concentrations below the laboratory practical quantitation limit of 1.0 microgram per liter (µg/L) (note: 1 µg/L is equivalent to 1 part per billion). The highest concentrations of VOCs occur in the vicinity of the former solvent storage shed, suggesting that the source of the contamination is historical leaks and spills in this area. VOCs were not detected in soil samples collected in the area of the former solvent shed during the Phase II RI, possibly because near-surface soils at Site 2 were removed during road construction activities conducted prior to the RI.

Figures 2-8 and 2-9 show the approximate lateral and vertical extent of chlorinated VOCs in groundwater. Dissolved VOCs have migrated primarily toward the northwest (in the direction of ERP Sites 1 and 3) from the presumed source area at ERP Site 2. This migration pattern is consistent with the predominant northwesterly groundwater flow direction in the Shallow Zone. As shown in Figure 2-8, dissolved VOCs also have spread to the east and northeast of Site 2, consistent with an easterly groundwater gradient observed locally in this area during the wet season (see Figure 2-5). The absence or relatively low concentrations of VOCs in direct-push groundwater samples collected immediately south and southeast of ERP Site 2 provides additional evidence that the VOC source area is at Site 2.

ODEQ guidance defines hot spots of contamination as areas of affected soil or groundwater causing a significant adverse effect on the beneficial use of the resource (ODEQ 1998a). Based on this definition, portions of the Site 2 VOC plume in the Shallow and Deep Zones qualify as groundwater hot spots. The hot spots correspond to the areas where dissolved VOC concentrations exceed pre-calculated "significant adverse

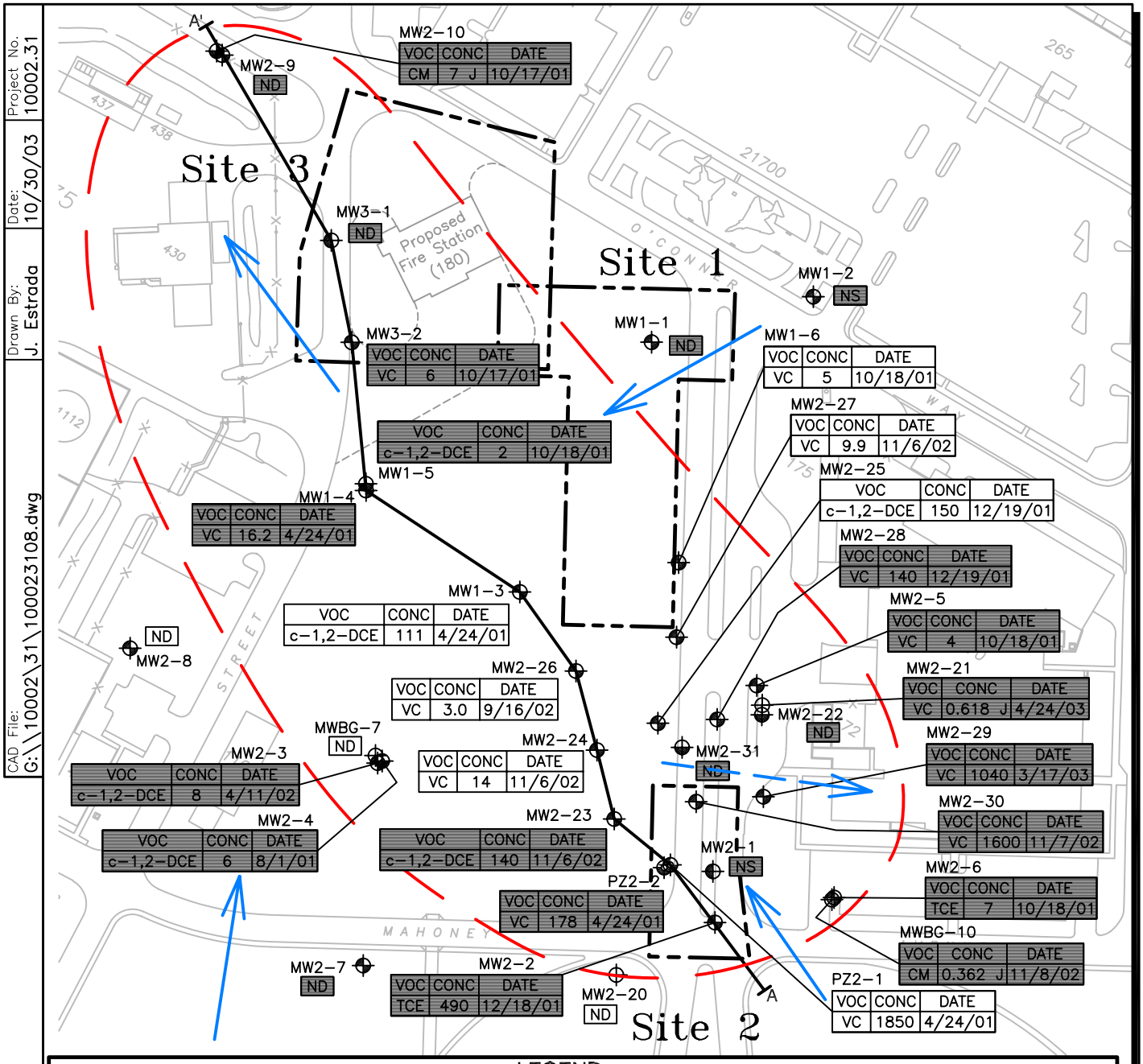

Figure 2-8

ERP Sites 1, 2 & 3 - Maximum VOC Concentrations Detected in Groundwater, 1/01-4/03

142nd FW, Portland ANGB

Portland International Airport

Portland, Oregon

ERM 10/03

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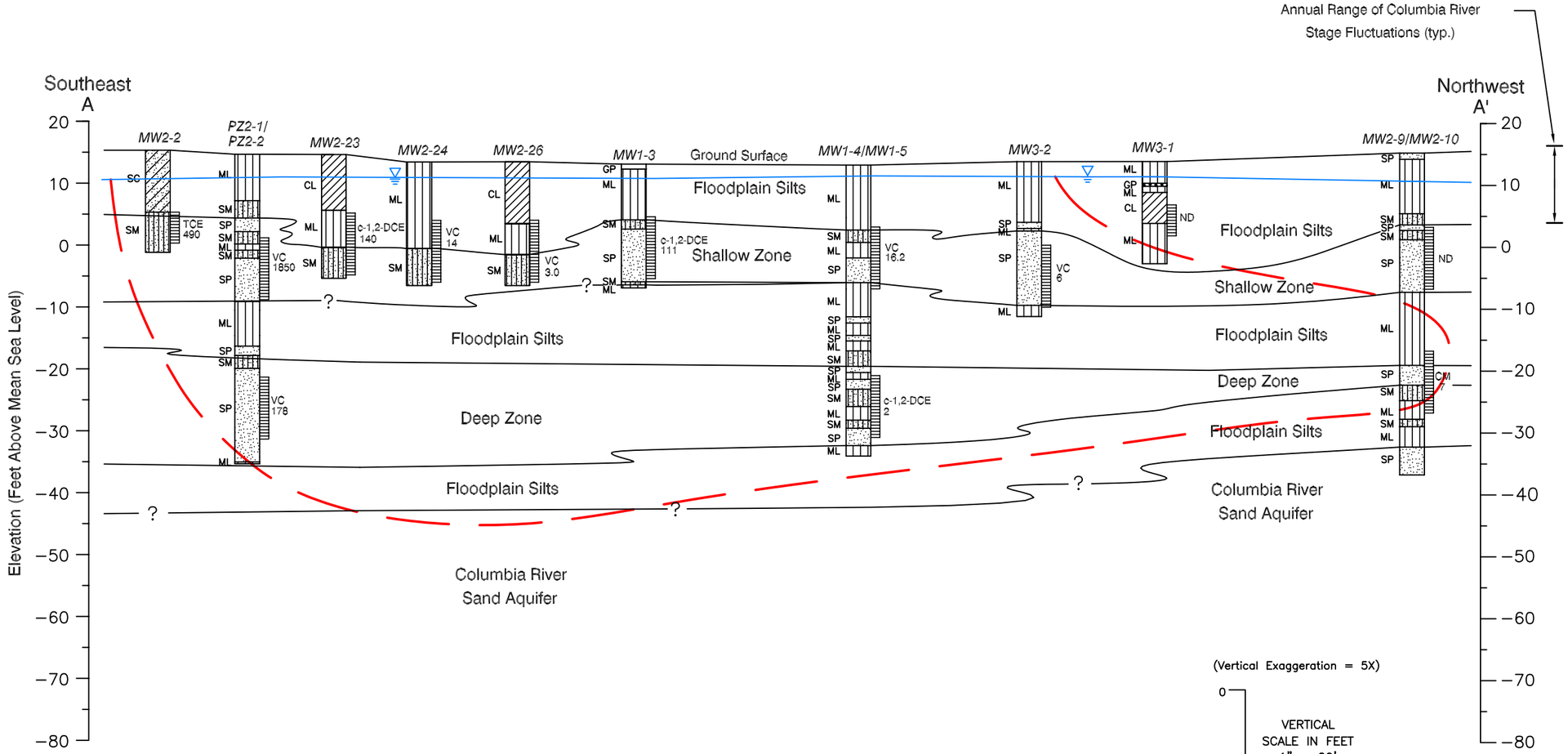

Note: See Figure 2–8 for Cross Section Orientation

LEGEND

69.2 Maximum VOC Concentration (µg/L); See Figure 2–8 for Sampling Dates.

Screened Interval

Shallow Zone Potentiometric Surface (April 2003)

Approximate Extent of Dissolved VOCs

CM	Chloromethane
VC	Vinyl Chloride
c–1,2–DCE	cis–1,2–Dichloroethene
TCE	Trichloroethene
ND	Not Detected

- Gravelly Clay/Sandy Clay/Silty Clay/Clay
- Silt/Clayey Silt/Sandy Silt
- Clayey Sand
- Silty Sand
- Gravelly Sand/Sand
- Gravel/Sandy Gravel

Figure 2-9
ERP Sites 1, 2, & 3
Hydrogeologic Cross Section
Maximum VOC Concentrations Detected in Goundwater, 1/01-4/03
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon

ERM 10/03

effect" levels for an assumed drinking-water use of groundwater (ODEQ 1998a, 1998b). Figure 2-10 shows the approximate extent of the groundwater hot spots at ERP Sites 1, 2, and 3, based on maximum contaminant concentrations detected in groundwater from January 2001 through April 2003. The hot spots are defined primarily by the presence of vinyl chloride above 2 µg/L (the Federal primary drinking water standard for vinyl chloride). As groundwater at the Base is not currently used for drinking water, this hot spot designation is based on the potential future use as drinking water and the potential for contaminants to migrate to an off-site drinking water resource.

2.5.4.2 ERP Site 4 - Main Drainage Ditch

Contaminants have been detected in both sediment and surface water at ERP Site 4. Contaminants detected in sediment include VOCs, semivolatile organic compounds (SVOCs), PCBs, total petroleum hydrocarbons (TPH), and metals. Contaminants detected in surface water include VOCs, SVOCs, TPH, and metals. Suspected sources of the Site 4 contamination include leaks and spills, indirect discharge, and runoff of contaminated wash water from adjacent facilities.

Response actions are necessary at ERP Site 4 to address unacceptable ecological risks posed by the contaminants (see Section 2.7). Contaminants of potential ecological concern in sediment include VOCs, SVOCs, PCBs, and metals. Lead is the only contaminant of potential ecological concern in surface water. Figures 2-11 and 2-12 (from *Final Site Ecology Screening Report for Environmental Restoration Program Site 4*; ERM 2002a) show the distribution of individual constituents that exceed Oregon ecological screening criteria.

2.5.4.3 ERP Site 9 - Petroleum, Oil, and Lubricants Facility

Contaminants detected in soil at ERP Site 9 include TPH as gasoline and TPH as diesel. Contaminants detected in Shallow Zone groundwater include TPH as gasoline, diesel, and heavy-oil; benzene, toluene, ethylbenzene, and xylenes (BTEX); and petroleum-related PAHs. Low concentrations of chlorinated VOCs also have been reported in several groundwater samples. The petroleum contamination (primarily benzene) in groundwater poses an unacceptable risk to human health (see Section 2.7). The approximate extent of dissolved TPH and BTEX in groundwater is depicted in Figure 2-13.

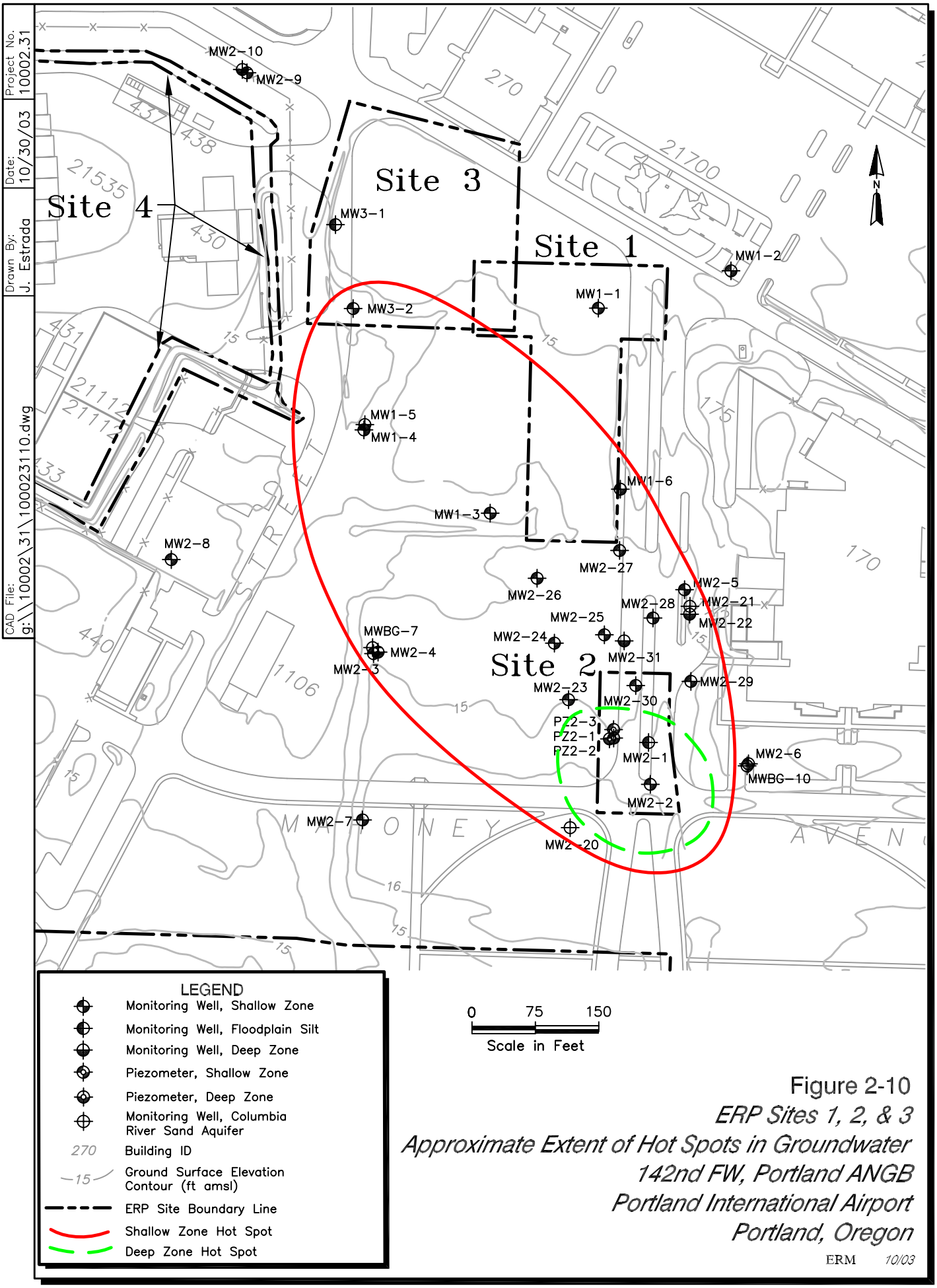

Figure 2-10

ERP Sites 1, 2, & 3

Approximate Extent of Hot Spots in Groundwater

142nd FW, Portland ANGB

Portland International Airport

Portland, Oregon

ERM 10/03

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0 150 300
Scale in Feet

N

N.E. TRANSPORT WAY

LEGEND

- SI Sediment Sampling Location (SAIC 1991)
- Phase I RI Sediment Sampling Location (OpTech 1996)
- Phase II RI Sediment Sampling Location (ERM 2001a)
- FW Ratio — Freshwater Ratio
- Bio Ratio — Bioaccumulation Ratio
- *a1* — Exceeds Freshwater Screening for Individual Constituent
- *a2* — Exceeds Freshwater Screening for Multiple Constituents
- *b* — Exceeds Bioaccumulation Screening
- *c* — Exceeds Both Freshwater and Bioaccumulation Screening
- * — Freshwater SLV Based on Apparent Effects Threshold, Marine Sediment, SQuiRTs
- ** — SLVs for PCB–1254 Used as a Surrogate for PCB–1260
- SLV — Screening Level Value
- Direction of Water Flow
- Drainline Outfall
- ERP Site Boundary

04SD–1

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Zinc	*b*	*30 mg/kg*		*10*

04SD–2

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Pyrene	*a2*	*210 µg/kg*	*4.0*	
Arsenic	*c*	*30 mg/kg*	*5.0*	*7.5*
Cadmium	*c*	*2.1 mg/kg*	*3.5*	*700*
Copper	*b*	*32 mg/kg*		*3.2*
Zinc	*b*	*260 mg/kg*		*87*

04SD–3

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Benzo(a)pyrene	*c*	*300 µg/kg*	*9.4*	*3.0*
Benzo(k)fluoranthene	*a1*	*340 µg/kg*	*13*	
Chrysene	*a1*	*540 µg/kg*	*9.5*	
Pyrene	*a1*	*580 µg/kg*	*11*	
Cadmium	*b*	*0.44 mg/kg*		*147*
Copper	*b*	*11 mg/kg*		*1.1*
Zinc	*b*	*130 mg/kg*		*43*

04SD–4

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
PCB–1254	*c*	*19 µg/kg*	*2.7*	*1.9*
Pyrene	*a2*	*76 µg/kg*	*1.4*	
Cadmium	*b*	*0.41 mg/kg*		*137*
Copper	*b*	*13 mg/kg*		*1.3*
Zinc	*b*	*83 mg/kg*		*28*

04SD–5

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
PCB–1254	*c*	*96 µg/kg*	*14*	*9.6*
Cadmium	*b*	*1.1 mg/kg*		*367*
Copper	*b*	*18 mg/kg*		*1.8*
Zinc	*b*	*150 mg/kg*		*50*

04SD–6

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Benzo(a)anthracene	*a1*	*960 µg/kg*	*30*	
Benzo(a)pyrene	*c*	*720 µg/kg*	*23*	*7.2*
Benzo(k)fluoranthene	*a1*	*590 µg/kg*	*22*	
Chrysene	*a1*	*1200 µg/kg*	*21*	
Dibenzo(a,h)anthracene	*a1*	*190 µg/kg*	*5.8*	
Fluoranthene	*a1*	*1400 µg/kg*	*13*	
Indeno(1,2,3–cd)pyrene	*a1*	*330 µg/kg*	*19*	
Phenanthrene	*a1*	*560 µg/kg*	*13*	
Pyrene	*a1*	*1600 µg/kg*	*30*	
Arsenic	*b*	*4.3 mg/kg*		*1.1*
Copper	*b*	*23 mg/kg*		*2.3*
Zinc	*b*	*59 mg/kg*		*20*

04SD–7

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Cadmium	*b*	*0.61 mg/kg*		*203*
Copper	*b*	*15 mg/kg*		*1.5*
Zinc	*b*	*87 mg/kg*		*29*

04SD–8

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Acetone	*b*	*360 µg/kg*		*1.2*
Antimony	*c*	*85 mg/kg*	*28*	*8.5*
Arsenic	*b*	*23 mg/kg*		*5.8*
Cadmium	*c*	*15 mg/kg*	*25*	*5000*
Copper	*c*	*190 mg/kg*	*5.3*	*19*
Lead	*c*	*550 mg/kg*	*16*	*4.3*
Selenium	*b*	*0.63 mg/kg*		*6.3*
Zinc	*b*	*460 mg/kg*		*153*

04SD–9

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Benzyl alcohol*	*a1*	*3100 µg/kg*	*60*	
Benzo(a)pyrene	*b*	*110 µg/kg*		*1.1*
Di–n–butylphthalate	*b*	*510 µg/kg*		*8.5*
Indeno(1,2,3–cd)pyrene	*a1*	*160 µg/kg*	*9.4*	
PCB–1260**	*b*	*22 µg/kg*		*2.2*
Cadmium	*c*	*3.2 mg/kg*	*5.3*	*1067*
Copper	*b*	*37 mg/kg*		*3.7*
Lead	*b*	*130 mg/kg*		*1.0*
Zinc	*b*	*200 mg/kg*		*67*

04SD–10

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Benzo(a)pyrene	*b*	*130 µg/kg*		*1.3*
Indeno(1,2,3–cd)pyrene	*a1*	*87 µg/kg*	*5.1*	
Pyrene	*a2*	*260 µg/kg*	*4.9*	
Copper	*b*	*15 mg/kg*		*1.5*
Zinc	*b*	*56 mg/kg*		*19*

04SD–12

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Indeno(1,2,3–cd)pyrene	*a2*	*85 µg/kg*	*5.0*	
Arsenic	*b*	*13 mg/kg*		*3.3*
Copper	*b*	*13 mg/kg*		*1.3*
Zinc	*b*	*68 mg/kg*		*23*

S4–1

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Cadmium	*b*	*1.6 mg/kg*		*533*
Nickel	*a1*	*120 mg/kg*	*6.7*	
Zinc	*b*	*120 mg/kg*		*40*

S4–2

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Cadmium	*b*	*0.44 mg/kg*		*147*
Zinc	*b*	*83 mg/kg*		*28*

S4–3

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Acetone	*b*	*320 µg/kg*		*1.1*
Cadmium	*c*	*2.9 mg/kg*	*4.8*	*967*
Zinc	*b*	*330 mg/kg*		*110*

S4–4

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Cadmium	*b*	*0.26 mg/kg*		*87*
Zinc	*b*	*68 mg/kg*		*23*

S4–5

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Cadmium	*b*	*0.65 mg/kg*		*217*
Zinc	*b*	*120 mg/kg*		*40*

S4–6

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Cadmium	*b*	*0.27 mg/kg*		*90*
Zinc	*b*	*59 mg/kg*		*20*

S4–7

Constituent	Exceeds	Concentration	FW Ratio	Bio Ratio
Cadmium	*b*	*1.1 mg/kg*		*367*
Zinc	*b*	*76 mg/kg*		*25*

FORMER FLIGHT APRON OUTFALL

ERP SITE 1 AREA OUTFALL

BLDG 455 AREA OUTFALL

DETENTION POND #1

Figure 2-11

ERP Site 4
Contaminants of Potential
Ecological Concern Detected In Sediment
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon

ERM 10/03

Project No. 10002.31
Date: 10/30/03
Drawn By: J. Estrada
CAD File: g:\10002\31\100023112.dwg

LEGEND

- Phase I RI Surface Water Sampling Location (OpTech 1996)
- Phase II RI and Subsequent Surface Water Monitoring Location (ERM 2001a)
- *a1* Exceeds Aquatic Screening for Individual Constituent
- *a2* Exceeds Aquatic Screening for Multiple Constituents
- Direction of Water Flow
- Drainline Outfall
- ERP Site Boundary

0 150 300
Scale in Feet

04SW-1

Constituent	Exceeds	Concentration	Aquatic Ratio
Copper	*a2*	*0.037* mg/l	*4.1*
Lead	*a2*	*0.011* mg/l	*4.4*

04SW-6

Constituent	Exceeds	Concentration	Aquatic Ratio
Lead	*a2*	*0.012* mg/l	*4.8*

04SW-7

Constituent	Exceeds	Concentration	Aquatic Ratio
Lead	*a1*	*0.018* mg/l	*7.2*

04SW-8

Constituent	Exceeds	Concentration	Aquatic Ratio
Lead	*a1*	*0.033* mg/l	*13*

Figure 2-12
ERP Site 4
Contaminants of Potential
Ecological Concern Detected In Surface Water
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon

ERM 10/03

Project No. 10002.32
Date: 12/22/03
Drawn By: R. Olson
CAD File: G:\10002\32\100023201.dwg

AREA B

Site 9

AREA A

DISPENSING STATION

FILLING STATION

AVENUE

CAREY

BOULEVARD

HAMPSHIRE

JOHNSO

1001

115

ARMY NATIONAL GUARD ARMORY

CONC.

CONC.

GP9-17	ND
GP9-20	ND
GP9-21SZ*	T 0.590J
GP9-16	ND
MW9-1**	ND
MW9-2**	ND
GP9-15	ND
GP9-22	G 52.6J
GP9-22 DZ*	ND
GP9-5	D 1,000; G 190
MW9-3*	ND
GP9-14	ND
MW9-4*	G 88.6; D 225J
GP9-18	ND
GP9-13	D 300
MW9-5*	ND
GP9-4	D 1,000; G 530
GP9-8	D 1,000; G 370; B 80; E 1.0; X 1.0
GP9-23	D 548; G 51.0J
GP9-23 DZ*	ND
GP9-12	ND
GP9-19	ND
GP9-11	ND
GP9-10	B 3.0; E 2.0; X 1.0
GP9-9	D 380; B 1.0
GP9-3	D 1,900; G 780
GP9-7	D 18,000; G 5,100; B 1,200; E 780; X 760
GP9-6	ND
GP9-1	D 2,500; G 3,500; B 8.0; E 4.0
GP9-24 SZ*	D 621; H 400J
GP9-2	ND
GP9-26	G 60.9J; H 1,160
GP9-25	G 65.7

LEGEND

- Monitoring Well, Shallow Zone
- Monitoring Well, Deep Zone
- Phase II RI Direct-Push Point
- * Samples collected in October 1999
- ** Samples collected in March 1999

Concentrations in micrograms per liter (ug/l)
J – Estimated Concentration

- Approximate Extent of Dissolved TPH/BTEX
- Dominant Groundwater Flow Direction (Shallow Zone)
- ERP Site Boundary
- Former 25,000 Gal. UST Location
- 270 Building ID

ABBREVIATIONS
D – TPH as Diesel
H – TPH as Heavy Oil
G – TPH as Gasoline
B – Benzene
E – Ethylbenzene
T – Toluene
X – Xylenes
ND – Not Detected
SZ – Shallow Zone
DZ – Deep Zone

N

0 40 80
Scale in Feet

Figure 2-13
ERP Site 9
TPH and BTEX Concentrations Detected in Groundwater
February/March 1998 and March/October 1999
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon

ERM 12/03

Groundwater contamination at ERP Site 9 is limited to the Shallow Zone. No direct or indirect evidence of free-phase hydrocarbons has been observed in soil borings or groundwater monitoring wells installed at ERP Site 9. The concentrations of TPH and BTEX detected in soil and groundwater are significantly less than the concentrations typically observed at sites where free-phase hydrocarbons are present.

The presumed source of the Site 9 contamination is historical leaks and spills that occurred during operation of the former USTs, ASTs, and associated piping and fuel dispensing systems at the site. The dissolved PAHs detected in groundwater are assumed to be components of the petroleum products that were stored/dispensed at the site. The source of the chlorinated VOCs detected sporadically at low concentrations in groundwater is unknown. These compounds were not detected in soil, and there are no known sources of chlorinated compounds at ERP Site 9.

Based on ODEQ guidance for the identification of hot spots (ODEQ 1998a), a portion of the ERP Site 9 TPH plume qualifies as a groundwater hot spot. The hot spot corresponds to the area where dissolved VOC concentrations exceed pre-calculated significant adverse effect levels for an assumed drinking-water use of groundwater (ODEQ 1998b). Figure 2-14 shows the approximate extent of the groundwater hot spot at ERP Site 9, based on maximum historical contaminant concentrations detected in groundwater. The hot spot is defined primarily by the presence of benzene above 5 µg/L (the Federal primary drinking water standard for benzene). As groundwater at the Base is not currently used for drinking water, this hot spot designation is based on the potential future use as drinking water and the potential for contaminants to migrate to an off-site drinking water resource.

2.5.4.4 ERP Site 11 - Washrack West of Building 250

Contaminants detected in soil and groundwater at ERP Site 11 include chlorinated VOCs, BTEX, and TPH. The lateral extent of VOCs and TPH in soil prior to the 1999 soil removal action was generally limited to within 25 feet of the former oil/water separator. Figure 2-15 shows the extent of organic contaminants remaining in soil after the 1999 removal action. The residual VOCs and TPH in soil near the water table pose a continuing threat to groundwater quality.

VOCs and petroleum hydrocarbons are present in groundwater in the Shallow and Deep Zones at ERP Site 11. There have been no confirmed detections of contaminants in the CRSA. The approximate lateral and

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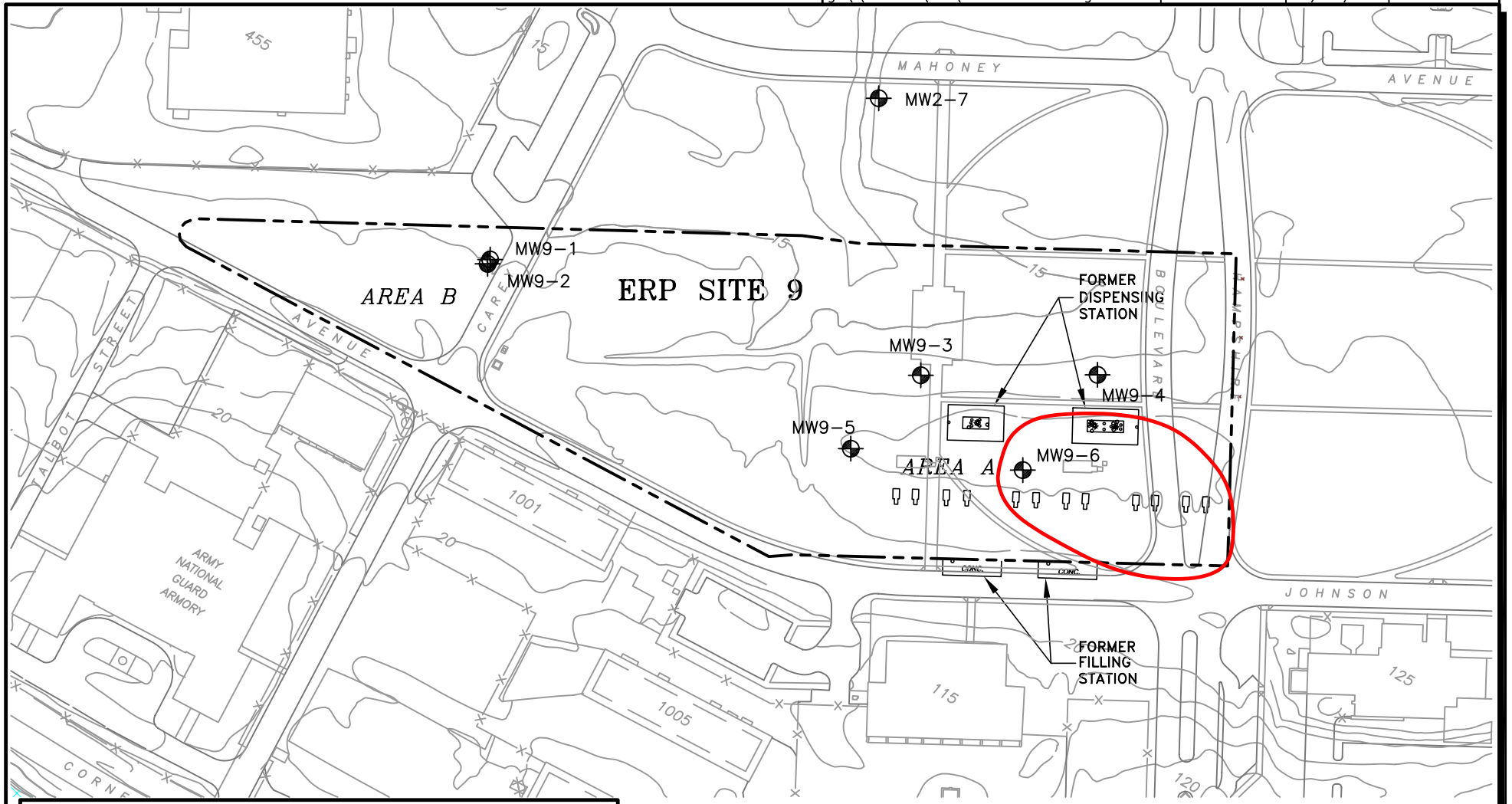

LEGEND

- Monitoring Well, Shallow Zone
- Monitoring Well, Deep Zone
- 1113 Building ID
- Shallow Zone Hot Spot
- ERP Site Boundary
- Former 25,000-Gallon UST Location
- 15 Ground Surface Elevation Contour (ft amsl)

N

0 75 150

Scale in Feet

Figure 2-14

ERP Site 9

Approximate Extent of Hot Spot in Groundwater

142nd FW, Portland ANGB

Portland International Airport

Portland, Oregon

ERM 10/03

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Date: 10/30/03
Project No. 10002.31

Site 11

GP11-19
GP11-16
GP11-17
GP11-18
GP11-20
GP11-4
GP11-22
GP11-11
GP11-15
GP11-23
GP11-13
GP11-9
GP11-2
GP11-1
GP11-14
GP11-24

Concrete Driveway

Former Concrete Washrack Area

Former Oil Water Separator

CS1-083199

CS3-090199-6.0'	
G	1,690
D	743
B	18.3J
CB	605
1,4-DCB	469
E	1,210

CS9-090399-6.0'	
G	322
D	698
B	21.1J
CB	582
1,4-DCB	431
E	1,550

GP11-6@3.0'	
D	160
GP11-6@5.0'	
CIS-1,2-DCE	130
PCE	70
T	1,000
GP11-6@7.0'	
CIS-1,2-DCE	180
E	3,200
T	3,700
X	22,000
G	1,300
D	**420**

CS14-090399-4.0'	
G	694
D	641
B	39.7J
CB	519
1,4-DCB	358
CIS-1,2-DCE	1080
VC	1010
T	979
E	956

CS4-090199-6.0'	
G	1,910
D	532
B	56.6J
CB	776
1,4-DCB	498

CS2-090199-6'	
G	535
D	444
1,4-DCB	174
CIS-1,2-DCE	230
VC	104
CB	90.3J

GP11-5@6.0'	
D	250

GP11-10@5.0'	
B	4.0
D	180

CS8-090199-3.5'	
B	**2.07J**
VC	**7.77**

CS13-090399-3.0'	
G	1,250
D	2,430
B	28.5J
CB	1430
1,4-DCB	1060
E	2,290

GP11-3@5.5'	
G	600
D	580

GP11-12@2.0'	
VC	5.0
GP11-12@5.0'	
VC	5.0

CS16-090399-7.5'	
G	836
D	217
CB	311
1,4-DCB	163

CS7-090199-3.5'	
VC	**7.66**
CIS-1,2-DCE	**36.3**

CS12-090399-7.5'	
G	1,570
D	2,640
B	37.7J
E	26,900
X	20,730
CB	1,180
1,4-DCB	612
VC	109

CS15-090399-7.5'	
G	1,500
D	2,900
B	119
X	32,500
1,2-DCB	1,110
1,4-DCB	**467**
CIS-1,2-DCE	**410**
VC	**72.4J**
E	4,450
T	5,870

LEGEND

- EE/CA DIRECT-PUSH POINT
- EXCAVATION SAMPLE
- APPROXIMATE EXTENT OF TOTAL PETROLEUM HYDROCARBONS and VOLATILE ORGANIC COMPOUNDS ABOVE PSGs IN SOIL
- EXCAVATION LIMITS, SEPTEMBER 1999
- GRASS
- SITE 11 BOUNDARY

All concentrations in micrograms per kilogram except as noted

ABBREVIATIONS
D – TPH-Diesel (milligrams per kilogram)
G – TPH-Gasoline (milligrams per kilogram)
CIS-1,2-DCE – Cis-1,2-Dichloroethene
PCE – Tetrachloroethene
B – Benzene
T – Toluene
E – Ethylbenzene
X – Xylene
VC – Vinyl Chloride
CB – Chlorobenzene
1,2-DCB – 1,2-Dichlorobenzene
1,4-DCB – 1,4-Dichlorobenzene
J=Estimated Concentration
PSG – Project Screening Goal

N

0 15 30
Scale in Feet

Figure 2-15
ERP Site 11
Extent of Organic Contaminants Remaining In Soil After September 1999 Removal Action
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon

ERM 10/03

vertical extent of chlorinated VOCs in groundwater is shown in Figures 2-16 and 2-17. Dissolved VOCs have migrated primarily toward the northwest, west, and southwest from the former oil/water separator source area. The concentrations of chlorinated VOCs have fluctuated since groundwater monitoring began in 1997. These fluctuations likely reflect seasonal changes in groundwater levels and flow directions.

During the Phase II RI, two direct-push groundwater samples were collected from the bottom of the Shallow Zone in the immediate vicinity of the former oil/water separator to assess the potential presence of dense non-aqueous phase liquid (DNAPL). Although dissolved VOCs were detected in these groundwater samples, the concentrations were not indicative of DNAPL; the maximum VOC concentration detected was 63 µg/L (vinyl chloride). Concentrations of the order of 10,000 µg/L indicate the possible presence of DNAPL (Pankow and Cherry 1996).

Based on ODEQ guidance for the identification of hot spots (ODEQ 1998a), portions of the Site 11 VOC plume in the Shallow and Deep Zones qualify as groundwater hot spots. The hot spots correspond to the areas where dissolved VOC concentrations exceed pre-calculated significant adverse effect levels for an assumed drinking-water use of groundwater (ODEQ 1998b). Figure 2-18 shows the approximate extent of the groundwater hot spots at ERP Site 11, based on maximum contaminant concentrations detected in groundwater from January 2001 through April 2003. The hot spots are defined primarily by the presence of vinyl chloride above 2 µg/L (the Federal primary drinking water standard for vinyl chloride). As groundwater at the Base is not currently used for drinking water, this hot spot designation is based on the potential future use as drinking water and the potential for contaminants to migrate to an off-site drinking water resource.

2.5.5 Conceptual Site Model

The conceptual site model (CSM) for contaminated soil, sediment, and groundwater at the Portland ANGB is summarized in bullet form below. The evaluation of site risks and remedial alternatives during the RI/FS was based on this model. The response actions will address the contaminant pathways and potential exposure routes identified in the CSM.

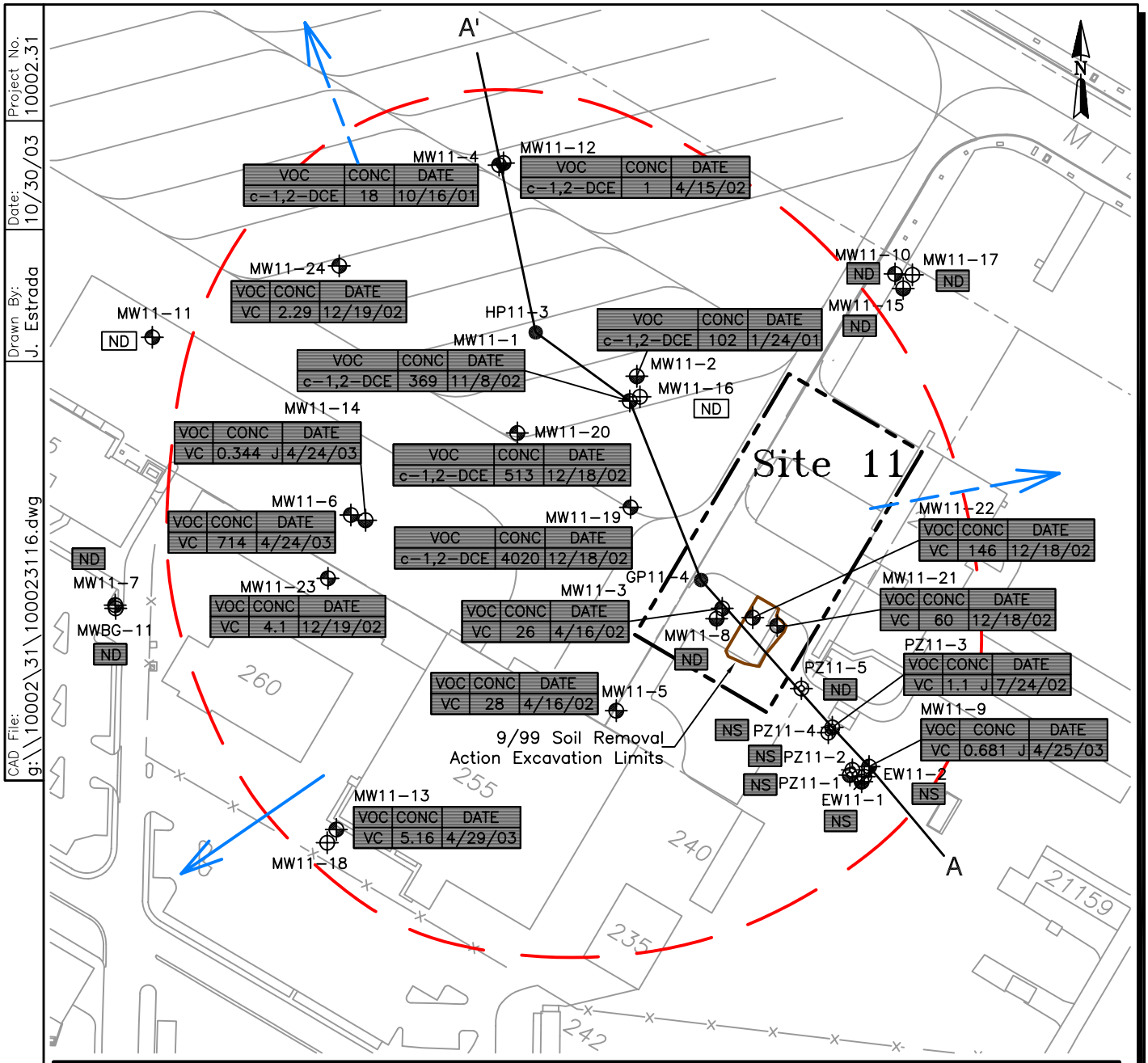

Figure 2-16

ERP Site 11 - Maximum VOC Concentrations Detected in Groundwater, 1/01-4/03

142nd FW, Portland ANGB

Portland International Airport

Portland, Oregon

ERM 10/03

CAD File: g:\10002\31\100023117.dwg
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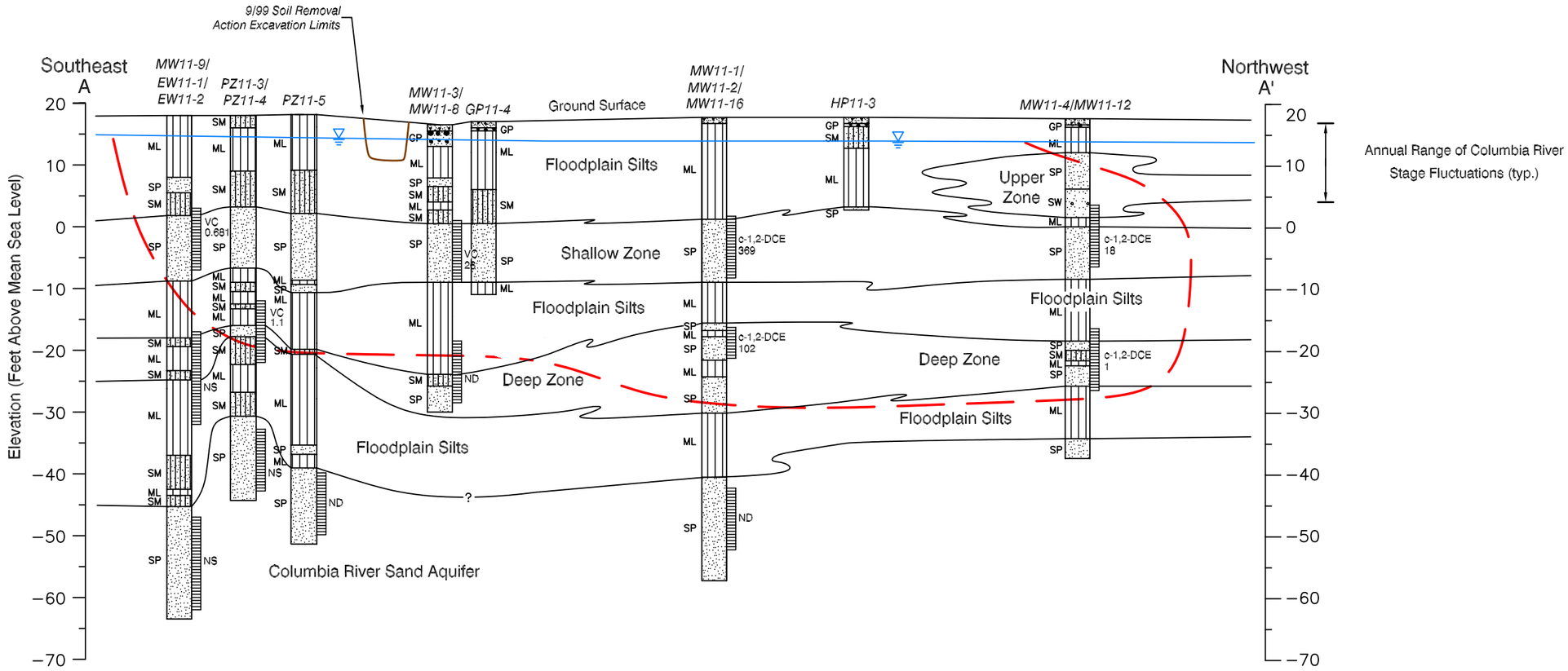

Note: See Figure 2–16 for Cross Section Orientation

Legend

35.0	Maximum VOC Concentration (µg/L); See Figure 2–16 for Sampling Dates.		Concrete
	Screened Interval		Silt/Clayey Silt/Sandy Silt
	Shallow Zone Potentiometric Surface (April 2003)		Clayey Sand
	Approximate Extent of Dissolved VOCs		Silty Sand
c–1,2–DCE	cis–1,2–Dichloroethene		Poorly Graded Gravelly Sand/Sand
VC	Vinyl Chloride		Well Graded Gravelly Sand/Sand
ND	Not Detected		Gravel/Sandy Gravel
NS	Not Sampled		

(Vertical Exaggeration = 5X)

VERTICAL SCALE IN FEET 1" = 20'

HORIZONTAL SCALE IN FEET 1" = 100'

Figure 2-17
ERP Site 11
Hydrogeologic Cross Section
Maximum VOC Concentrations Detected in Groundwater, 1/01-4/03
142nd FW, Portland ANGB
Portland International Airport
Portland, Oregon

ERM 10/03

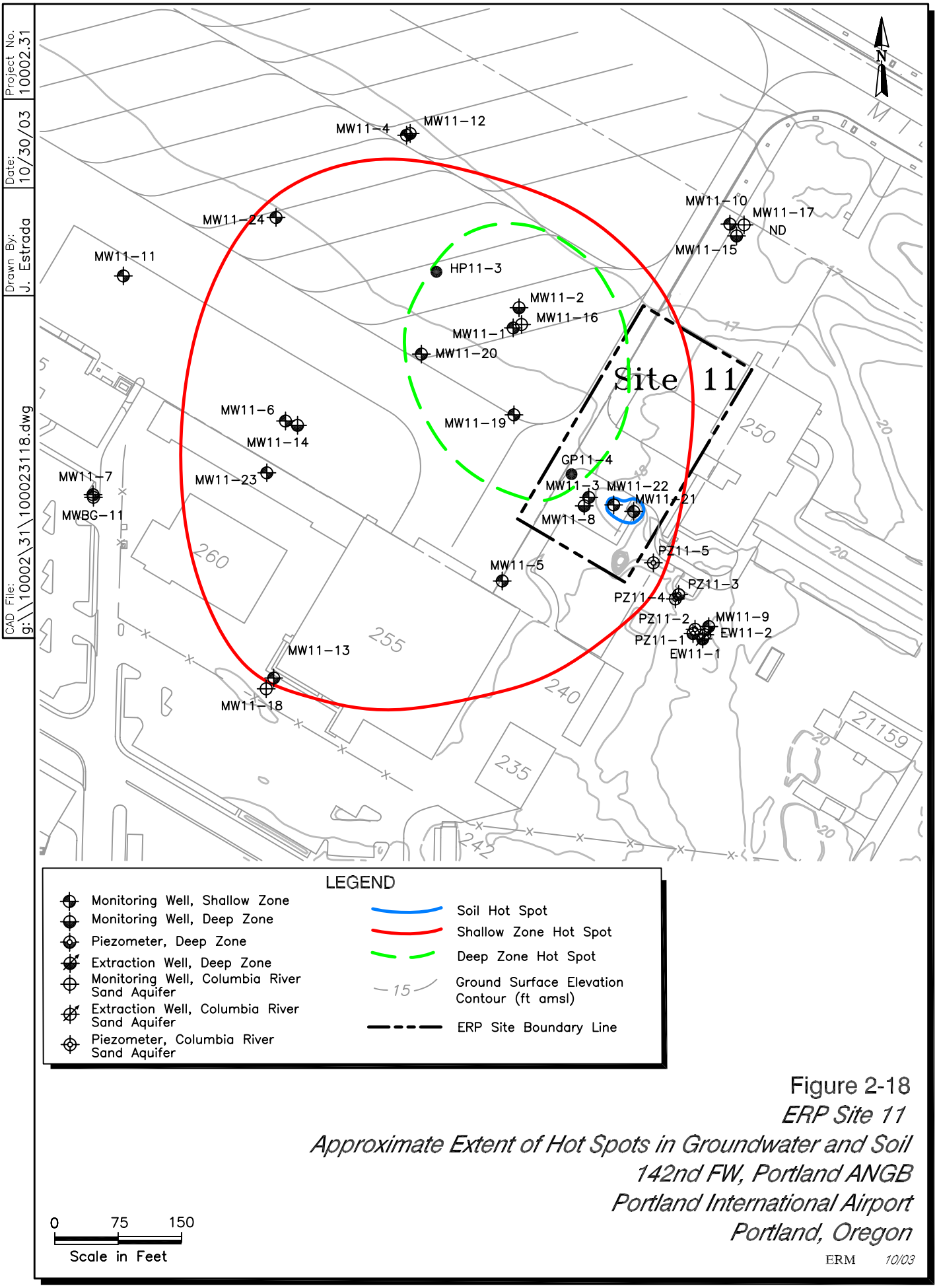

Figure 2-18

ERP Site 11

Approximate Extent of Hot Spots in Groundwater and Soil

142nd FW, Portland ANGB

Portland International Airport

Portland, Oregon

ERM 10/03

- Primary Sources:
  - ERP Site 2 – drums and other containers of chlorinated solvents stored in former solvent storage shed
  - ERP Site 4 – fuel hydrocarbons, heavy oils, and solvents in surface runoff from various facilities basewide
  - ERP Site 9 – jet fuel stored in USTs
  - ERP Site 11 – fuel hydrocarbons and solvents in rinsate/runoff from aircraft washing operations at washrack
- Primary Release Mechanisms:
  - ERP Sites 2 and 9 – leaks and incidental spills
  - ERP Site 4 – conveyance of contaminated runoff from various facilities to ditch via Base stormwater drainage system
  - ERP Site 11 – leaks through cracks in former oil/water separator
- Secondary Sources:
  - ERP Sites 2 and 9 – contaminated soil (historical source; no longer applicable due to leaching, degradation, and/or soil removal during site improvements)
  - ERP Site 4 – groundwater contaminant plume at ERP Sites 1, 2, and 3
  - ERP Site 11 – residual contamination in soil around former oil/water separator
- Secondary Release Mechanisms:
  - ERP Sites 2 and 9 – infiltration/soil leaching (no longer applicable; see previous bullet)
  - ERP Site 4 – discharge of groundwater to ditch
  - ERP Site 11 – infiltration/soil leaching
- Pathway:
  - ERP Sites 2, 9, and 11 – groundwater, indoor air in areas where contaminant plume extends under buildings
  - ERP Site 4 – sediment, surface water

- Potential Receptors:
  - ERP Sites 2, 9, and 11 – Base workers, reservists, construction workers, hypothetical on-site residents (ingestion, inhalation, and/or dermal exposure routes)
  - ERP Site 4 – construction workers, benthic invertebrates, fish, birds, small mammals

It should be emphasized that groundwater at the Portland ANGB is not currently used for any purpose, and there are no plans to use it in the future. The Base and surrounding area are served by the City of Portland public water supply, which comes primarily from surface water in the Bull Run Watershed. The public water supply is supplemented as necessary by the Portland well field. The inclusion of hypothetical on-site residents as potential receptors in the CSM for ERP Sites 2, 9, and 11 is based on the possible future use of Base groundwater as drinking water. Additionally, the on-site residential scenario was included as a conservative means of assessing "worst-case" risks associated with the potential off-site migration of contaminated groundwater.

2.6 Current and Potential Future Land and Resource Uses

The Portland ANGB site is currently used for ongoing operations of the 142nd FW. These operations include Base administrative functions and aircraft and support equipment operation, maintenance, and repair activities consistent with the mission of the 142nd FW. Surrounding land use in the vicinity of the site is a mixture of industrial, commercial, residential, and recreational. The Colwood Golf Course is immediately east of the Base. The PIA borders the Base on the north, and immediately north of the PIA is the Columbia River. The Base is bordered on the south by the Columbia Slough, which discharges to the Columbia River. In addition to providing abundant wildlife habitat, the Columbia River is a major recreational resource and shipping corridor. At this time, no significant future changes in land use are anticipated.

Groundwater at the Base is not currently used for any purpose, and there are no plans to use the groundwater. However, to be conservative, the assessment of site risks was based on the assumption that groundwater could potentially be used as a drinking water source in the future.

2.7 Summary of Site Risks

The potential human health and ecological risks posed by contaminants in soil, sediment, groundwater, and surface water at the Base were evaluated in a baseline risk assessment performed during the RI. A baseline risk assessment estimates the risks posed by a site if no action is taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the response action. The Portland ANGB baseline risk assessment was performed in accordance with United States Environmental Protection Agency (USEPA) and ODEQ guidance. The potential ecological risks associated with ERP Site 4 were further evaluated in a Level I (scoping) and Level II (screening) ecological risk assessment, conducted per ODEQ guidance. The following sections summarize the methods and results of the risk assessments. Details of the risk assessments are provided in the Final RI Report (ERM 2001a) and the *Final Site Ecology Screening Report for Environmental Restoration Program Site 4* (ERM 2002a). The risk assessment results are summarized in Table 2-2.

2.7.1 Human Health Risk Assessment

In accordance with ODEQ's *Guidance for Conduct of Deterministic Human Health Risk Assessments* (ODEQ 2000) and USEPA's *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual/Part A* (USEPA 1989), the human health risk assessment followed the traditional risk assessment process defined in *Risk Assessment in the Federal Government: Managing the Process* (National Research Council 1983). This process consisted of the following four steps:

- Data evaluation/identification of contaminants of potential concern. In this initial step, the site characterization data were reviewed and contaminants of potential concern were selected for evaluation in the risk assessment.

- Exposure assessment. In the exposure assessment, populations that may be exposed to site contaminants were identified, and potential exposure pathways were defined. A complete exposure pathway requires a contaminant source, an exposure point (such as on-site soils), and an exposure route (such as inhalation, dermal contact, or ingestion).

- Toxicity assessment. In the toxicity assessment, toxicity data for individual contaminants of potential concern were compiled from standard government sources for use in the risk calculations.

- Risk characterization. In the fourth step of the risk assessment, the results of the exposure and toxicity assessments were combined with Federal and State-defined risk equations to calculate estimated risk.

The populations/exposure scenarios evaluated in the human health risk assessment included a temporary construction/trench worker scenario, a full-time Base worker scenario, an ANG reservist scenario, and a hypothetical on-site resident scenario. Risks exceeding USEPA and/or Oregon acceptable levels were identified at ERP Sites 1, 2, 3, 9, and 11. The unacceptable risks were associated with the potential future use of groundwater as drinking water; the primary COCs responsible for the unacceptable risks are identified in Table 2-2. Detailed results of the human health risk assessment for each ERP site are presented in the Final RI Report (ERM 2001a).

2.7.2 Ecological Risk Assessment

A Level I (scoping) ecological risk assessment was conducted in accordance with ODEQ guidance (ODEQ 1998c) at each of the ERP sites evaluated in the RI. Potential sensitive ecological receptors and complete exposure pathways were identified at ERP Site 4 (Main Drainage Ditch). Ecological risks were not identified at the other ERP sites. Based on the results of the Level I assessment, a Level II (screening) ecological risk assessment was performed at ERP Site 4. The results of the Level II assessment indicate that Site 4 presents a potential ecological risk due to the presence of contaminants in sediments (primarily SVOCs, PCBs, and metals) at concentrations exceeding Oregon risk-based screening level values. Ecological receptors may be exposed to these contaminants through several pathways. For example, the contaminants can be taken up by vegetation in the ditch (e.g., grasses) and then ingested by local bird populations that forage in the ditch. Detailed results of the Level II assessment are presented in the *Final Site Ecology Screening Report for Environmental Restoration Program Site 4* (ERM 2002a).

2.8 Remedial Action Objectives

The RAOs for the Portland ANGB address the potential risks identified at ERP Sites 1, 2, 3, 4, 9, and 11. The ANG's goal in implementing remedial actions at these sites is to reduce potential risks to acceptable levels that comply with State and Federal regulations. The RAOs are as follows:

- Restore the beneficial use of site groundwater by treating groundwater hot spots of contamination to concentrations below significant adverse effect levels defined by ODEQ.

- Prevent on-site exposure to groundwater containing COCs above acceptable risk level risk-based concentrations. For deterministic risk estimates, ODEQ defines the acceptable risk level for human exposure to individual carcinogens as a lifetime excess cancer risk of less than or equal to one per one million (i.e., 1×10^{-6}; Oregon Administrative Rules [OAR] 340-122-0115(2)(a)). ODEQ defines the acceptable risk level for human exposure to noncarcinogens as a hazard index less than or equal to one (OAR 340-122-0115(4)(a)). These risk levels correspond to different risk-based concentrations for individual COCs.

- Prevent off-site migration of groundwater containing COCs above acceptable risk-based concentrations.

- To prevent potential future impacts to the beneficial use of groundwater, treat residual soil contamination in the area of the former oil/water separator at ERP Site 11.

- Prevent ecological exposure to ditch sediments at ERP Site 4 that contain contaminants above acceptable ecological risk-based concentrations.

The target cleanup levels for individual COCs in groundwater are presented in Table 2-3. The groundwater cleanup levels are based on a drinking-water beneficial use scenario. The cleanup levels for the treatment of groundwater hot spots correspond to ODEQ pre-calculated significant adverse effect levels (Table 2-1 of *Final Pre-Calculated Hot Spot Look-Up Tables*; ODEQ 1998b). The cleanup levels for the prevention of off-site migration and on-site exposure above acceptable risk levels correspond to USEPA Region 9 Preliminary Remediation Goals for tap water (USEPA 2002).

TABLE 2-3

Target Cleanup Levels for Groundwater
142nd FW, Portland ANGB, Portland, Oregon

ERP Site	Contaminant of Concern	Cleanup Level (µg/L)	
		Treatment of Hot Spots[a]	Prevention of Off-Site Migration & On-Site Exposure Above Acceptable Risk Levels[b]
1, 2, & 3	Benzene	5	0.34
	1,1-Dichloroethene	340[c]	340
	cis-1,2-Dichloroethene	70	61
	1,2-Dichloropropane	5	0.16
	Trichloroethene	5	0.028
	Vinyl Chloride	2	0.02
9	Benzene	5	0.34
	Benzo(a)anthracene	0.092[c]	0.092
	Benzo(b)fluoranthene	0.092[c]	0.092
	Benzo(a)pyrene	0.2	0.0092
	Bis(2-ethylhexyl)phthalate	6	4.8
11	Benzene	5	0.34
	1,2-Dichloroethane	5	0.12
	Vinyl Chloride	2	0.02

Notes:

µg/L = Micrograms per liter

(a) Cleanup levels for hot spots correspond to ODEQ pre-calculated "significant adverse effect" levels (Table 2-1 in *Final Pre-Calculated Hot Spot Look-Up Tables;* ODEQ 1998). The basis for the "significant adverse effect" levels is the National Primary Drinking Water Standard Maximum Contaminant Levels (MCLs), except as noted.

(b) Cleanup levels for prevention of off-site migration & on-site exposure above acceptable risk levels correspond to USEPA Region 9 Preliminary Remediation Goals (PRGs) for tap water (USEPA Region 9, October 2002).

(c) Basis is USEPA Region 9 PRGs for tap water.

The baseline human health risk assessment concluded that the contaminated soil at ERP Site 11 and the contaminated sediments at ERP Site 4 do not pose unacceptable risks under the exposure scenarios analyzed (i.e., construction/trench worker, Base worker, reservist, and hypothetical on-site resident; ERM 2001a). The objective of treating the residual soil contamination at Site 11 is to prevent potential future impacts to the beneficial use of groundwater. The effectiveness of the Site 11 soil treatment will be assessed through groundwater monitoring and comparison of dissolved COC concentrations to the target cleanup levels in Table 2-3.

The planned stormwater improvement/ditch filling project at ERP Site 4 will cover the contaminated ditch sediments with approximately 5 to 10 feet of clean fill material. This sediment cap will prevent ecological exposure to the ditch sediments, thereby eliminating ecological risks. The ditch sediments are not expected to pose a risk to underlying groundwater due to the low leachability of the contaminants.

No other soil or sediment contamination requiring remedial action has been identified at the Base. Consequently, cleanup levels for soil and sediment were not developed.

2.9 Description of Alternatives

Six remedial alternatives for addressing contaminated groundwater at ERP Sites 2, 9, and 11 were evaluated in the FS (ERM 2001b):

- Alternative 1: No Action. Under this alternative, no site modifications, monitoring, or other actions would be implemented to reduce or eliminate human health and environmental risks.

- Alternative 2: Monitored Natural Attenuation. Natural attenuation reduces the mass and concentrations of contaminants through naturally occurring biological, physical, and chemical processes. This alternative involves monitoring and documenting the intrinsic bioremediation element of natural attenuation; active treatment measures would not be taken.

- Alternative 3: In Situ Oxidation – Potassium Permanganate/Sodium Persulfate Injection with Monitored Natural Attenuation. This alternative involves the injection of a solution of either potassium

permanganate to treat chlorinated VOCs, or sodium persulfate to treat benzene (and trace PAHs, if present), into the contaminated zone. These materials are strong oxidants that have been shown to rapidly destroy dissolved VOCs. This alternative also includes the use of MNA in areas with low concentrations of VOCs.

- Alternative 4: In Situ Oxidation – Ozonation with Monitored Natural Attenuation. This alternative involves the injection of a mixture of air and ozone gas into the contaminated zone. Ozone is a strong oxidant that has been shown to rapidly destroy dissolved VOCs. This alternative also includes the use of MNA in areas with low concentrations of VOCs.

- Alternative 5: Enhanced Bioremediation with Monitored Natural Attenuation. This alternative involves the injection of a material that stimulates natural biological activity into the contaminated zone. The increased activity of native microbes in the saturated zone results in an increased rate of contaminant biodegradation. This alternative also includes the use of MNA in areas with low concentrations of VOCs.

- Alternative 6: In-Well Aeration with Monitored Natural Attenuation. This alternative involves the stripping of dissolved VOCs from groundwater within treatment/aerator wells. Groundwater flows into the treatment well through a lower screen and is pumped to the upper section of the well, where it is sparged with air. The sparged water then flows back into the surrounding formation through an upper well screen. This alternative also includes the use of MNA in areas with low concentrations of VOCs.

Two remedial alternatives for addressing contaminated sediment at ERP Site 4 were considered in the Proposed Plan (ERM 2003a):

- Alternative 1: Excavation and Off-Site Disposal. This alternative involves the excavation and off-site disposal of contaminated ditch sediments. Following removal of contaminated sediments, confirmation samples would be collected to verify that contaminant concentrations in the remaining sediments are below site-specific cleanup levels.

- Alternative 2: Ditch Filling/Sediment Capping. In this alternative, ecological risks would be eliminated by installing stormwater drainage piping in the ditch, and then filling the entire ditch with clean fill material. Since the United States Army Corps of Engineers has

designated the Main Drainage Ditch as a jurisdictional wetland, mitigation measures would be necessary to offset the loss of this wetland.

The remedial alternatives for ERP Sites 2, 9, and 11 developed in the FS are described further below; a detailed analysis of each alternative relative to the individual FS evaluation criteria is presented in the Final FS Report (ERM 2001b). Since the Portland ANGB plans to implement sediment Alternative 2 as part of a facility stormwater improvement project, thereby eliminating potential ecological risks, the two alternatives for ERP Site 4 were not analyzed further through the FS process. Accordingly, because the Site 4 remedy was not selected through the normal remedy selection process, the remaining sections of this ROD pertain mainly to the groundwater alternatives.

Upon attaining the RAOs, each alternative described below (with the exception of Alternative 1) is expected to result in the availability of Base groundwater for unrestricted use. Land will continue to be available for industrial use.

2.9.1 Alternative 1: No Action

Under Alternative 1, no active treatment measures, site modifications, groundwater monitoring, or other actions would be taken to prevent or eliminate human health and environmental risks associated with COCs in groundwater. This alternative is not expected to be effective, as it includes no measures to protect human health and the environment, comply with RAOs, or reduce contaminant TMV. However, consistent with Federal CERCLA guidance, the No Action alternative was included in the FS as a baseline for comparison against the other alternatives. There would be no costs associated with implementing this alternative.

2.9.2 Elements Common to Alternatives 2, 3, 4, 5, and 6

Alternatives 2, 3, 4, 5, and 6 share several common elements that fall into the general category of institutional controls. Such controls provide protection from existing risks or future residual risks at the Base. Institutional controls will be utilized as necessary to manage risks during and/or after the active treatment phase at each ERP site. Because the common elements are the same for Alternatives 2, 3, 4, 5, and 6, they are described below separately, rather than repeatedly in the subsequent sections describing each alternative. Additionally, the costs associated

with the common elements are not included in the remedial cost estimates, because these costs are the same for each site and each alternative.

The elements common to Alternatives 2, 3, 4, 5, and 6 include:

- Long-term monitoring of VOC concentrations in the Shallow Zone, Deep Zone, and/or CRSA within and beyond the boundaries of the active treatment areas at ERP Sites 2, 9, and 11. Monitoring would be conducted annually for up to 30 years.

- Use of basewide access restrictions to prevent access by unauthorized persons or use of the facility for unauthorized purposes. Access is currently limited to Base workers and authorized visitors and contractors. A chain-link fence surrounds the property, and all workers and visitors must enter and exit the Base through a manned security gate. Access to the Base is strictly controlled by ANG security personnel.

- Use of digging permits, contaminated media management plans, and health and safety plans that require proper approvals and appropriate training, equipment, monitoring, and material handling/waste management practices during activities that could potentially put workers in contact with contaminated media or otherwise pose risks. Examples of such activities include subsurface construction work or trenching.

- Utilization of alternative water supplies, such as the existing public water supply, when additional water capacity is required, rather than obtaining this capacity through extraction of groundwater at the Base.

2.9.3 Alternative 2: Monitored Natural Attenuation

Alternative 2 utilizes MNA as the primary treatment method. MNA would be implemented at each site. Based on the observed COC concentrations, the duration of this alternative is expected to be approximately 30 years. This alternative also includes the use of institutional controls as described in Section 2.9.2.

2.9.3.1 Implementation of Alternative 2 at ERP Site 2

Implementation of Alternative 2 at ERP Site 2 would involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone.
- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and two CRSA monitoring wells within, and surrounding, the hot spots of contamination.
- Monitoring the new and existing monitoring wells quarterly for 1 year and annually for up to 30 years. Groundwater would be monitored for VOCs and MNA parameters.

The total estimated cost for implementing Alternative 2 at ERP Site 2, including a 30 percent contingency, is $717,000.

2.9.3.2 Implementation of Alternative 2 at ERP Site 9

Implementation of Alternative 2 at ERP Site 9 would involve:

- Installing seven Shallow Zone monitoring wells within, and surrounding, the hot spot of contamination.
- Monitoring the new and existing monitoring wells quarterly for 1 year and annually for 30 years. Groundwater would be monitored for VOCs, PAHs, and MNA parameters.

The total estimated cost for implementing Alternative 2 at ERP Site 9, including a 30 percent contingency, is $292,000.

2.9.3.3 Implementation of Alternative 2 at ERP Site 11

Implementation of Alternative 2 at ERP Site 11 would involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone.
- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and three CRSA monitoring wells within, and surrounding, the hot spots of contamination.

- Monitoring the new and existing monitoring wells quarterly for 1 year and annually for up to 30 years. Groundwater would be monitored for VOCs and MNA parameters.

The total estimated cost for implementing Alternative 2 at ERP Site 11, including a 30 percent contingency, is $763,000.

2.9.4 Alternative 3: In Situ Oxidation - Potassium Permanganate/Sodium Persulfate Injection with Monitored Natural Attenuation

Alternative 3 utilizes a combination of treatment processes. The primary treatment method within the hot spots is in situ oxidation, using either potassium permanganate or sodium persulfate as the oxidant. The application technique for both of these oxidants would be the same; i.e., subsurface injection through wells or direct-push borings. Potassium permanganate would be used to treat chlorinated VOCs at ERP Sites 2 and 11; sodium persulfate would be used to treat benzene (and trace PAHs, if present above target cleanup levels in baseline groundwater samples) at ERP Site 9. MNA would be used to monitor the natural degradation of contaminants within and outside of the hot spots. Based on the observed COC concentrations, information from vendors, and experience at similar sites, the active treatment duration for this alternative is expected to be 2 years, followed by up to 5 years of monitoring. This alternative also includes the use of institutional controls as described in Section 2.9.2.

2.9.4.1 Implementation of Alternative 3 at ERP Site 2

Implementation of Alternative 3 at ERP Site 2 would involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone.

- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and two CRSA monitoring wells within, and surrounding, the hot spots of contamination.

- Injecting approximately 35 pounds of potassium permanganate as a 2 percent (minimum) water-based solution in multiple direct-push borings within the groundwater hot spots. This is the anticipated injection quantity in each boring during each application; several applications would be performed.

- Monitoring the new and existing monitoring wells quarterly for 2 years and annually for 5 years. Groundwater would be monitored for VOCs, MNA parameters, and potential secondary effects of oxidation such as increased concentrations of chromium, cadmium, and mercury derived from aquifer materials.

The total estimated cost for implementing Alternative 3 at ERP Site 2, including a 30 percent contingency, is $2,301,000.

2.9.4.2 Implementation of Alternative 3 at ERP Site 9

Implementation of Alternative 3 at ERP Site 9 would involve:

- Installing seven Shallow Zone monitoring wells within, and surrounding, the hot spot of contamination.

- Injecting approximately 95 pounds of iron-catalyzed sodium persulfate as a 3 to 5 percent (minimum) water-based solution in multiple direct-push borings within the groundwater hot spot. This is the anticipated injection quantity in each boring during each application; several applications would be performed.

- Monitoring the new and existing monitoring wells quarterly for 2 years and annually for 5 years. Groundwater would be monitored for VOCs, PAHs, MNA parameters, and potential secondary effects of oxidation such as increased concentrations of chromium, cadmium, and mercury derived from aquifer materials.

The total estimated cost for implementing Alternative 3 at ERP Site 9, including a 30 percent contingency, is $573,000.

2.9.4.3 Implementation of Alternative 3 at ERP Site 11

Implementation of Alternative 3 at ERP Site 11 would involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone.

- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and three CRSA monitoring wells within, and surrounding, the hot spots of contamination.

- Installing seven or eight Shallow Zone horizontal injection wells and four Deep Zone horizontal injection wells within the hot spots of contamination. Horizontal injection wells were selected over vertical

wells or direct-push drilling methods to prevent disturbance of flight operations and damage to the concrete flight apron.

- Injecting potassium permanganate as a 2 percent (minimum) water-based solution in each of the injection wells. Approximately 12 gallons of permanganate solution would be injected for each foot of screen length in each well. This is the anticipated injection quantity in each well during each application; several applications would be performed.

- Monitoring the new and existing monitoring wells quarterly for 2 years and annually for 5 years. Groundwater would be monitored for VOCs, MNA parameters, and potential secondary effects of oxidation such as increased concentrations of chromium, cadmium, and mercury derived from aquifer materials.

The total estimated cost for implementing Alternative 3 at ERP Site 11, including a 30 percent contingency, is $2,607,000.

2.9.5 Alternative 4: In Situ Oxidation - Ozonation with Monitored Natural Attenuation

Alternative 4 utilizes a combination of treatment processes. The primary treatment method within the hot spots is in situ oxidation, using ozone gas as the oxidant. The ozone would be injected into the subsurface through ozone sparging wells. A soil vapor extraction (SVE) system would be used to collect excess ozone and volatilized VOCs. MNA would be used to monitor the natural degradation of contaminants within and outside of the hot spots. Based on the observed COC concentrations, information from vendors, and experience at similar sites, the active treatment duration for this alternative is expected to be 3 years, followed by up to 5 years of monitoring. This alternative also includes the use of institutional controls as described in Section 2.9.2.

2.9.5.1 Implementation of Alternative 4 at ERP Site 2

Implementation of Alternative 4 at ERP Site 2 would involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone.

- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and two CRSA monitoring wells within, and surrounding, the hot spots of contamination.

- Installing 32 ozone sparging/SVE wells within the Shallow Zone hot spot and 12 ozone sparging/SVE wells within the Deep Zone hot spot.

- Installing ozone sparging and SVE system equipment and piping, and operating the treatment systems for 3 years.

- Monitoring the new and existing monitoring wells quarterly for 3 years and annually for 5 years. Groundwater would be monitored for VOCs and MNA parameters.

- Sampling the SVE system air effluent quarterly to assess system performance.

The total estimated cost for implementing Alternative 4 at ERP Site 2, including a 30 percent contingency, is $3,501,000.

2.9.5.2 Implementation of Alternative 4 at ERP Site 9

Implementation of Alternative 4 at ERP Site 9 would involve:

- Installing seven Shallow Zone monitoring wells within, and surrounding, the hot spot of contamination.

- Installing 16 ozone sparging/SVE wells within the Shallow Zone hot spot.

- Installing ozone sparging and SVE system equipment and piping, and operating the treatment systems for 3 years.

- Monitoring the new and existing monitoring wells quarterly for 3 years and annually for 5 years. Groundwater would be monitored for VOCs, PAHs, and MNA parameters.

- Sampling the SVE system air effluent quarterly to assess system performance.

The total estimated cost for implementing Alternative 4 at ERP Site 9, including a 30 percent contingency, is $1,198,000.

2.9.5.3 Implementation of Alternative 4 at ERP Site 11

Implementation of Alternative 4 at ERP Site 11 would involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone.

- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and three CRSA monitoring wells within, and surrounding, the hot spots of contamination.

- Installing eight horizontal ozone sparging wells within the Shallow Zone hot spot and four horizontal ozone sparging wells within the Deep Zone hot spot. Horizontal sparging wells were selected over vertical wells to prevent disturbance of flight operations and damage to the concrete flight apron.

- Installing eight horizontal SVE wells above the water table and four horizontal SVE wells near the top of the Deep Zone, directly above the respective sparging wells. The Deep Zone SVE wells would be under saturated conditions, and would serve to relieve pressure build-up in the Deep Zone resulting from ozone sparging, rather than acting as traditional SVE wells.

- Installing ozone sparging and SVE system equipment and piping, and operating the treatment systems for 3 years.

- Monitoring the new and existing monitoring wells quarterly for 3 years and annually for 5 years. Groundwater would be monitored for VOCs and MNA parameters.

- Sampling the SVE system air effluent quarterly to assess system performance.

The total estimated cost for implementing Alternative 4 at ERP Site 11, including a 30 percent contingency, is $4,409,000.

2.9.6 Alternative 5: Enhanced Bioremediation with Monitored Natural Attenuation

Alternative 5 utilizes enhanced aerobic and anaerobic bioremediation and MNA to treat COCs within the hot spots. Areas affected by TCE, such as the presumed source area at ERP Site 2, would be treated using a hydrogen releasing material. Other areas would be treated using an

oxygen releasing material. MNA would also be used to monitor the natural degradation of contaminants outside of the hot spots. Based on the observed COC concentrations, information from vendors, and experience at similar sites, the active treatment duration for this alternative is expected to be 2 years, followed by up to 5 years of monitoring. This alternative also includes the use of institutional controls as described in Section 2.9.2.

2.9.6.1 Implementation of Alternative 5 at ERP Site 2

Implementation of Alternative 5 at ERP Site 2 would involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone.
- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and two CRSA monitoring wells within, and surrounding, the hot spots of contamination.
- Injecting approximately 30 pounds of hydrogen releasing material in multiple direct-push borings within the area of the Shallow Zone impacted by TCE. This is the anticipated injection quantity in each boring during each application; several applications would be performed.
- Injecting approximately 30 pounds of oxygen releasing material in multiple direct-push borings within the groundwater hot spots, outside the area of the Shallow Zone impacted by TCE. This is the anticipated injection quantity in each boring during each application; several applications would be performed.
- Monitoring the new and existing monitoring wells quarterly for 2 years and annually for 5 years. Groundwater would be monitored for VOCs and MNA parameters.

The total estimated cost for implementing Alternative 5 at ERP Site 2, including a 30 percent contingency, is $2,780,000.

2.9.6.2 Implementation of Alternative 5 at ERP Site 9

Implementation of Alternative 5 at ERP Site 9 would involve:

- Installing seven Shallow Zone monitoring wells within, and surrounding, the hot spot of contamination.

- Injecting approximately 30 pounds of oxygen releasing material in multiple direct-push borings within the groundwater hot spot. This is the anticipated injection quantity in each boring during each application; several applications would be performed.

- Monitoring the new and existing monitoring wells quarterly for 2 years and annually for 5 years. Groundwater would be monitored for VOCs, PAHs, and MNA parameters.

The total estimated cost for implementing Alternative 5 at ERP Site 9, including a 30 percent contingency, is $596,000.

2.9.6.3 Implementation of Alternative 5 at ERP Site 11

Implementation of Alternative 5 at ERP Site 11 would involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone.

- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and three CRSA monitoring wells within, and surrounding, the hot spots of contamination.

- Injecting approximately 30 pounds of oxygen releasing material in multiple direct-push borings within the groundwater hot spots. This is the anticipated injection quantity in each boring during each application; several applications would be performed.

- Monitoring the new and existing monitoring wells quarterly for 2 years and annually for 5 years. Groundwater would be monitored for VOCs and MNA parameters.

The total estimated cost for implementing Alternative 5 at ERP Site 11, including a 30 percent contingency, is $4,309,000.

2.9.7 Alternative 6: In-Well Aeration with Monitored Natural Attenuation

Alternative 6 utilizes a combination of treatment processes. The primary treatment method within the hot spots is in-well aeration, with granular activated carbon treatment of the aeration well air effluent. MNA would be used to monitor the natural degradation of contaminants within and outside of the hot spots. Based on the observed COC concentrations and information from vendors, the active treatment duration for this alternative is expected to be 3 years, followed by up to 5 years of

monitoring. This alternative also includes the use of institutional controls as described in Section 2.9.2.

2.9.7.1 Implementation of Alternative 6 at ERP Site 2

Implementation of Alternative 6 at ERP Site 2 would involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone.
- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and two CRSA monitoring wells within, and surrounding, the hot spots of contamination.
- Installing 21 aeration wells within the Shallow Zone hot spot and 5 aeration wells within the Deep Zone hot spot.
- Installing in-well aeration system equipment and piping, and operating the treatment system for 3 years.
- Monitoring the new and existing monitoring wells quarterly for 3 years and annually for 5 years. Groundwater would be monitored for VOCs and MNA parameters.
- Sampling the treatment system air effluent quarterly to assess system performance.

The total estimated cost for implementing Alternative 6 at ERP Site 2, including a 30 percent contingency, is $3,721,000.

2.9.7.2 Implementation of Alternative 6 at ERP Site 9

Implementation of Alternative 6 at ERP Site 9 would involve:

- Installing seven Shallow Zone monitoring wells within, and surrounding, the hot spot of contamination.
- Installing four aeration wells within the Shallow Zone hot spot.
- Installing in-well aeration system equipment and piping, and operating the treatment system for 3 years.
- Monitoring the new and existing monitoring wells quarterly for 3 years and annually for 5 years. Groundwater would be monitored for VOCs, PAHs, and MNA parameters.

- Sampling the treatment system air effluent quarterly to assess system performance.

The total estimated cost for implementing Alternative 6 at ERP Site 9, including a 30 percent contingency, is $1,075,000.

2.9.7.3 Implementation of Alternative 6 at ERP Site 11

Implementation of Alternative 6 at ERP Site 11 would involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone.
- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and three CRSA monitoring wells within, and surrounding, the hot spots of contamination.
- Installing 26 aeration wells within the Shallow Zone hot spot and 7 aeration wells within the Deep Zone hot spot.
- Installing in-well aeration system equipment and piping, and operating the treatment system for 3 years.
- Monitoring the new and existing monitoring wells quarterly for 3 years and annually for 5 years. Groundwater would be monitored for VOCs and MNA parameters.
- Sampling the treatment system air effluent quarterly to assess system performance.

The total estimated cost for implementing Alternative 6 at ERP Site 11, including a 30 percent contingency, is $5,554,000.

2.10 Comparative Analysis of Alternatives

In accordance with USEPA and ODEQ guidance (USEPA 1988; ODEQ 1998d), the FS evaluated each of the six remedial alternatives with respect to ten criteria, and recommended a Preferred Alternative for each ERP site based on this analysis. The alternatives were evaluated both individually, and relative to each other in a comparative analysis. Sections 2.10.1 through 2.10.10 below describe the ten evaluation criteria used to select the remedies; Sections 2.10.11 through 2.10.13 summarize the comparative

analysis of alternatives for ERP Sites 2, 9, and 11. A summary of the comparative analysis for each site is presented in Table 2-4.

2.10.1 Overall Protection of Human Health and the Environment

This USEPA criterion is used to assess whether a remedial alternative provides sufficient protection of human health and the environment. The assessment of overall protection considers the degree to which an alternative satisfies the requirements of the other evaluation criteria, particularly compliance with applicable or relevant and appropriate requirements (ARARs), long-term effectiveness and permanence, and short-term effectiveness. Evaluation against this criterion includes consideration of whether an alternative poses any unacceptable short-term or cross-media impacts.

In Oregon, the protectiveness of an alternative is addressed by the criteria defined for the "effectiveness" and "long-term reliability" remedy selection balancing factors (OAR 340-122-090(3)(a) and (b)). These criteria generally correspond to the factors considered by the USEPA criterion.

2.10.2 Compliance with ARARs

This USEPA criterion is used to assess whether a remedial alternative will satisfy Federal and State ARARs. The primary ARARs for remediation of groundwater at the Portland ANGB are contained in Oregon's Hazardous Substance Remedial Action Rules, OAR Chapter 340-122. Chemical-specific ARARs applicable to contaminated groundwater at the Base include ODEQ pre-calculated significant adverse effect levels for hot spots in water (Table 2-1 in *Final Pre-Calculated Hot Spot Look-Up Tables*; ODEQ 1998b); ODEQ generic risk-based concentrations for groundwater (contained in Appendices A and J of *Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites*; ODEQ 2003); and USEPA Region 9 Preliminary Remediation Goals for tap water (USEPA 2002).

In Oregon, compliance with ARARs is addressed by some of the criteria defined for the effectiveness balancing factor. These criteria generally correspond to the factors considered by the USEPA criterion.

2.10.3 Long-Term Effectiveness and Permanence

This USEPA criterion is used to assess the long-term effectiveness and permanence of a remedial alternative, and is evaluated by considering the

TABLE 2-4

Comparative Analysis Summary
142nd FW, Portland ANGB, Portland, Oregon

ERP Site	Remedial Alternative	Evaluation Criteria									Comparative Ranking
		Overall Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of TMV Through Treatment	Short-Term Effectiveness	Implementability	Estimated Cost	Cost Reasonableness	Treatment of Hot Spots	
2	1. No Action	Low	Low	Low	Low	Low	High	$0	Low	Low	6
	2. Monitored Natural Attenuation	Low	Low	Low	Low	Low	High	$717,000	Low	Low	5
	3. In Situ Oxidation - Potassium Permanganate Injection w/ MNA	High	High	High	High	Medium	High	$2,301,000	High	High	1
	4. In Situ Oxidation – Ozonation w/ MNA	High	High	High	High	Medium	Medium	$3,501,000	Medium	High	2
	5. Enhanced Bioremediation w/ MNA	Medium	Medium	Medium	Medium	Medium	High	$2,780,000	Medium	Medium	4
	6. In-Well Aeration w/ MNA	Medium	High	High	High	Medium	Medium	$3,721,000	Medium	High	3
9	1. No Action	Low	Low	Low	Low	Low	High	$0	Low	Low	6
	2. Monitored Natural Attenuation	Low	Low	Low	Low	Low	High	$292,000	Low	Low	5
	3. In Situ Oxidation - Sodium Persulfate Injection w/ MNA	High	High	High	High	Medium	High	$573,000	High	High	1
	4. In Situ Oxidation – Ozonation w/ MNA	High	High	High	High	Medium	Medium	$1,198,000	Medium	High	3
	5. Enhanced Bioremediation w/ MNA	High	High	High	High	Medium	High	$596,000	High	High	2
	6. In-Well Aeration w/ MNA	High	High	High	High	Medium	Medium	$1,075,000	Medium	High	4
11	1. No Action	Low	Low	Low	Low	Low	High	$0	Low	Low	6
	2. Monitored Natural Attenuation	Low	Low	Low	Low	Low	High	$763,000	Low	Low	5
	3. In Situ Oxidation - Potassium Permanganate Injection w/ MNA	High	High	High	High	Medium	Medium	$2,607,000	High	High	1
	4. In Situ Oxidation – Ozonation w/ MNA	High	High	High	High	Medium	Medium	$4,409,000	Medium	High	2
	5. Enhanced Bioremediation w/ MNA	Medium	Medium	Medium	Medium	Medium	Low	$4,309,000	Medium	Medium	4
	6. In-Well Aeration w/ MNA	Medium	High	High	High	Medium	Low	$5,554,000	Medium	High	3

NOTES:

ARARs - Applicable or relevant and appropriate requirements

TMV - Toxicity, mobility, or volume

MNA - Monitored natural attenuation

The degree to which an alternative meets the requirements of the individual evaluation criteria is rated as low, medium, or high. The remedial alternatives for each ERP site are then ranked from 1 (highest) to 6 (lowest) based on the overall results of the alternatives analysis. For further discussion of the evaluation criteria and qualitative ratings for each alternative, see *Final Feasibility Study* (ERM 2001b).

risks remaining at the site after the remedial goals have been met. The evaluation considers four main factors:

- The magnitude of residual risk to human and environmental receptors remaining from untreated waste or treatment residues at the completion of remedial activities;
- The type, degree, and adequacy of long-term management required for untreated waste or treatment residues remaining at the site;
- The long-term reliability of engineering and/or institutional controls for providing continued protection from untreated waste or treatment residues; and
- The potential need for replacement of the remedy, and the continuing need for repairs to maintain the performance of the remedy.

In Oregon, long-term effectiveness and permanence are addressed by the criteria defined for the long-term reliability balancing factor, and by some of the criteria defined for the effectiveness balancing factor. These criteria generally correspond to the factors considered by the USEPA criterion.

2.10.4 Reduction of TMV through Treatment

This USEPA criterion addresses the degree to which a remedial alternative employs treatment technologies that permanently and significantly reduce the TMV of the hazardous substance(s). The evaluation considers the following factors:

- Treatment processes;
- The amount of hazardous substances that will be treated;
- The degree of expected reduction in TMV, including how the principal threat is addressed through treatment;
- The degree to which the treatment will be irreversible; and
- The type and quantity of treatment residuals that will remain following treatment.

In Oregon, reduction of TMV through treatment is addressed by some of the criteria defined for the effectiveness and long-term reliability

balancing factors. These criteria generally correspond to the factors considered by the USEPA criterion.

2.10.5 Short-Term Effectiveness

This USEPA criterion is used to assess the short-term effectiveness of a remedial alternative relative to its effect on human health and the environment during implementation of the alternative. The evaluation considers the following factors:

- Short-term risks that might be posed to the community during implementation of an alternative;
- Potential impacts on workers during implementation, and the effectiveness and reliability of protective measures;
- Potential environmental impacts during implementation, and the effectiveness and reliability of mitigative measures; and
- The time required to complete the remedial action/meet RAOs.

In Oregon, short-term effectiveness is addressed by the criteria defined for the "implementation risk" balancing factor (OAR 340-122-090(3)(d)), and by some of the criteria defined for the effectiveness balancing factor. These criteria generally correspond to the factors considered by the USEPA criterion.

2.10.6 Implementability

This USEPA criterion refers to the technical, administrative, and environmental feasibility of implementing an alternative, and the availability of various materials and services required during its implementation. The following factors are used to assess implement-ability:

- Practical, technical, and legal difficulties or unknowns associated with the construction and implementation of a technology, engineering control, or institutional control, including potential scheduling delays;
- The ability to monitor the effectiveness of the remedy;
- Consistency with Federal, State, and local requirements;

- The activities needed to coordinate with regulatory agencies, and the ability and time required to obtain any necessary authorization from other governmental bodies; and

- The availability of necessary services, materials, equipment, and specialists, including the availability of prospective technologies and adequate off-site treatment, storage, and disposal capacity and services.

In Oregon, implementability is addressed by the criteria defined for the "implementability" balancing factor (OAR 340-122-090(3)(c)). These criteria correspond to the factors considered by the USEPA criterion.

2.10.7 Cost

To evaluate this USEPA criterion, cost estimates were developed in the FS for each remedial alternative in accordance with the *Remedial Action Costing Procedures Manual* (USEPA 1985). The estimated costs are based on the preliminary conceptual plans for each alternative outlined in Section 2.9, and are expressed in terms of year 2000 dollars.

The factors considered for each alternative included:

- Capital costs, including both direct and indirect costs;

- Annual O&M costs;

- Costs of any periodic review requirements; and

- Net present value of all of the above.

In Oregon, cost is addressed by the criteria defined for the "reasonableness of cost" balancing factor (OAR 340-122-090(3)(e)). In addition to the factors listed above, the reasonableness of cost balancing factor considers the following:

- The degree to which the costs of the remedial action are proportionate to the benefits to human health and the environment created through risk reduction or risk management;

- With respect to hot spots of contamination in water, the degree to which the costs of the remedial action are proportionate to the benefits created through restoration or protection of existing and reasonably likely future beneficial uses of water;

- The degree of sensitivity and uncertainty of the costs; and
- Any other information relevant to cost-reasonableness.

2.10.8 Treatment of Hot Spots

Oregon's Environmental Cleanup Law requires that remedies treat hot spots of contamination to the extent feasible. The evaluation of feasibility is based on Oregon's five remedy selection balancing factors; however, a "higher cost threshold" is applied to the cost reasonableness for treating hot spots. For hot spots in groundwater, the FS must evaluate the feasibility of treatment to levels that will no longer produce significant adverse effects on the beneficial use(s) of the water (OAR 340-122-0085(5)(a)). This criterion assesses the ability of an alternative to meet the requirement to treat contaminated groundwater to below significant adverse effect levels.

2.10.9 State Acceptance

This USEPA criterion is used to identify technical and administrative issues and concerns the State regulatory agency (i.e., ODEQ) may have regarding a remedial alternative.

2.10.10 Community Acceptance

This USEPA criterion is used to identify technical and administrative issues and concerns the public may have regarding a remedial alternative.

2.10.11 Comparative Analysis of Alternatives – ERP Site 2

This section summarizes the comparative analysis of alternatives for ERP Site 2. Because all of the alternatives involve the use of institutional controls as described in Section 2.9.2, the comparative analysis focuses only on those elements that are unique to each alternative.

2.10.11.1 ERP Site 2 - Overall Protection of Human Health and the Environment

Contaminated groundwater at ERP Site 2 does not pose an immediate risk to human health and the environment because groundwater at the Base is not currently used. However, the levels of COCs observed in shallow groundwater could pose a risk to site occupants or off-site receptors based

on other exposure pathways, such as vapor intrusion into buildings, direct contact during construction/trenching activities, or migration of contaminated groundwater to deeper aquifers or surface water. Alternatives that involve no or delayed action are therefore less protective than those utilizing active treatment measures. The most protective alternative would be that which most reliably, completely, and quickly removes the COCs (chlorinated VOCs) in groundwater at ERP Site 2.

Alternatives 1 (No Action) and 2 (MNA) are not expected to reliably, completely, or quickly remove the COCs in groundwater.

Alternative 5 (Enhanced Bioremediation with MNA) is expected to reliably reduce COC concentrations. However, based on treatability tests conducted at ERP Site 2 (ERM 2001d), Alternative 5 is not expected to reduce chlorinated VOC concentrations to below target cleanup levels. Additionally, the effectiveness of a bioremediation-enhancing material may diminish over time as the amount of VOCs and other organic material available for microbial activity decreases.

Alternative 6 (In-Well Aeration with MNA) is expected to reliably remove COCs. A technology similar to Alternative 6 has been shown to be effective in removing VOCs from groundwater extracted from the Shallow Zone at ERP Site 2 (ERM 2001a, Appendix E). However, the ability of Alternative 6 to achieve target cleanup levels throughout the treatment area is uncertain, as the proposed application technique of this technology (i.e., recirculation wells) has not been tested at the Base.

Alternative 4 (In Situ Oxidation - Ozonation with MNA) also is expected to reliably remove COCs. However, the proposed application technique of this technology at ERP Site 2 is based on a recirculation principle similar to that in Alternative 6. Consequently, the ability of Alternative 4 to achieve target cleanup levels throughout the treatment area is uncertain.

The most protective alternative is Alternative 3 (In Situ Oxidation - Potassium Permanganate Injection with MNA). Treatability tests and a full-scale technology demonstration have shown that potassium permanganate can quickly destroy chlorinated VOCs in groundwater at the Base (ERM 2001d, 2003b). This alternative is more reliable and thorough than the others because potassium permanganate provides residual treatment capacity, and the effectiveness of this technology is more easily monitored. Incomplete removal under this alternative can be remedied by repeated injections of potassium permanganate.

2.10.11.2 ERP Site 2 - Compliance with ARARs

Alternatives 1, 2, and 5 are not expected to reduce COC concentrations to below the target cleanup levels.

Alternatives 4 and 6 could potentially reduce COC concentrations to below the target cleanup levels. However, as described in the previous section, the reliability of these alternatives in achieving target cleanup levels throughout the treatment area is uncertain.

Alternative 3 will most reliably reduce COC concentrations to below target cleanup levels. Because of the complete destruction of VOCs that occurs upon contact with potassium permanganate, and the simplicity of delivering the permanganate solution to the subsurface (i.e., direct-push injection), this alternative can be tailored in the field to provide complete destruction of the dissolved COCs at ERP Site 2.

2.10.11.3 ERP Site 2 - Long-Term Effectiveness and Permanence

Alternatives 1 and 2 do not provide long-term effectiveness. These alternatives are not expected to reduce COC concentrations to below the target cleanup levels.

Alternatives 3, 4, and 5 would provide equal long-term effectiveness, assuming they were equally capable of reducing COC concentrations. These alternatives utilize technologies that destroy contaminants in situ, are irreversible, and do not pose additional risks after treatment goals are met. Alternative 3 is expected to achieve target cleanup levels. Alternative 5 is not expected to achieve target cleanup levels, and the reliability of Alternative 4 in achieving target cleanup levels is uncertain.

Alternative 6 would provide long-term effectiveness similar to that of Alternative 3, assuming it could reliably achieve target cleanup levels. Rather than destroying contaminants in situ, this alternative utilizes a technology that strips VOCs from groundwater and transfers them to an aboveground treatment system, where the VOCs are destroyed. This technology is also irreversible and poses no additional risks after treatment goals are met. However, the reliability of Alternative 6 in achieving target cleanup levels is uncertain.

Alternative 3 is the most effective alternative in the long term due to the greater residual ability of potassium permanganate to destroy VOCs.

2.10.11.4 ERP Site 2 - Reduction of TMV through Treatment

Alternatives 1 and 2 will not significantly reduce the TMV of VOC-impacted groundwater. Some reduction of toxicity may occur locally through natural attenuation of COCs. However, the mobility and volume of contaminated groundwater would likely not change, and could possibly increase.

Alternatives 3, 4, and 6 are expected to significantly reduce the TMV of VOC-impacted groundwater. Alternative 3 is expected to provide the greatest reduction.

Alternative 5 is expected to significantly reduce the toxicity of VOC-impacted groundwater in the short term. However, enhanced bioremediation is not expected to provide effective treatment of residual chlorinated VOCs remaining after the initial reductions. Consequently, Alternative 5 might not reduce the volume of contaminated groundwater as much as the reductions expected with Alternatives 3, 4, and 6.

2.10.11.5 ERP Site 2 - Short-Term Effectiveness

Alternatives 1 and 2 are not expected to significantly reduce COC concentrations in the short term. Contaminated groundwater could potentially migrate off-site within the timeframe required to reach cleanup goals under these alternatives.

Alternatives 3, 4, 5, and 6 provide short-term effectiveness. These alternatives are expected to significantly reduce dissolved VOC concentrations in a relatively short time. Alternatives 3 and 4 would pose potential hazards to workers implementing these alternatives due to the oxidants used. These hazards can be controlled through the use of appropriate health and safety measures. No threats to workers are expected during implementation of Alternative 6, beyond the usual mechanical hazards associated with well drilling and machinery installation.

2.10.11.6 ERP Site 2 - Implementability

Alternatives 1 and 2 are the easiest alternatives to implement. Alternative 1 requires no action, and Alternative 2 requires only installation of additional monitoring wells and periodic monitoring of COCs and natural attenuation parameters. However, these alternatives are not considered reliable, and they would likely require future replacement.

The next easiest alternatives to implement are Alternatives 3 and 5. These alternatives involve the direct-push injection of a treatment material and periodic monitoring. Alternative 3 is expected to achieve greater VOC reductions than Alternative 5. Alternative 5 may require replacement if it fails to achieve target cleanup levels.

Alternatives 4 and 6 are the most difficult alternatives to implement. These alternatives involve the construction of a network of sparging or aeration wells and associated piping, compressors, and controls. These treatment systems would require periodic monitoring and maintenance during operation.

2.10.11.7 ERP Site 2 - Cost

Alternatives 1 and 2 are the least expensive alternatives. However, these alternatives do not satisfy the protectiveness criterion because they are not expected to meet the site RAOs within a reasonable timeframe. These alternatives are therefore not cost reasonable. Alternative 5 is one of the least expensive alternatives employing active remedial measures, but it is also not expected to meet the RAOs within a reasonable timeframe. Consequently, Alternative 5 is not the most cost reasonable option. Alternatives 4 and 6 are the most expensive alternatives, and their ability to achieve target cleanup levels throughout the dissolved VOC plume within a reasonable timeframe is uncertain. Alternative 3 is at least as protective as Alternatives 4 and 6 and is less expensive. Therefore, Alternative 3 is the most cost reasonable alternative.

2.10.11.8 ERP Site 2 - Treatment of Hot Spots

Alternatives 1 and 2 are not expected to effectively treat the hot spots of contamination in groundwater. Under both of these alternatives, the extent of the hot spots in the Shallow and Deep Zones could potentially increase.

The remaining alternatives are expected to reduce the size of the hot spots through treatment. However, Alternative 5 may have difficulty treating the Site 2 COCs, particularly vinyl chloride, to below significant adverse effect levels within a reasonable timeframe. Additionally, the reliability of Alternatives 4 and 6 in achieving COC reductions throughout the hot spots is uncertain. Alternative 3 is expected to be the most reliable alternative for treatment of hot spots.

2.10.11.9 ERP Site 2 – State Acceptance

Alternatives 1 and 2 are not expected to effectively treat hot spots of contamination or meet site RAOs within a reasonable timeframe, and thus would likely not be acceptable to ODEQ. The remaining alternatives are expected to reduce the size of the hot spots through treatment as required by ODEQ. However, Alternative 5 is not expected to achieve target cleanup levels, and the reliability of Alternatives 4 and 6 is uncertain. It is anticipated that Alternative 3 would be scrutinized the most by ODEQ, as this alternative involves the injection of an oxidant (potassium permanganate) into groundwater.

2.10.11.10 ERP Site 2 – Community Acceptance

Alternatives 1 and 2 are not expected to effectively treat hot spots of contamination or meet site RAOs within a reasonable timeframe, and thus would likely not be acceptable to the local community. The remaining alternatives are expected to be acceptable because they reduce the size of the hot spots through treatment. However, to gain community acceptance of Alternatives 4, 5, and 6, additional treatability testing would likely be necessary to address the uncertainties associated with these alternatives. Due to anticipated public concerns regarding potential impacts to groundwater quality from potassium permanganate injection, Alternative 3 would most likely need to include plans for the timely reporting of groundwater monitoring results in a format that can be easily accessed and reviewed by the public.

2.10.12 Comparative Analysis of Alternatives – ERP Site 9

This section summarizes the comparative analysis of alternatives for ERP Site 9. Because all of the alternatives involve the use of institutional controls as described in Section 2.9.2, the comparative analysis focuses only on those elements that are unique to each alternative.

2.10.12.1 ERP Site 9 - Overall Protection of Human Health and the Environment

Contaminated groundwater at ERP Site 9 does not pose an immediate risk to human health and the environment because groundwater at the Base is not currently used. However, the levels of COCs observed in shallow groundwater could pose a risk to site occupants or off-site receptors based on other exposure pathways, such as vapor intrusion into buildings, direct contact during construction/trenching activities, or migration of contaminated groundwater to deeper aquifers or surface water.

Alternatives that involve no or delayed action are therefore less protective than those utilizing active treatment measures. The most protective alternative would be that which most reliably, completely, and quickly removes the COCs (benzene and PAHs) in groundwater at ERP Site 9.

Alternatives 1 and 2 are not expected to reliably, completely, or quickly remove the COCs in groundwater.

Alternative 6 is expected to reliably remove COCs. A technology similar to Alternative 6 has been shown to be effective in removing VOCs from groundwater extracted from the Shallow Zone at ERP Site 2. However, the ability of Alternative 6 to achieve target cleanup levels throughout the treatment area is uncertain, as the proposed application technique of this technology (i.e., recirculation wells) has not been tested at the Base.

Alternatives 4 and 5 also are expected to reliably remove COCs. However, they are not expected to reduce COC concentrations as quickly as Alternative 3. Additionally, the ability of Alternative 4 to achieve target cleanup levels throughout the treatment area is uncertain, since the proposed application technique of this technology at ERP Site 9 is based on a recirculation principle similar to that in Alternative 6.

The most protective alternative is Alternative 3 (In Situ Oxidation – Sodium Persulfate Injection with MNA). This alternative is expected to reliably, completely, and quickly remove benzene from groundwater at ERP Site 9. Although sodium persulfate injection has not been tested at the Base, this oxidant is expected to be effective in reducing benzene concentrations based on experience at similar sites. PAHs typically are not as amenable to oxidation as aromatic hydrocarbons such as benzene. However, due to the isolated occurrence and low concentrations of dissolved PAHs detected at Site 9 (generally less than 2 µg/L), sodium persulfate is expected to be effective in reducing concentrations of these COCs as well.

2.10.12.2 ERP Site 9 - Compliance with ARARs

Alternatives 1 and 2 are not expected to reduce COC concentrations to below the target cleanup levels.

Alternatives 4 and 6 could potentially reduce COC concentrations to below the target cleanup levels. However, the reliability of these alternatives in achieving target cleanup levels throughout the treatment area is uncertain.

Alternatives 3 and 5 will most reliably reduce benzene (the primary COC) to below target cleanup levels. Because of the complete destruction of benzene that occurs upon contact with sodium persulfate, and the simplicity of delivering the persulfate solution to the subsurface (i.e., direct-push injection), Alternative 3 can be tailored in the field to provide complete destruction of the dissolved benzene at ERP Site 9. In addition, sodium persulfate is expected to be effective in reducing trace concentrations of PAHs at Site 9, should baseline groundwater sampling prior to the injection work indicate that these compounds are present. Alternative 5 also is expected to be effective in reducing dissolved benzene concentrations, since benzene readily degrades under aerobic conditions.

2.10.12.3 ERP Site 9 - Long-Term Effectiveness and Permanence

Alternatives 1 and 2 do not provide long-term effectiveness. These alternatives are not expected to reduce COC concentrations to below the target cleanup levels.

Alternatives 3, 4, and 5 would provide equal long-term effectiveness, assuming they were equally capable of reducing COC concentrations. These alternatives utilize technologies that destroy contaminants in situ, are irreversible, and do not pose additional risks after treatment goals are met. Alternative 3 is expected to achieve target cleanup levels. The reliability of Alternative 4 in achieving target cleanup levels is uncertain.

Alternative 6 would provide long-term effectiveness similar to Alternatives 3 and 5, assuming it could reliably achieve target cleanup levels. Rather than destroying contaminants in situ, this alternative utilizes a technology that strips VOCs from groundwater and transfers them to an aboveground treatment system, where the VOCs are destroyed. This technology is also irreversible and poses no additional risks after treatment goals are met. However, the reliability of Alternative 6 in achieving target cleanup levels is uncertain.

Alternatives 3 and 5 are the most effective alternatives in the long term. These alternatives are the most likely to meet the site RAOs and the least likely to require future replacement.

2.10.12.4 ERP Site 9 - Reduction of TMV through Treatment

Alternatives 1 and 2 will not significantly reduce the TMV of contaminated groundwater. Some reduction of toxicity may occur locally through natural attenuation of the COCs. However, the mobility and

volume of contaminated groundwater likely would not change, and could possibly increase.

Alternatives 3, 4, 5, and 6 are expected to significantly reduce the TMV of contaminated groundwater. Alternatives 3 and 5 are expected to provide the greatest reduction.

2.10.12.5 ERP Site 9 - Short-Term Effectiveness

Alternatives 1 and 2 are not expected to significantly reduce COC concentrations in the short term. Contaminated groundwater could potentially migrate off-site within the timeframe required to reach cleanup goals under these alternatives.

Alternatives 3, 4, 5, and 6 provide short-term effectiveness. These alternatives are expected to significantly reduce concentrations of dissolved benzene (the primary COC) in a relatively short time. Alternatives 3 and 4 would pose potential hazards to workers implementing these alternatives due to the oxidants used. These hazards can be controlled through the use of appropriate health and safety measures. No threats to workers are expected during implementation of Alternative 6, beyond the usual mechanical hazards associated with well drilling and machinery installation.

2.10.12.6 ERP Site 9 - Implementability

Alternatives 1 and 2 are the easiest alternatives to implement. Alternative 1 requires no action, and Alternative 2 requires only installation of additional monitoring wells and periodic monitoring of COCs and natural attenuation parameters. However, these alternatives are not considered reliable, and they would likely require future replacement.

The next easiest alternatives to implement are Alternatives 3 and 5. These alternatives involve the direct-push injection of a treatment material and periodic monitoring. Neither of these alternatives is expected to require replacement.

Alternatives 4 and 6 are the most difficult alternatives to implement. These alternatives involve the construction of a network of sparging or aeration wells and associated piping, compressors, and controls. These treatment systems would require periodic monitoring and maintenance during operation.

2.10.12.7 ERP Site 9 - Cost

Alternatives 1 and 2 are the least expensive alternatives. However, these alternatives do not satisfy the protectiveness criterion because they are not expected to meet the site RAOs within a reasonable timeframe. These alternatives are therefore not cost reasonable. Alternatives 4 and 6 are the most expensive alternatives, and their ability to achieve target cleanup levels throughout the dissolved TPH plume within a reasonable timeframe is uncertain. Alternatives 3 and 5 are at least as protective as Alternatives 4 and 6, and are less expensive. Therefore, Alternatives 3 and 5 are the most cost reasonable alternatives.

2.10.12.8 ERP Site 9 - Treatment of Hot Spots

Alternatives 1 and 2 are not expected to effectively treat the hot spot of contamination in groundwater. Under both of these alternatives, the extent of the hot spot in the Shallow Zone could potentially increase.

The remaining alternatives are expected to reduce the size of the hot spot through treatment. Alternative 3 is expected to be the most reliable alternative for treating the hot spot to below significant adverse effect levels.

2.10.12.9 ERP Site 9 – State Acceptance

Alternatives 1 and 2 are not expected to effectively treat the hot spot of contamination or meet site RAOs within a reasonable timeframe, and thus would likely not be acceptable to ODEQ. The remaining alternatives are expected to reduce the size of the hot spot through treatment as required by ODEQ. However, the reliability of Alternatives 4 and 6 is uncertain. It is anticipated that Alternative 3 would be scrutinized the most by ODEQ, as this alternative involves the injection of an oxidant (sodium persulfate) into groundwater.

2.10.12.10 ERP Site 9 – Community Acceptance

Alternatives 1 and 2 are not expected to effectively treat the hot spot of contamination or meet site RAOs within a reasonable timeframe, and thus would likely not be acceptable to the local community. The remaining alternatives are expected to be acceptable because they reduce the size of the hot spot through treatment. However, to gain community acceptance of Alternatives 4 and 6, additional treatability testing would likely be necessary to address the uncertainties associated with these alternatives. Due to anticipated public concerns regarding potential impacts to

groundwater quality from sodium persulfate injection, Alternative 3 would most likely need to include plans for the timely reporting of groundwater monitoring results in a format that can be easily accessed and reviewed by the public.

2.10.13 Comparative Analysis of Alternatives – ERP Site 11

This section summarizes the comparative analysis of alternatives for ERP Site 11. Because all of the alternatives involve the use of institutional controls as described in Section 2.9.2, the comparative analysis focuses only on those elements that are unique to each alternative.

2.10.13.1 ERP Site 11 - Overall Protection of Human Health and the Environment

Contaminated groundwater at ERP Site 11 does not pose an immediate risk to human health and the environment because groundwater at the Base is not currently used. However, the levels of COCs observed in shallow groundwater could pose a risk to site occupants or off-site receptors based on other exposure pathways, such as vapor intrusion into buildings, direct contact during construction/trenching activities, or migration of contaminated groundwater to deeper aquifers or surface water. Alternatives that involve no or delayed action are therefore less protective than those utilizing active treatment measures. The most protective alternative would be that which most reliably, completely, and quickly removes the COCs (chlorinated VOCs) in groundwater at ERP Site 11.

Alternatives 1 and 2 are not expected to reliably, completely, or quickly remove the COCs in groundwater.

Alternative 5 is expected to reliably reduce COC concentrations. However, based on treatability tests conducted at ERP Site 2, Alternative 5 is not expected to reduce chlorinated VOC concentrations to below target cleanup levels. Additionally, the effectiveness of a bioremediation-enhancing material may diminish over time as the amount of VOCs and other organic material available for microbial activity decreases.

Alternative 6 is expected to reliably remove COCs. A technology similar to Alternative 6 has been shown to be effective in removing VOCs from groundwater extracted from the Shallow Zone at ERP Site 2. However, the ability of Alternative 6 to achieve target cleanup levels throughout the treatment area is uncertain, as the proposed application technique of this technology (i.e., recirculation wells) has not been tested at the Base.

Alternative 4 also is expected to reliably remove COCs. However, it is not expected to reduce COC concentrations as quickly as Alternative 3.

The most protective alternative is Alternative 3 (In Situ Oxidation - Potassium Permanganate Injection with MNA). Treatability tests and a full-scale technology demonstration have shown that potassium permanganate can quickly destroy chlorinated VOCs in groundwater at the Base. This alternative is more reliable and thorough than the others because potassium permanganate provides residual treatment capacity, and the effectiveness of this technology is more easily monitored. Incomplete removal under this alternative can be remedied by repeated injections of potassium permanganate.

2.10.13.2 ERP Site 11 - Compliance with ARARs

Alternatives 1, 2, and 5 are not expected to reduce COC concentrations to below the target cleanup levels.

Alternative 6 could potentially reduce COC concentrations to below the target cleanup levels. However, the reliability of this alternative in achieving target cleanup levels throughout the treatment area is uncertain.

Alternatives 3 and 4 will most reliably reduce COC concentrations to below target cleanup levels. These alternatives provide complete destruction of dissolved VOCs through direct contact with potassium permanganate (Alternative 3) and ozone (Alternative 4).

2.10.13.3 ERP Site 11 - Long-Term Effectiveness and Permanence

Alternatives 1 and 2 do not provide long-term effectiveness. These alternatives are not expected to reduce COC concentrations to below the target cleanup levels.

Alternatives 3, 4, and 5 would provide equal long-term effectiveness, assuming they were equally capable of reducing COC concentrations. These alternatives utilize technologies that destroy contaminants in situ, are irreversible, and do not pose additional risks after treatment goals are met. Alternatives 3 and 4 are expected to achieve target cleanup levels; Alternative 5 is not expected to achieve target cleanup levels.

Alternative 6 would provide long-term effectiveness similar to that of Alternatives 3 and 4, assuming it could reliably achieve target cleanup levels. Rather than destroying contaminants in situ, this alternative utilizes a technology that strips VOCs from groundwater and transfers

them to an aboveground treatment system, where the VOCs are destroyed. This technology is also irreversible and poses no additional risks after treatment goals are met. However, the reliability of Alternative 6 in achieving target cleanup levels is uncertain.

Alternative 3 is the most effective alternative in the long term due to the greater residual ability of potassium permanganate to destroy VOCs.

2.10.13.4 ERP Site 11 - Reduction of TMV through Treatment

Alternatives 1 and 2 will not significantly reduce the TMV of VOC-impacted groundwater. Some reduction of toxicity may occur locally through natural attenuation of COCs. However, the mobility and volume of contaminated groundwater would likely not change, and could possibly increase.

Alternatives 3, 4, and 6 are expected to significantly reduce the TMV of VOC-impacted groundwater. Alternatives 3 and 4 are expected to provide the greatest reduction.

Alternative 5 is expected to significantly reduce the toxicity of VOC-impacted groundwater in the short term. However, enhanced bioremediation is not expected to provide effective treatment of residual chlorinated VOCs remaining after the initial reductions. Consequently, Alternative 5 might not reduce the volume of contaminated groundwater as much as the reductions expected with Alternatives 3, 4, and 6.

2.10.13.5 ERP Site 11 - Short-Term Effectiveness

Alternatives 1 and 2 are not expected to significantly reduce COC concentrations in the short term. Contaminated groundwater could potentially migrate off-site within the timeframe required to reach cleanup goals under these alternatives.

Alternatives 3, 4, 5, and 6 provide short-term effectiveness. These alternatives are expected to significantly reduce dissolved VOC concentrations in a relatively short time. Alternatives 3 and 4 would pose potential hazards to workers implementing these alternatives due to the oxidants used. These hazards can be controlled through the use of appropriate health and safety measures. No threats to workers are expected during implementation of Alternative 6, beyond the usual mechanical hazards associated with well drilling and machinery installation.

2.10.13.6 ERP Site 11 - Implementability

Alternatives 1 and 2 are the easiest alternatives to implement. Alternative 1 requires no action, and Alternative 2 requires only installation of additional monitoring wells and periodic monitoring of COCs and natural attenuation parameters. However, these alternatives are not considered reliable, and they would likely require future replacement.

Implementation of the remaining four alternatives would be difficult at ERP Site 11 due to the thick concrete present on the flight apron. Alternatives 5 and 6 would be the most difficult to implement, due to the large number of direct-push injections or well installations required. Both of these alternatives would require significant coring and patching of the concrete flight apron, as neither can be implemented using horizontal wells similar to Alternatives 3 and 4.

Alternatives 3 and 4 can be implemented using horizontal wells under the concrete flight apron, thus avoiding damage to the apron and minimizing disruption of flight operations. Alternative 4 would be more difficult to implement that Alternative 3 due to the larger number of horizontal wells and the amount of equipment (e.g., ozone generators, sparge points, SVE blowers, etc.) required for operation.

2.10.13.7 ERP Site 11 - Cost

Alternatives 1 and 2 are the least expensive alternatives. However, these alternatives do not satisfy the protectiveness criterion because they are not expected to meet the site RAOs within a reasonable timeframe. These alternatives are therefore not cost reasonable. Alternative 5 is also not expected to meet the RAOs within a reasonable time period, and is thus not cost reasonable. Alternatives 4 and 6 are both expected to meet the RAOs; however, these alternatives are more expensive than Alternative 3. Alternative 3 is expected to meet the RAOs and is the least expensive of the alternatives employing active remedial measures. Accordingly, Alternative 3 is the most cost reasonable alternative.

2.10.13.8 ERP Site 11 - Treatment of Hot Spots

Alternatives 1 and 2 are not expected to effectively treat the hot spots of contamination in groundwater. Under both of these alternatives, the extent of the hot spots in the Shallow and Deep Zones could potentially increase.

The remaining alternatives are expected to reduce the size of the hot spots through treatment. However, Alternative 5 may have difficulty treating the Site 11 COCs, particularly vinyl chloride, to below significant adverse effect levels within a reasonable timeframe. Additionally, the reliability of Alternative 6 in achieving COC reductions throughout the hot spots is uncertain. Alternative 3 is expected to be the most reliable alternative for treatment of hot spots.

2.10.13.9 ERP Site 11 – State Acceptance

Alternatives 1 and 2 are not expected to effectively treat hot spots of contamination or meet site RAOs within a reasonable timeframe, and thus would likely not be acceptable to ODEQ. The remaining alternatives are expected to reduce the size of the hot spots through treatment as required by ODEQ. However, Alternative 5 is not expected to achieve target cleanup levels, and the reliability of Alternative 6 is uncertain. It is anticipated that Alternative 3 would be scrutinized the most by ODEQ, as this alternative involves the injection of an oxidant (potassium permanganate) into groundwater.

2.10.13.10 ERP Site 11 – Community Acceptance

Alternatives 1 and 2 are not expected to effectively treat hot spots of contamination or meet site RAOs within a reasonable timeframe, and thus would likely not be acceptable to the local community. The remaining alternatives are expected to be acceptable because they reduce the size of the hot spots through treatment. However, to gain community acceptance of Alternatives 5 and 6, additional treatability testing would likely be necessary to address the uncertainties associated with these alternatives. Due to anticipated public concerns regarding potential impacts to groundwater quality from potassium permanganate injection, Alternative 3 would most likely need to include plans for the timely reporting of groundwater monitoring results in a format that can be easily accessed and reviewed by the public.

2.11 Principal Threat Wastes

The NCP establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). Additionally, the Oregon Hazardous Substance Remedial Action Rules stipulate that in the event of a release of hazardous substances to groundwater constituting a hot spot of contamination,

treatment shall be required in accordance with OAR 340-122-0085(5) and OAR 340-122-0090 (OAR 340-122-0040(4)).

Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur (USEPA 1999). The USEPA defines a source material as "material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure" (USEPA 1999).

Contaminated groundwater, such as that present at ERP Sites 2, 9, and 11, generally is not considered to be a source material (USEPA 1999). Furthermore, the contaminated soil at ERP Site 11 and the contaminated sediments at ERP Site 4 do not fit the definition of a principal threat waste, as they are neither highly toxic nor highly mobile, and they do not present a significant risk to human health or the environment. Accordingly, none of the contamination identified at the Portland ANGB constitutes a USEPA-defined principal threat waste. Nevertheless, consistent with ODEQ's requirement for treatment of hot spots in groundwater, the response actions selected in this ROD for ERP Sites 2, 9, and 11 will use treatment as a principal element of the remedy.

2.12 Selected Remedy

The Selected Remedy for ERP Sites 2, 9, and 11 is identified and described in this section. The Selected Remedy for ERP Site 4 also is identified. However, because the Site 4 remedy will be implemented as a stormwater improvement/O&M project by the Portland ANGB, and not as an ERP project (see Section 2.12.2), details of the Site 4 remedy (e.g., rationale, costs, etc.) are not discussed further in this ROD.

2.12.1 Selected Remedy for ERP Sites 2, 9, and 11

The Selected Remedy for ERP Sites 2, 9, and 11 is Alternative 3: In Situ Oxidation – Permanganate/Persulfate Injection with MNA. This alternative best satisfies the remedy-selection evaluation criteria utilized in the FS. Alternative 3 involves injecting an oxidant solution (potassium permanganate or sodium persulfate) through the lateral and vertical extent of groundwater impacted by VOC concentrations exceeding ODEQ hot spot

criteria, combined with MNA and institutional controls. The oxidant solution will spread throughout the contaminated zone, completely and permanently destroying dissolved VOCs through chemical oxidation.

Alternative 3 is expected to achieve ODEQ hot spot cleanup levels within a relatively short time (i.e., 2 to 5 years). Additional benefits of this alternative include:

- The residual risk remaining after completion of the remedy is expected to be acceptable (ERM 2001b), thus human health and the environment will be protected over the long term.

- In situ oxidation using potassium permanganate for chlorinated VOCs and sodium persulfate for benzene (and trace PAHs, as necessary) is the simplest and most cost-effective technology among the alternatives that utilize active remedial measures.

2.12.2 Selected Remedy for ERP Site 4

The two remedial alternatives considered for ERP Site 4 – Excavation and Off-Site Disposal of Contaminated Sediments (Alternative 1) and Ditch Filling/Sediment Capping (Alternative 2) – are expected to be equally effective in mitigating potential ecological risks. In addition, both alternatives would be relatively easy to implement. Consequently, neither alternative was chosen as the preferred alternative in the Proposed Plan (ERM 2003a); both alternatives would meet the RAO of preventing ecological exposure to contaminants above risk-based concentrations.

The Portland ANGB plans to install drainage piping in the Main Drainage Ditch in fiscal year 2005 as part of a stormwater improvement project. Accordingly, the Selected Remedy for ERP Site 4 is Alternative 2: Ditch Filling/Sediment Capping. In this alternative, ecological risks are eliminated by installing culvert pipe in the ditch to convey stormwater, and then filling the entire channel with clean fill material. An impervious liner will be installed between the ditch sediments and the fill material to prevent possible cross-contamination of the clean fill. Placement of the liner and clean fill will effectively cap the contaminated ditch sediments, thereby preventing ecological exposures and eliminating potential ecological risks. In addition, filling the channel will eliminate habitat that serves as a wildlife attractant in the vicinity of the PIA, thus contributing to the Port of Portland's goal of reducing the potential for aircraft wildlife strikes. Since the Main Drainage Ditch has been designated as a

jurisdictional wetland by the United States Army Corps of Engineers, mitigation measures will be necessary to offset the loss of this wetland.

As noted previously, the ERP Site 4 remedy was not selected through the normal FS/remedy-selection process. The stormwater improvements will be undertaken by the Portland ANGB as a facility O&M project. Although the project work at ERP Site 4 will be partially paid for with ERP funds, the work will not be contracted or managed under the ERP. Accordingly, the remainder of this ROD pertains only to the response actions planned at ERP Sites 2, 9, and 11. Plans for filling the Main Drainage Ditch will be developed separately as part of the Base O&M project.

2.12.3 Summary of Rationale for the Selected Remedy

Alternative 3 was chosen as the Selected Remedy for ERP Site 2, 9, and 11 because it provides the best balance of trade-offs with respect to the evaluation criteria discussed in Section 2.10. The expected performance of the remedy relative to each of these criteria is summarized below.

Overall Protection of Human Health and the Environment. The Selected Remedy is expected to effectively remove or significantly reduce the concentrations of COCs in groundwater at the Base. The risks associated with exposure to the COCs will be reduced or managed to an acceptable level within a reasonable timeframe based on the current and anticipated future land use.

Compliance with ARARs. The Selected Remedy is expected to effectively reduce concentrations of COCs in groundwater to below the ODEQ pre-calculated significant adverse effect levels through treatment, and to prevent on-site exposure to, and off-site migration of, COC concentrations above Oregon acceptable risk-based levels through the use of institutional controls. The subsurface injection of potassium permanganate/sodium persulfate will need to comply with the substantive requirements of Oregon's Underground Injection Control program.

Long-Term Effectiveness and Permanence. The Selected Remedy is expected to reduce the residual risk posed by groundwater at the Base because dissolved COCs will be destroyed by oxidation and attenuated through natural degradation. Groundwater monitoring will be used to assess performance relative to the RAOs, and institutional controls will be used to prevent exposure to contaminants below ODEQ hot spot cleanup levels but above acceptable risk-based levels.

Reduction of TMV through Treatment. The use of potassium permanganate/sodium persulfate oxidation and MNA to treat COCs in groundwater will result in the permanent reduction of contaminant TMV. This reduction is achieved through chemical and biological destruction rather than transfer of contaminants from one medium to another. The treatment process is irreversible and will result in the production of harmless byproducts.

Short-Term Effectiveness. Implementation of the Selected Remedy will require worker handling of potassium permanganate and sodium persulfate in solid or dissolved form. Worker exposure will be minimized through the use of appropriate health and safety measures.

Adverse effects on groundwater quality from in situ oxidation are not expected. The oxidative effects of the potassium permanganate and sodium persulfate will diminish with time as they react with organic material in the subsurface.

Risks associated with VOCs in groundwater are expected to be quickly reduced due to the rapid treatment resulting from in situ oxidation. VOC concentrations within the treatment areas are expected to be reduced to levels below ODEQ significant adverse effect levels within 2 to 5 years of implementation.

Implementability. The equipment and construction methods required for the direct-push or horizontal well injection of potassium permanganate and sodium persulfate are readily available and easily implemented. However, the implementability may be inhibited by inhomogeneities in the subsurface geology. Preferential flow paths and areas of low conductivity will dictate where injected oxidants will flow, which could result in portions of the treatment areas not receiving injected material. For direct-push injections, this can be overcome by reducing the spacing/separation of the injections, and/or by staggering the locations of later injections. Diffusion and advection are expected to contribute to the dispersion of the oxidants through the treatment areas over time.

Cost. The estimated total costs for the Selected Remedy, including a 30 percent contingency, are $2,335,000 at ERP Site 2; $586,000 at ERP Site 9; and $2,641,000 at ERP Site 11. These cost estimates are slightly higher than the estimates for Alternative 3 presented in the FS and in Table 2-4, due to a change in the planned groundwater monitoring component of the remedy; see Sections 2.12.4 and 2.12.5. These estimated costs are the

lowest among the alternatives that employ active remedial measures, and are expected to be accurate to within +50 to –30 percent.

Treatment of Hot Spots. The Selected Remedy is expected to treat dissolved COCs in the groundwater hot spots to below ODEQ significant adverse effect levels within a reasonable timeframe.

State Acceptance. The use of potassium permanganate/sodium persulfate oxidation, MNA, and institutional controls to reduce risks associated with contaminated groundwater at the Base is expected to be acceptable to ODEQ. State acceptance will require an adequate monitoring and reporting plan to meet the substantive requirements of applicable ODEQ permits for underground injection.

Community Acceptance. The use of potassium permanganate/sodium persulfate oxidation, MNA, and institutional controls is expected to be acceptable to the community. However, because the remedy involves the subsurface injection of a material with which the public is generally not familiar, an appropriate monitoring and reporting plan will be an important component of the remedy. The monitoring and reporting plan will allow the public to monitor changes in water quality during the response actions.

2.12.4 Description of Selected Remedy

This section describes, in general terms, how the Selected Remedy will be implemented at ERP Sites 2, 9, and 11. The ANG will prepare detailed remedial designs prior to initiating response actions at each site. In addition, the ANG will complete an evaluation of remedy effectiveness after 1 year of injection work and annually thereafter as part of the groundwater monitoring program, to assess whether the remedy is likely to accomplish the RAOs within a reasonable timeframe. The results and recommendations of the evaluation will be submitted to ODEQ and other interested parties for review. Based on the results, modification of the treatment regime described in the remedial design documents may be necessary.

Note that since the FS and Proposed Plan were completed, the groundwater monitoring component of the remedy has been modified slightly. Based on discussions with the ODEQ, the initial groundwater monitoring program at each site will consist of one baseline, pre-treatment sampling event (including MNA parameters) followed by 3 years of quarterly monitoring, rather than 2 years of quarterly monitoring and

5 years of annual monitoring as outlined in the FS and Proposed Plan. This will allow better monitoring of groundwater quality during the period immediately following the final round of oxidant injections at each site.

2.12.4.1 ERP Site 2

The primary treatment method in the Selected Remedy for ERP Site 2 is in situ chemical oxidation of chlorinated VOCs using potassium permanganate. A potassium permanganate solution will be injected throughout the vertical and lateral extent of the Shallow and Deep Zone hot spots using direct-push technology. Additionally, MNA will be used to verify and monitor the natural attenuation of COCs within and outside the treatment area. Institutional controls will be used to prevent exposure to COCs below ODEQ hot spot cleanup levels but above acceptable risk-based levels; institutional controls are described in Section 2.9.2.

Implementation of the Selected Remedy at ERP Site 2 will involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone. The concentrations of VOCs in the Deep Zone are expected to fluctuate prior to the implementation of remedial actions at Site 2. The investigation will consist of collecting approximately 30 direct-push groundwater samples prior to initiating permanganate injections.

- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and two CRSA monitoring wells within, and surrounding, the hot spots of contamination. Four of these wells (one Shallow Zone well, one Deep Zone well, and both CRSA wells) have already been installed at Site 2.

- Injecting approximately 35 pounds of potassium permanganate as a 2 percent (minimum) water-based solution in multiple direct-push borings. This is the anticipated injection quantity in each boring during each application; several applications will be performed as described below. The injection quantity and permanganate concentration may vary based on the conductivity of the soil and other local site conditions, as well as performance monitoring results. The injection locations and frequency will consist of:

  - Approximately 250 injections on 25-foot centers within the primary treatment area of the Shallow Zone hot spot, injected from the bottom of the Shallow Zone up to the water table. The primary

treatment area is the area of the dissolved VOC plume with relatively higher concentrations (e.g., vinyl chloride > 20 µg/L). These injections will be performed approximately every 6 months for 2 years, for a total of four applications. During the second, third, and fourth applications, the injection locations will be offset from the previous locations, resulting in a net spacing of approximately 12 feet.

  - Approximately 60 injections on 25-foot centers within the Shallow Zone hot spot but outside of the primary treatment area, injected from the bottom of the Shallow Zone up to the water table. These injections will be performed approximately every year for 2 years, for a total of two applications. The injection locations will be offset for each application, resulting in a net spacing of approximately 18 feet. Fewer permanganate applications are expected to be necessary outside of the primary treatment area due to the lower VOC concentrations near the downgradient and lateral margins of the dissolved plume.

  - Between 45 and 80 injections on 25-foot centers within the Deep Zone hot spot, injected from the bottom of the Deep Zone up to the top of the Deep Zone. These injections will be performed approximately every 6 months for 2 years, for a total of four applications. The injection locations will be offset for each application, resulting in a net spacing of approximately 12 feet.

- Performing a baseline groundwater sampling event and 3 years of quarterly groundwater monitoring. Approximately 26 wells will be monitored for VOC concentrations. Additionally, approximately ten of these wells will be monitored for MNA parameters and potential secondary effects of oxidation, such as increased concentrations of chromium, cadmium, and mercury derived from aquifer materials.

Figure 2-19 shows the layout of the primary components of the Selected Remedy for ERP Site 2. The spacing of the injection borings described above and depicted in Figure 2-19 is based on preliminary estimates; injection spacing may be adjusted during remedial design. The hot spot cleanup levels shown in Table 2-3 are expected to be achieved within 2 to 5 years of implementing the remedy. Residual risks associated with COC concentrations below the hot spot cleanup levels but above the off-site migration/on-site exposure cleanup levels (see Table 2-3) will be managed using institutional controls.

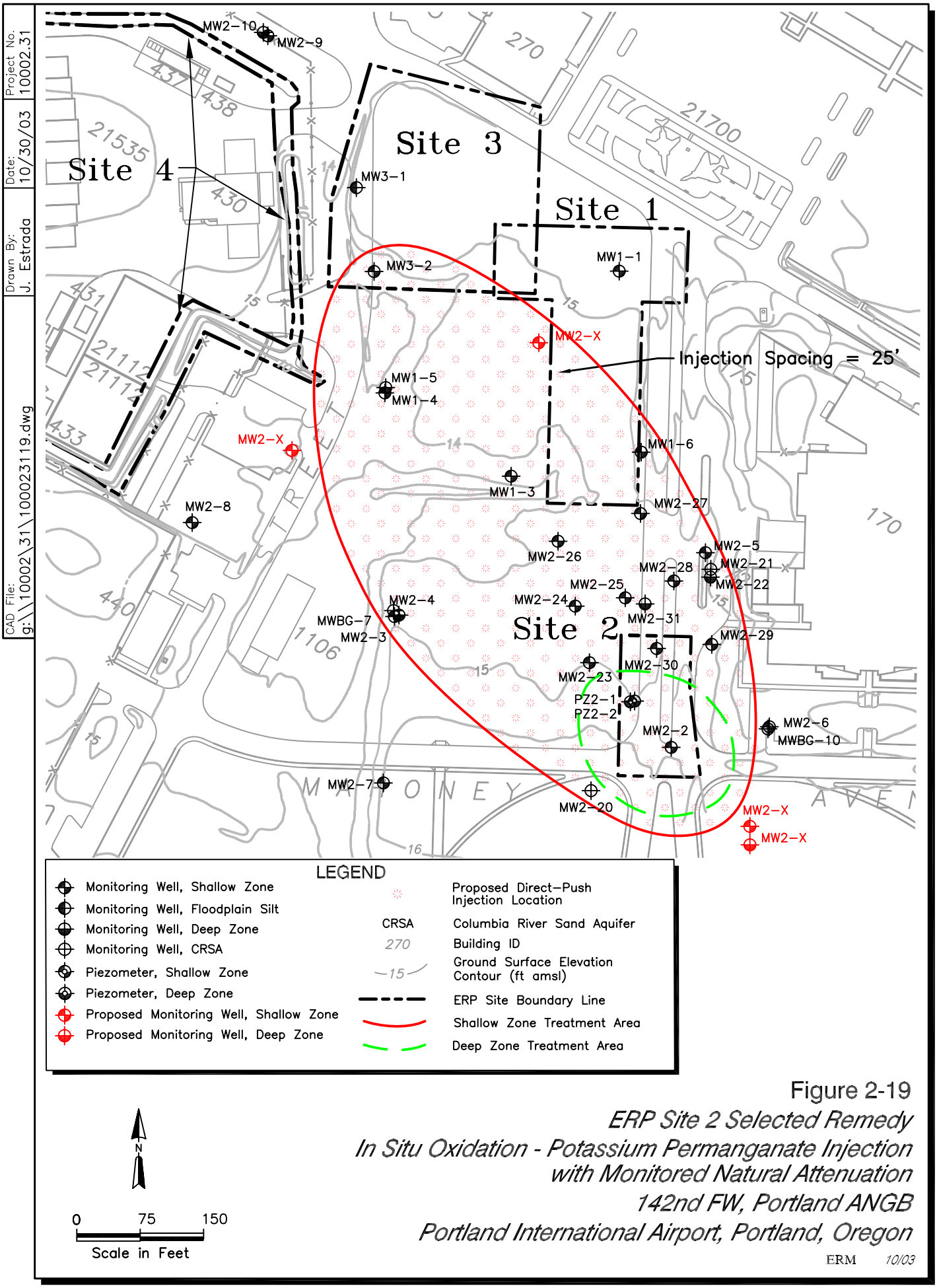

Figure 2-19

ERP Site 2 Selected Remedy

In Situ Oxidation - Potassium Permanganate Injection with Monitored Natural Attenuation

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2.12.4.2 ERP Site 9

The primary treatment method in the Selected Remedy for ERP Site 9 is in situ chemical oxidation of benzene (and trace PAHs, if present) using sodium persulfate. A sodium persulfate solution will be injected throughout the vertical and lateral extent of the Shallow Zone hot spot using direct-push technology. Additionally, MNA will be used to verify and monitor the natural attenuation of COCs within and outside the treatment area. Institutional controls will be used to prevent exposure to COCs below ODEQ hot spot cleanup levels but above acceptable risk-based levels; institutional controls are described in Section 2.9.2.

Implementation of the Selected Remedy at ERP Site 9 will involve:

- Installing seven Shallow Zone monitoring wells within, and surrounding, the hot spot of contamination. These seven wells and three additional Shallow Zone monitoring wells have already been installed at Site 9.

- Injecting iron-catalyzed sodium persulfate in approximately 50 direct-push borings installed on 25-foot centers within the Shallow Zone hot spot. Approximately 95 pounds of persulfate as a 3 to 5 percent (minimum) water-based solution will be injected from the bottom of the Shallow Zone up to the water table. This is the anticipated injection quantity in each boring during each application. The injection quantity and persulfate concentration may vary based on the conductivity of the soil and other local site conditions, as well as performance monitoring results. The injections will be performed approximately every 6 months for 2 years, for a total of four applications. The injection locations will be offset for each application, resulting in a net spacing of approximately 12 feet.

- Performing a baseline groundwater sampling event and 3 years of quarterly groundwater monitoring. Approximately ten wells will be monitored for VOC and PAH concentrations. Additionally, approximately three of these wells will be monitored for MNA parameters and potential secondary effects of oxidation, such as increased concentrations of chromium, cadmium, and mercury derived from aquifer materials.

Figure 2-20 shows the layout of the primary components of the Selected Remedy for ERP Site 9. The spacing of the injection borings described above and depicted in Figure 2-20 is based on preliminary estimates;

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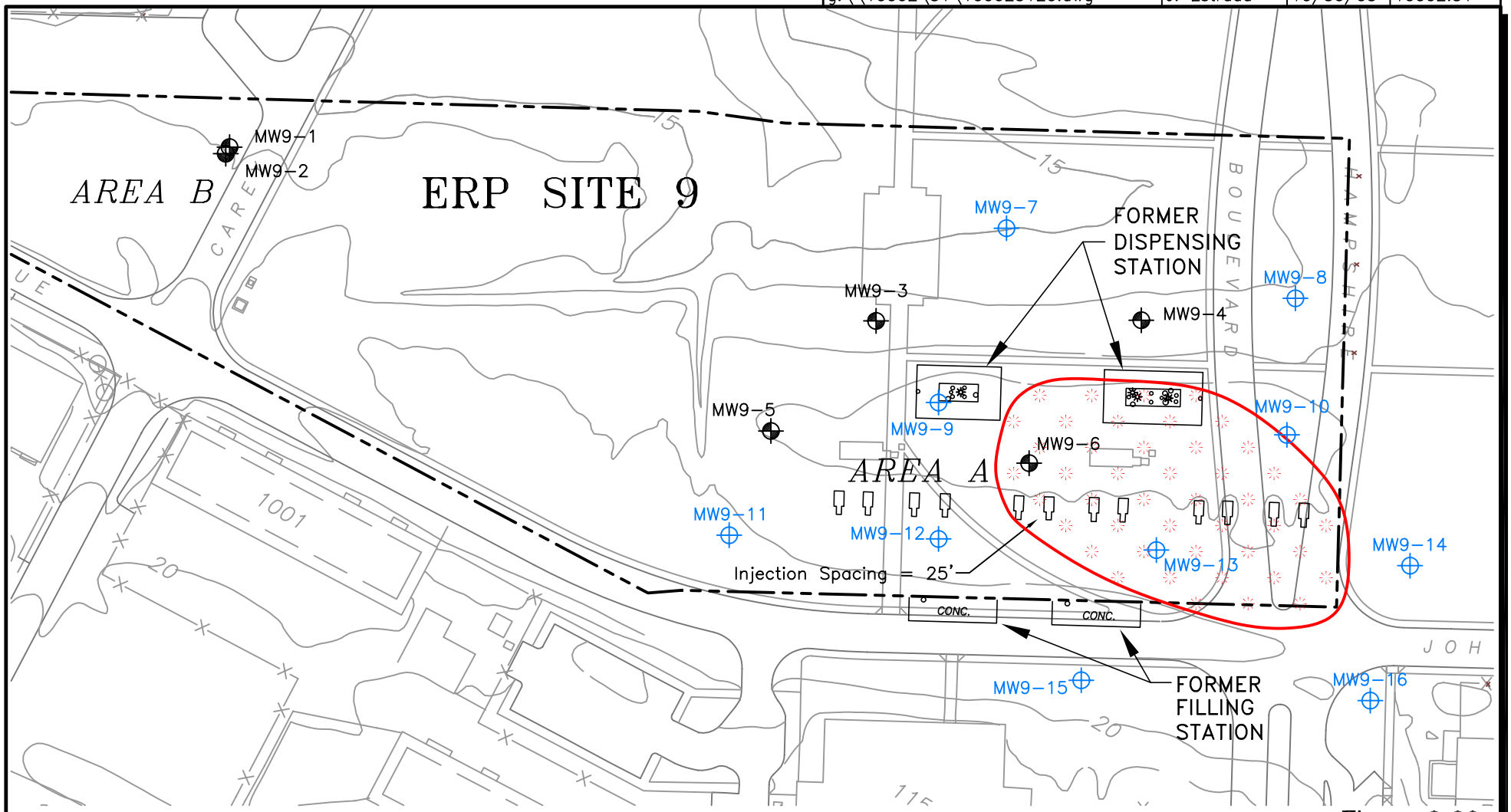

LEGEND

- Monitoring Well, Shallow Zone
- Monitoring Well, Deep Zone
- Proposed Monitoring Well, Shallow Zone
- Proposed Direct-Push Injection Location
- Shallow Zone Treatment Area
- ERP Site Boundary
- Former 25,000-Gallon UST Location
- 15 — Ground Surface Elevation Contour (ft amsl)
- 1113 — Building ID

N

0 50 100

Scale in Feet

Figure 2-20

ERP Site 9 Selected Remedial
In Situ Oxidation - Sodium Persulfate Injection
with Monitored Natural Attenuation
142nd FW, Portland ANGB
Portland International Airport, Portland, Oregon

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injection spacing may be adjusted during remedial design. The hot spot cleanup levels shown in Table 2-3 are expected to be achieved within 2 to 5 years of implementing the remedy. Residual risks associated with COC concentrations below the hot spot cleanup levels but above the off-site migration/on-site exposure cleanup levels (see Table 2-3) will be managed using institutional controls.

2.12.4.3 ERP Site 11

The primary treatment method in the Selected Remedy for ERP Site 11 is in situ chemical oxidation of chlorinated VOCs using potassium permanganate. A potassium permanganate solution will be injected into the Shallow and Deep Zone hot spots using horizontal injection wells. Additionally, MNA will be used to verify and monitor the natural attenuation of COCs within and outside the treatment area. Institutional controls will be used to prevent exposure to COCs below ODEQ hot spot cleanup levels but above acceptable risk-based levels; institutional controls are described in Section 2.9.2.

Implementation of the Selected Remedy at ERP Site 11 will involve:

- Performing a direct-push groundwater investigation to assess the current lateral extent of dissolved VOCs in the Deep Zone. The investigation will consist of collecting approximately 30 direct-push groundwater samples prior to initiating permanganate injections.

- Installing four Shallow Zone monitoring wells, two Deep Zone monitoring wells, and three CRSA monitoring wells within, and surrounding, the hot spots of contamination. These nine wells have already been installed at Site 11.

- Installing seven or eight Shallow Zone horizontal injection wells and four Deep Zone horizontal injection wells within the hot spots of contamination. These wells will be placed at the approximate vertical midpoint of the Shallow Zone and Deep Zone. Four Shallow Zone injection wells have already been installed as part of the Site 11 IRA.

- Injecting potassium permanganate as a 2 percent (minimum) water-based solution in each of the injection wells. Approximately 12 gallons of permanganate solution will be injected for each foot of screen length in each well. This is the anticipated injection quantity in each well during each application. The injection quantity and permanganate concentration may vary based on the conductivity of the soil and other

local site conditions, as well as performance monitoring results. The injections will be performed approximately every 6 months for 2 years, for a total of four applications.

- Performing a baseline groundwater sampling event and 3 years of quarterly groundwater monitoring. Approximately 23 wells will be monitored for VOC concentrations. Additionally, approximately ten of these wells will be monitored for MNA parameters and potential secondary effects of oxidation, such as increased concentrations of chromium, cadmium, and mercury derived from aquifer materials.

Figure 2-21 shows the layout of the primary components of the Selected Remedy for ERP Site 11. The spacing of the horizontal wells depicted in Figure 2-21 is based on preliminary estimates; well spacing may be adjusted during remedial design. The hot spot cleanup levels shown in Table 2-3 are expected to be achieved within 2 to 5 years of implementing the remedy. Residual risks associated with COC concentrations below the hot spot cleanup levels but above the off-site migration/on-site exposure cleanup levels (see Table 2-3) will be managed using institutional controls.

2.12.5 Summary of Estimated Remedy Costs

This section summarizes the estimated costs for implementing the Selected Remedy at ERP Sites 2, 9, and 11. The cost estimates are based primarily on information and assumptions presented in the FS report (ERM 2001b) regarding the anticipated scope of the response actions. However, the costs for groundwater monitoring are based on one baseline sampling event and 3 years of quarterly monitoring, rather than the 2 years of quarterly monitoring and 5 years of annual monitoring assumed in the FS.

The cost estimates presented in this section are considered preliminary, order-of-magnitude estimates, with an expected accuracy of +50 to –30 percent. The estimated costs are likely to change as a result of new information gathered during the remedial design phase. Major changes may be documented in the form of a memorandum in the Administrative Record, an Explanation of Significant Differences, or a ROD amendment.

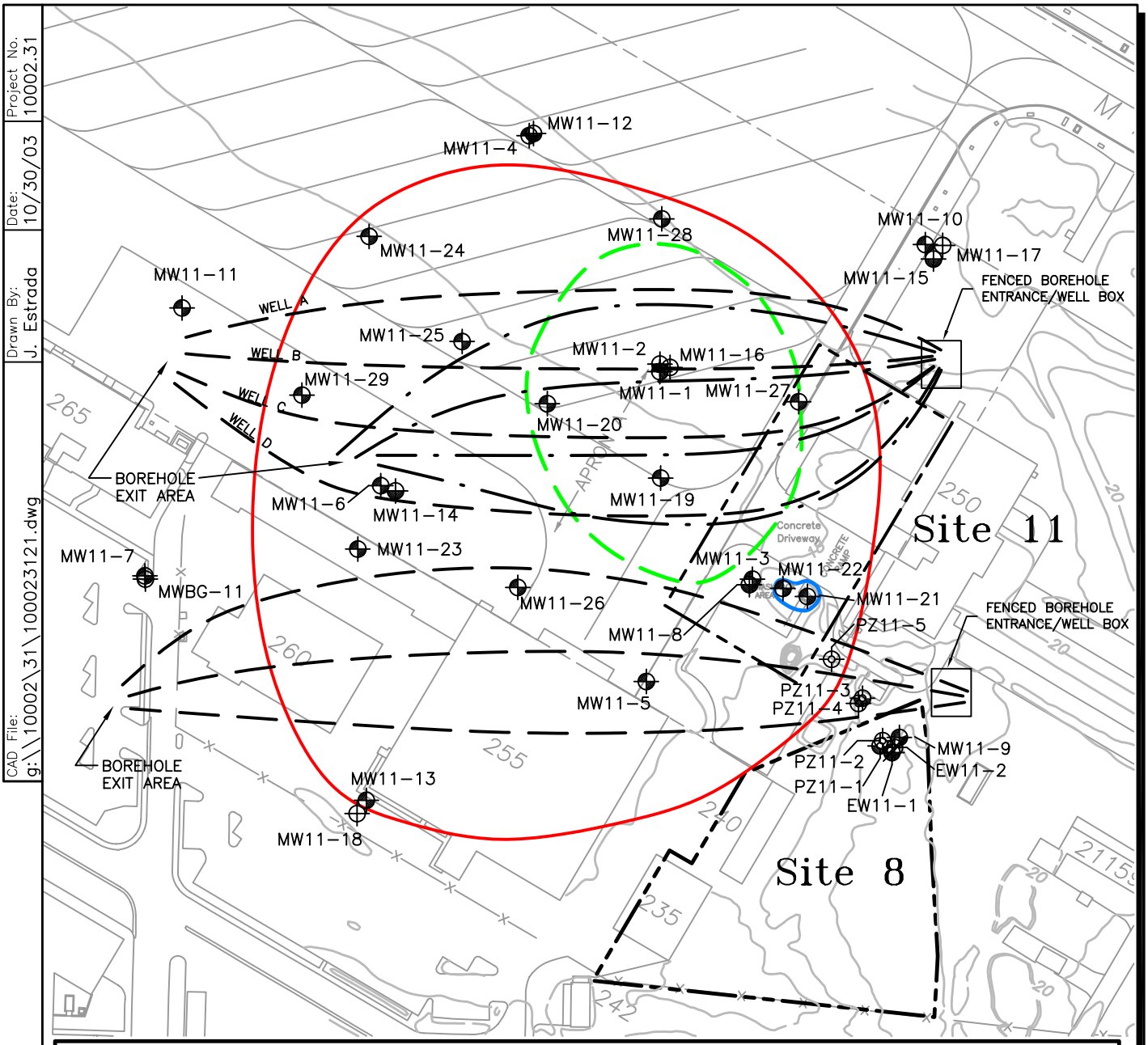

Figure 2-21

ERP Site 11 Selected Remedy

In Situ Oxidation - Potassium Permanganate Injection

with Monitored Natural Attenuation

142nd FW, Portland ANGB

Portland International Airport, Portland, Oregon

ERM 10/03

2.12.5.1 ERP Site 2

Direct and indirect capital costs for implementing the Selected Remedy at ERP Site 2 are estimated to be $1,438,550; this includes equipment, materials, contractor services, labor, project administration, and project management. The O&M cost for 3 years of quarterly groundwater monitoring is estimated to be $357,500. The total estimated cost for the Selected Remedy, including a 30 percent contingency, is $2,335,000.

2.12.5.2 ERP Site 9

Direct and indirect capital costs for implementing the Selected Remedy at ERP Site 9 are estimated to be $319,000; this includes equipment, materials, contractor services, labor, project administration, and project management. The O&M cost for 3 years of quarterly groundwater monitoring is estimated to be $131,300. The total estimated cost for the Selected Remedy, including a 30 percent contingency, is $586,000.

2.12.5.3 ERP Site 11

Direct and indirect capital costs for implementing the Selected Remedy at ERP Site 11 are estimated to be $1,673,950; this includes equipment, materials, contractor services, labor, project administration, and project management. The O&M cost for 3 years of quarterly groundwater monitoring is estimated to be $357,500. The total estimated cost for the Selected Remedy, including a 30 percent contingency, is $2,641,000.

2.12.6 Expected Outcomes of Selected Remedy

The purpose of the response actions selected for ERP Sites 2, 9, and 11 is to control risks associated with potential exposure to COCs in groundwater. The results of the baseline risk assessment indicate that existing conditions at these sites pose unacceptable risks based on a hypothetical residential exposure scenario. The Selected Remedy will address groundwater containing COC concentrations above acceptable risk-based concentrations. The response actions are expected to restore the beneficial use of groundwater by treating hot spots of contamination to concentrations below ODEQ-defined significant adverse effect levels. Groundwater will be monitored to assess performance of the remedy relative to the target cleanup levels. The hot spot cleanup levels are expected to be achieved within 2 to 5 years of implementing the Selected Remedy. After the hot spot cleanup levels are achieved, Base groundwater is generally expected

to be available for unrestricted use, except as limited by any institutional controls necessary to prevent exposure to COCs above risk-based concentrations. Land will continue to be available for industrial use.

2.13 Statutory Determinations

Under CERCLA Section 121 and the NCP, the lead agency (ANG, in this case) must select remedies that are protective of human health and the environment; comply with ARARs (unless a statutory waiver is justified); are cost-effective; and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the TMV of hazardous substances as a principal element.

Per Section 340-122-0090 of the Oregon Hazardous Substance Remedial Action Rules, Oregon requires the selection of remedial actions that are protective of the environment and public health, safety, and welfare; provide a balance of the remedy selection factors (i.e., effectiveness, long-term reliability, implementability, implementation risk, and cost reasonableness); and treat hot spots of contamination to the extent feasible.

The Selected Remedy for ERP Sites 2, 9, and 11 (Alternative 3) utilizes in situ chemical oxidation technology to destroy dissolved COCs. The remedy also utilizes MNA and institutional controls to ensure that no long-term residual risks remain at the sites. This remedy meets the Oregon requirements for selection of remedial actions and is the most cost-effective of the remedial alternatives evaluated in the FS. The following sections discuss how the Selected Remedy meets the CERCLA requirements.

2.13.1 Protection of Human Health and the Environment

The Selected Remedy will protect human health and the environment through a combination of in situ chemical oxidation treatment of groundwater hot spots, MNA, and institutional controls. The remedy will remove contamination to below Federal and/or Oregon standards, prevent the existing contaminant plumes from migrating off-site, and eliminate the threat of exposure to dissolved COCs via ingestion of contaminated groundwater. The current excess cancer risk associated

with the ingestion exposure pathway at ERP Sites 2, 9, and 11 exceeds the Oregon acceptable level of 1×10^{-6} for individual carcinogens. The Selected Remedy will reduce the cancer risk to less than 1×10^{-6} and the hazard index to less than one. These levels comply with Federal and State requirements. There are no short-term threats associated with the Selected Remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the Selected Remedy.

2.13.2 Compliance with ARARs

The Selected Remedy of potassium permanganate/sodium persulfate oxidation with MNA complies with Oregon requirements for remedial actions (OAR 340-122-0090) and ODEQ pre-calculated significant adverse effect levels (ODEQ 1998b). The Selected Remedy also complies with Federal Safe Drinking Water Act Maximum Contaminant Levels (40 Code of Federal Regulations Part 141), which specify acceptable contaminant concentrations in groundwater that serves as a potential source of drinking water.

2.13.3 Cost-Effectiveness

In the ANG's judgment, the Selected Remedy is cost-effective (i.e., its costs are proportional to its overall effectiveness), and the remedy represents a reasonable value for the money to be spent. In making this determination, the overall effectiveness of each remedial alternative (with the exception of the No Action alternative, which is not protective of human health and the environment and does not comply with ARARs) was appraised by assessing three of the evaluation criteria in combination: long-term effectiveness and permanence, reduction of TMV through treatment, and short-term effectiveness. Overall effectiveness was then compared to costs to determine cost-effectiveness. The overall effectiveness of the Selected Remedy, Alternative 3, was determined to be proportional to its costs and hence this alternative represents a reasonable value for the money to be spent.

The estimated total cost of the Selected Remedy ranges from $586,000 at ERP Site 9 to $2,641,000 at ERP Site 11. Although Alternative 2 (MNA) is less expensive by approximately $300,000 to $1,900,000, it is not protective in the short term because it does not meet the RAOs within a reasonable timeframe, and is therefore not cost-effective. The Selected Remedy's additional cost for more rapid attainment of RAOs provides increased protection of human health and the environment and is cost-effective. The

Selected Remedy's combination of potassium permanganate/sodium persulfate oxidation and MNA will provide an overall level of protection comparable to Alternatives 4 (ozonation) and 6 (in-well aeration) at a significantly lower cost.

2.13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The ANG has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Base. Of those alternatives that are protective of human health and the environment and comply with ARARs, the ANG has determined that the Selected Remedy provides the best balance of trade-offs in terms of the evaluation criteria, while also considering the statutory preference for treatment as a principal element.

The Selected Remedy utilizes in situ chemical oxidation and MNA to significantly reduce COC concentrations in groundwater, thereby satisfying the criteria for long-term effectiveness. The Selected Remedy does not present short-term risks different from the other treatment alternatives, and there are no special implementability issues that set the Selected Remedy apart from the other alternatives.

2.13.5 Preference for Treatment as a Principal Element

By treating the contaminated groundwater with in situ chemical oxidation and MNA, the Selected Remedy addresses potential risks posed by the contamination through the use of treatment technologies. Accordingly, the statutory preference for remedies that employ treatment as a principal element is satisfied.

2.13.6 Five-Year Review Requirements

The Selected Remedy for ERP Sites 2, 9, and 11 is expected to achieve hot spot cleanup levels within 2 to 5 years of implementation, and is not expected to result in hazardous substances remaining in groundwater above levels that allow for unlimited use and unrestricted exposure. However, it may take longer than 5 years to achieve target cleanup levels and meet site RAOs. Therefore, a policy review may be conducted within

5 years of construction completion to ensure that the Selected Remedy is, or will be, protective of human health and the environment.

2.14 Documentation of Significant Changes

The Proposed Plan for the Portland ANGB was released for public comment in April 2003. The Proposed Plan identified Alternative 3, In Situ Oxidation – Potassium Permanganate/Sodium Persulfate Injection with MNA, as the Preferred Alternative for groundwater remediation. No comments were submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

SECTION 3.0

RESPONSIVENESS SUMMARY

This section presents stakeholder concerns about the Portland ANGB and preferences regarding the remedial alternatives. It also documents how stakeholder concerns were addressed and how the preferences were factored into the remedy selection process.

3.1 Stakeholder Issues and Lead Agency Responses

The ODEQ and the Port of Portland reviewed and provided comments on the FS report and the Proposed Plan. In addition, a public information meeting and several RAB meetings were held during the remedy selection process. The ODEQ and Port of Portland review comments and the ANG responses are included in Appendix A. Minutes of the RAB and public information meetings are included in Appendix B. Documentation of stakeholder issues raised during planning and implementation of the IRAs at ERP Sites 2 and 11 is contained in the Administrative Record for the Portland ANGB.

3.2 Technical and Legal Issues

There are no technical or legal issues that require additional discussion.

SECTION 4.0

REFERENCES

Environmental Resources Management (ERM). 2003a. *Final Proposed Plan, 142nd Fighter Wing, Portland Air National Guard Base, Portland, Oregon.* April 2003.

ERM. 2003b. *Final Interim Remedial Action Construction Technology Demonstration Report, 142nd Fighter Wing, Portland Air National Guard Base, Portland, Oregon.* July 2003.

ERM. 2002a. *Final Site Ecology Screening Report for Environmental Restoration Program Site 4, 142nd Fighter Wing, Portland Air National Guard Base, Portland, Oregon.* November 2002.

ERM. 2002b. *Final Interim Remedial Design 100 Percent Submittal, 142nd Fighter Wing, Portland Air National Guard Base, Portland, Oregon.* December 2002.

ERM. 2001a. *Final Remedial Investigation Report, 142nd Fighter Wing, Portland Air National Guard Base, Portland, Oregon.* January 2001.

ERM. 2001b. *Final Feasibility Study, 142nd Fighter Wing, Portland Air National Guard Base, Portland, Oregon.* July 2001.

ERM. 2001c. *Final Engineering Evaluation/Cost Analysis For Groundwater at ERP Site 11, 142nd Fighter Wing, Portland Air National Guard Base, Portland, Oregon.* June 2001.

ERM. 2001d. *Interim Remedial Action Construction Phase I Interim Report, 142nd Fighter Wing, Portland Air National Guard Base, Portland, Oregon.* February 2001.

ERM. 2000. *Final Completion Report for Site 11 Interim Remedial Action Construction for Soils Media, 142nd Fighter Wing, Portland Air National Guard Base, Portland, Oregon.* September 2000.

Hazardous Materials Training Center. 1987. *Phase I Records Search for Portland International Airport (ANG), Portland, Oregon and North Bend Air National Guard Station, North Bend, Oregon.*

National Research Council. 1983. *Risk Assessment in the Federal Government: Managing the Process.* National Academy Press, Washington, D.C.

Operational Technologies Corporation (OpTech). 1996. *Draft Remedial Investigation Report for 142nd Fighter Wing, Portland Air National Guard Base, Portland, Oregon*. November 1996.

Oregon Department of Environmental Quality (ODEQ). 2003. *Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites.* Land Quality Division, Environmental Cleanup and Tanks Program. 22 September 2003.

ODEQ. 2000. *Final Guidance for Conduct of Deterministic Human Health Risk Assessments.* Waste Management and Cleanup Division, Cleanup Policy and Program Development Section. December 1998, Updated May 2000.

ODEQ. 1998a. *Final Guidance for Identification of Hot Spots*. 23 April 1998.

ODEQ. 1998b. *Final Pre-Calculated Hot Spot Look-Up Tables*. 20 October 1998.

ODEQ. 1998c. *Final Guidance for Ecological Risk Assessment: Levels I, II, III, IV*. April 1998.

ODEQ. 1998d. *Final Guidance for Conducting Feasibility Studies*. 1 July 1998.

Pankow, J.F., and J.A. Cherry. 1996. Dense Chlorinated Solvents and other DNAPLs in Groundwater. Waterloo Press.

Science Applications International Corporation (SAIC). 1991. *Final Report for Site Investigation at the 142nd Fighter Interceptor Group, Oregon Air National Guard, Portland International Airport, Portland, Oregon.* May 1991.

United States Environmental Protection Agency (USEPA). 2002. *USEPA Region 9 Preliminary Remediation Goals, 2002 Update*. 1 October 2002. Available on the web at http://www.epa.gov/region09/waste/sfund/prg/index.htm.

USEPA. 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*. EPA 540-R-98-031. July 1999.

USEPA. 1989. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual/Part A (Interim Final).* Washington, D.C.: United States

Environmental Protection Agency. USEPA/540/1-89-002, 289p. December 1989.

USEPA. 1988. *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. Office of Emergency and Remedial Response. October 1988.

USEPA. 1985. *Remedial Action Costing Procedures Manual*. EPA Report #600/8-87/049. September 1985.

APPENDIX A

ODEQ AND PORT OF PORTLAND COMMENTS ON THE FEASIBILITY STUDY REPORT AND THE PROPOSED PLAN

State of Oregon

Department of Environmental Quality Memorandum

To: Oregon Air National Guard - 142nd Fighter I.G. ECSI No. 637

Date: June 1, 2001

From: Matt McClincy, Rod Struck and Tom Gainer, Voluntary Cleanup, Northwest Region

Subject: Comments Oregon Air National Guard - 142nd Fighter Interceptor Group Portland International Airport Portland, Oregon

This memorandum presents DEQ review comments on the following document: *Installation Restoration Program - Draft Final Feasibility Study - 142nd Fighter Wing - Portland Air National Guard Base - Portland International Airport - Portland, Oregon*. This report is dated May 2001 and was prepared for the Air National Guard - Andrews AFB, Maryland by Environmental Resources Management (ERM) of Bellevue, WA. This report was received by DEQ on May 2, 2001.

General

A. Previous DEQ comments on the Phase II Remedial Investigation (RI) Report (DEQ letter dated August 1, 2000) identified a number of significant characterization data gaps at IRP Sites 2, 4, 9, and 11. DEQ's approval of the RI was contingent on these data gaps being addressed in either the Feasibility Study (FS) or in the Engineering Evaluation/Cost Analysis (EECA). The following DEQ comments should be incorporated into the Final FS report:

- DEQ review comments, dated May 25, 2001, on the EECA for IRP Site 11.
- DEQ review comments, dated May 25, 2001, on the Conceptual Phase Design Submittal for IRAP Site 11.
- DEQ review comments, dated May 9, 2001 on the ecological risk assessment for IRP Site 4.
- DEQ review comments, dated April 13, 2001, on the Interim Remedial Action Construction Phase I Interim Report for IRP Site 2.
- DEQ review comments, dated April 13, 2001, on the Draft Addendum to the Interim Remedial Action Construction Work Plan for IRP Site 2.
- DEQ review comments, dated August 1, 2000, on the Preliminary Final Phase II Remedial Investigation Report.

B. Previous DEQ comments (see above) identified the need for additional groundwater monitoring wells are needed to verify VOC concentrations detected in groundwater grab samples collected during the RI, refine the understanding of groundwater flow directions, and assure adequate wells exist to fully evaluate the groundwater pathway.

C. The FS must be revised to include additional information regarding the potential impacts to groundwater quality due to the injection of potassium permanganate (See DEQ Memorandums regarding IRP No. 2 dated April 13, 2001) and sodium persulfate. Any potential changes in groundwater quality must be presented.

Specific Comments

1. Section 2.9.3. The RI report describes the numerous uncertainties associated with the groundwater modeling performed to date and with potential applications of the results. Either this discussion should be reiterated in the FS, or it should be clearly referenced.

2. Section 2.11. Appropriate figures illustrating the estimated extent of the VOC groundwater hot spots in the Deep Zone groundwater at IRP Sites 2 and 11 should be prepared and included in the FS. The FS should specifically discuss how these areas will be addressed in subsequent sections of the report.

3. Figures 2-10, 2-11, and 2-12. It should be noted that the estimated extent of the groundwater hot spots in the Shallow Zone Groundwater is based on very limited data points in some cases. Additional groundwater monitoring wells are required to adequately define the extent of these areas (see General Comments A and B).

4. Section 3. This section should be revised to address DEQ comments on the Risk Assessments.

5. Table 3-1. A footnote should be added to the table to indicate how the project screening goals were developed and to refer the reader to the appropriate section of the RI report for further information.

6. Table 3-2. IRP Areas 1, 3, and 7 should also be shown in blue on this table.

7. Section 3.7.4. Prior to eliminating IRP Area 7 from further consideration in the FS, the rationale for not carrying this area forward must be clearly defined (i.e., based on the uncertainty in the data should additional monitoring or additional investigation be required?).

8. Section 4.2. The RAOs should include the prevention or elimination of potential exposure from soil and groundwater via the indoor or outdoor air inhalation pathway.

   It is not clear why there are no remedial action objectives for soil, when remediation of residual soil contamination at Site 11 is included in the EE/CA and Remedial Design documents. In other parts of the FS, the EE/CA activities are ignored as a conservative assumption, but in this case it seems like the EE/CA's remediation of Site 11 soil is assumed successful and complete. The need for the RAO's to also address soil at sites 2 and 9 should be clarified.

9 Table 4-6 Reference citations on the table should be included in the document's References section.

10. Table 4-7. This table indicates that zero valent iron oxidation was screened out due to the conclusion that the "slowness and variability of groundwater flow at the Base are not compatible with this type of technology." Why doesn't this apply to the other in situ treatment technologies? The plume distribution at IRP Area 2 suggests that groundwater flow conditions are not incompatible with zero valent iron oxidation.

11. Section 4.5.5. A deep zone horizontal vapor extraction pipe is proposed between the horizontal deep and shallow zone ozone sparging pipes. It is not clear how vapors would be collected under saturated conditions. Vapor recovery pipes should be located above the seasonal high water table.

12. Section 5. This section does not address potential adverse impacts to groundwater quality from the injection of potassium permanganate or sodium persulfate. The ANG has stated that it will meet the substantive requirements associated with DEQ's Water Quality Program permits. The FS must clearly demonstrate that:

    - No activities will be conducted that exacerbate existing groundwater contamination or that could cause an adverse impact on existing or potential beneficial uses of groundwater.

    - Activities will include an adequate monitoring and reporting program to allow DEQ and the public to confirm that the activities are not having an adverse impact on the environment.

13. Section 4.5.4. The three different injection zones described for Site 2 Alternatives 3, 4, and 5 should be shown on a figure.

14. Table 5-1. Ratings in the table do not all match descriptions in the text. For example, see comment under Section 5.4.1.5.

15. Figures 5-6 through 5-10. It is DEQ's opinion that additional monitoring wells would be required to adequately monitor the effectiveness of any of the proposed alternatives. Additional wells should be placed near the estimated southeast and northwest limits of the estimated VOC hot spot.

16. Figures 5-11 through 5-15. It is DEQ's opinion that additional monitoring wells would be required to adequately monitor the effectiveness of any of the proposed alternatives. Additional shallow, deep, and CRSA wells should be installed to demonstrate that implementation of any of the in situ treatment alternatives are not adversely impacting groundwater quality.

17. Section 5.4.1.5. Site 11 Alternative 4 is one of the most expensive alternatives, not the least expensive. Correspondingly, the cost reasonableness is not high.

18. Section 6.1.6. See comment no. 7.

19. Section 6.1.10. This section should reference the Site 11 soil remediation described/planned in the EE/CA.

20. Section 6.2.2. This section states that institutional controls may not be reliable. Where residual risk exceeds acceptable levels, they can be controlled by engineering or institutional controls. If however, these controls are not implementable or reliable, the FS will need to identify and recommend alternative remedies which achieve the RAO's.

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ERM®

10 August 2001

Mr. Matt McClincy
Department of Environmental Quality
2020 SW Fourth Ave., Suite 400
Portland, Oregon 97201-4987

Subject: Response to 1 June 2001 ODEQ Comments on
Draft Final Feasibility Study
Oregon Air National Guard
142nd Fighter Wing, Portland, Oregon

Dear Mr. McClincy:

On behalf of the Air National Guard (ANG), Environmental Resources Management (ERM) is pleased to provide the Oregon Department of Environmental Quality (ODEQ) with two copies of the subject document. Please call me at (425) 462-8591 if you have any questions.

Sincerely,

Timothy S. McCormack, R.G.
Principal, Northwest Operations

TSM/clb/6049.17
attachment (response to comments)
cc: Mr. Michael Grimm, ANG/CEVR
Lt. Col. Roger Rein, OR ANG
Mr. Stan Jones, Port of Portland
Mr. Aaron Etnyre, Montgomery Watson
Mr. Rob Leet, ERM

To:	Matt McClincy	**From:**	Chris Bailey (ERM)
State:	OR **Base:** Portland	**Document Version:**	Draft Final
Title:	Feasibility Study	**Comments Received:**	4 June 01

No.	Page	Comment/Response
1.	General (General Comment A)	**Comment:** Previous DEQ comments on the Phase II Remedial Investigation (RI) Report (DEQ letter dated August 1, 2000) identified a number of significant characterization data gaps at IRP Sites 2, 4, 9, and 11. DEQ's approval of the RI was contingent on these data gaps being addressed in either the Feasibility Study (FS) or in the Engineering Evaluation/Cost Analysis (EECA). The following DEQ comments should be incorporated into the Final FS report: • DEQ review comments, dated May 25, 2001, on the EECA for IRP Site 11. • DEQ review comments, dated May 25, 2001, on the Conceptual Phase Design Submittal for IRAP Site 11. • DEQ review comments, dated May 9, 2001 on the ecological risk assessment for IRP Site 4. • DEQ review comments, dated April 13, 2001, on the Interim Remedial Action Construction Phase I Interim Report for IRP Site 2. • DEQ review comments, dated April 13, 2001, on the Draft Addendum to the Interim Remedial Action Construction Work Plan for IRP Site 2. • DEQ review comments, dated August 1, 2000, on the Preliminary Final Phase II Remedial Investigation Report. **Response:** The comments made by DEQ for the first five documents listed above have been reviewed. The comments previously made by DEQ on the documents listed above that are applicable to the FS process and that are not duplicated in specific comments on the Feasibility Study are presented below and addressed as the comment pertains to the production of the Final FS. The DEQ comments on the Preliminary Final Phase II Remedial Investigation Report that pertain to characterization data gaps are not addressed below. These comments are being ad-

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dressed through the phased installation of additional monitoring wells proposed in the Monitoring Well Installation Work Plan Addendum, the Addendum to the IRAC Work Plan , and the Feasibility Study. The well locations and timing for installing the additional wells were discussed in conference calls with DEQ on 27 June and 5 July 2001.
In addition to the DEQ comments identified above, DEQ's March 1, 2001 comments on the Final Remedial Investigation Report were reviewed and are addressed below as they relate to the FS.

- DEQ review comments, dated May 25, 2001, on the EECA for IRP Site 11.

  Comment: Section 3.1.3.3; Tables 3-1 and 3-2, This section should state these numbers are not to be considered ARARs (see Section 3.1.3.2). DEQ groundwater reference concentrations are presented in administrative rules for the purpose of establishing alternative soil cleanup levels under OAR 340-122-045.

  Response: The FS has been revised to reflect this comment.

  Comment: Section 4.3.2, The EE/CA should consider alternatives to using 2% K-permanganate (e.g., stronger K- permanganate or Na-permanganate) to reduce the total volume of water injected into the subsurface and improve treatment effectiveness.

  Response: As described in the original response to this comment, 2% is a preferable concentration to use due to the assurance of dissolution of potassium permanganate at ambient temperatures and the added benefit of a greater injection volume (i.e., larger radius of influence). The only benefit of sodium permanganate is the ability to apply a much more concentrated (40% by weight) permanganate solution, which is not desirable for treating widespread dilute contamination such as that found at Sites 2 and 11.

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Comment: Section 4.4, Based on the results of the pilot test at IRP Site # 2, air sparging without ozone should be considered as a remedial option.

Response: The air sparging portion of the IRAC ozone sparging pilot study was too brief (2 hours) to fully evaluate the effectiveness of this technology. However, the mass removal and radius of influence observed during the extended ozone sparging test would be expected to exceed that of an equivalent air sparging test due to the additional contaminant destruction mechanism of ozone.

Also, the infrastructure required and associated costs for an air sparging system would be nearly as extensive as that required for an ozone sparging system. Because of the expected lower effectiveness for little expected cost saving relative to ozone sparging, air sparging was not evaluated as a remedial alternative in the FS.

Comment: Section 5.2.3, Horizontal injection wells should be oriented perpendicular to groundwater flow to be most effective.

Response: The orientation of the injection wells was designed based on construction constraints presented by the active flight apron. A north-south well orientation would interfere with flight operations in the northern area of IRP Site 11. Disturbance of the flight apron concrete in the areas of the well entrances and exits would also be unacceptable.

Additionally, there is no single prevalent groundwater flow direction at IRP Site 11, as discussed in the *Final RI Report*, thus reducing the importance of placing the injection wells in a particular orientation relative to groundwater flow.

– DEQ review comments, dated May 25, 2001, on the Concep-

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tual Phase Design Submittal for IRAP Site 11.

Comment: Section 3.3 Page 3-2, The basis for the proposed injection system should be provided. The following information should be included:

- Basis for the selected depth of the horizontal wells. How was a target depth of 23 feet bgs selected for the horizontal wells? Do adequate data exist in the area of the proposed horizontal wells to define the continuous existence of the targeted sand zone?
- How will soil contamination between the target horizontal well depth (23 feet bgs) and the water table surface (~8 feet bgs) be addressed?
- The rationale for the orientation and spacing of the horizontal wells should be provided.
- The depth of the horizontal injection pipes should be located so that the permanganate is distributed to the zone of highest VOC concentrations.
- It would be helpful to show the vertical extent of VOCs in relation to the depth of the horizontal well on Sheet C-3.

Response: These issues will be addressed as they were in the 95% Design Document (see June 2001 response to DEQ comments on the Conceptual Phase Design Submittal, prepared by ERM).

– DEQ review comments, dated May 9, 2001 on the ecological risk assessment for IRP Site 4.

As discussed in the 27 June 2001 conference call with DEQ, the ANG plans to conduct a Level II (Screening) ecological risk assessment at IRP Site 4, in accordance with DEQ guidance. This additional ecological risk assessment is not expected to be performed prior to finalizing the FS. IRP Site 4 discussions in the FS will be revised to reflect this.

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- DEQ review comments, dated April 13, 2001, on the Interim Remedial Action Construction Phase I Interim Report for IRP Site 2.

  There were no comments unique to this document related to FS issues. The primary issues such as underground injection raised in DEQ comments on this document were duplicated in specific comments on the Feasibility Study. These comments are addressed below and the Feasibility Study will be revised accordingly.

- DEQ review comments, dated April 13, 2001, on the Draft Addendum to the Interim Remedial Action Construction Work Plan for IRP Site 2.

  There were no comments unique to this document related to FS issues. The primary issues such as underground injection raised in DEQ comments on this document were duplicated in specific comments on the Feasibility Study. These comments are addressed below and the Feasibility Study will be revised accordingly.

- DEQ review comments, dated March 1, 2001, on the Final Remedial Investigation Report.

  Comment: There are a number of subsurface utilities present in the groundwater-impacted areas (e.g., IRP Sites # 1-3, 9 and 11). DEQ believes there is potential for preferential groundwater or vapor phase migration via the utility corridors. FS work will need to determine if preferential migration is occurring along these potential preferential pathways.

  Response: The presence of subsurface utilities in the vicinity of IRP Site 2 and 9 will be addressed in the Final FS. However, most subsurface utilities at IRP Site 11 are away from the flight apron area, where the majority of Shallow Zone groundwater contamination exists, and thus are unlikely to

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		act as preferential pathways for contaminant migration.
2.	General (General Comment B)	**Comment:** Previous DEQ comments (see above) identified the need for additional groundwater monitoring wells are needed to verify VOC concentrations detected in groundwater grab samples collected during the RI, refine the understanding of groundwater flow directions, and assure adequate wells exist to fully evaluate the groundwater pathway. **Response:** Additional monitoring wells are currently planned for IRP Sites 2, 9, and 11 but will not be installed or monitored prior to finalizing this FS. It is expected that results from these new wells and results of future monitoring of existing wells will be used to refine the remedial alternatives during later design.
3.	General (General Comment C)	**Comment:** The FS must be revised to include additional information regarding the potential impacts to groundwater quality due to the injection of potassium permanganate (See DEQ Memorandums regarding IRP No. 2 dated April 13, 2001) and sodium persulfate. Any potential changes in groundwater quality must be presented. **Response:** The Final FS will include greater discussion of this issue.
4.	Section 2.9.3. (Specific Comment 1)	**Comment:** The RI report describes the numerous uncertainties associated with the groundwater modeling performed to date and with potential applications of the results. Either this discussion should be reiterated in the FS, or it should be clearly referenced. **Response:** A reference to the discussion of the modeling uncertainties in the RI Report will be added to the Final FS.
5.	Section 2.11 (Specific Comment 2)	**Comment:** Appropriate figures illustrating the estimated extent of the VOC groundwater hot spots in the Deep Zone groundwater at IRP Sites 2 and 11 should be prepared and included in the

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		FS. The FS should specifically discuss how these areas will be addressed in subsequent sections of the report. **Response:** Estimated Deep Zone hot spots will be added to the existing hot spot figures, as appropriate, and will be discussed in further detail in this section.
6.	Figures 2-10, 2-11, and 2-12. (Specific Comment 3)	**Comment:** It should be noted that the estimated extent of the groundwater hot spots in the Shallow Zone Groundwater is based on very limited data points in some cases. Additional groundwater monitoring wells are required to adequately define the extent of these areas (see General Comments A and B). **Response:** It is ANG's opinion that there are currently enough groundwater data to perform a feasibility study of remedial alternatives. Additional monitoring wells are currently planned for IRP Sites 2, 9, and 11 but will not be installed or monitored prior to finalizing this FS. It is expected that results from these new wells and results of future monitoring of existing wells will be used to refine the remedial alternatives during later design.
7.	Section 3. (Specific Comment 4)	**Comment:** This section should be revised to address DEQ comments on the Risk Assessments. **Response:** As discussed in the 27 June 2001 conference call with DEQ, Section 3.0 will be revised to reflect the additional planned work at Site 4 (Level II ecological risk assessment) and Site 7 (verification sampling for PAHs in groundwater using Method 8270-SIM). Other risk assessment issues raised in DEQ's 1 March 2001 comments on the Final RI Report will be addressed in a separate response to comments submittal.
8.	Table 3-1. (Specific Comment 5)	**Comment:** A footnote should be added to the table to indicate how the project screening goals were developed and to refer the reader to the appropriate section of the RI report for further information.

No.	Page	Comment/Response
		Response: The document will be revised based on this comment.
9.	Table 3-2. (Specific Comment 6)	**Comment:** IRP Areas 1, 3, and 7 should also be shown in blue on this table. **Response:** As noted in this table, IRP Sites 1 and 3 are addressed under IRP Site 2 since groundwater impacts at those sites are related to a source at IRP Site 2. Highlighting IRP Sites 1 and 3 could be confusing to a reader, since remedial alternatives were not evaluated in Section 5.0 for these sites. IRP Site 7 is not shown in blue because unacceptable risks were not identified at this site during the baseline risk assessment, and therefore this site was not included in the full alternatives. See also response to Comment 10.
10.	Section 3.7.4. (Specific Comment 7)	**Comment:** Prior to eliminating IRP Area 7 from further consideration in the FS, the rationale for not carrying this area forward must be clearly defined (i.e., based on the uncertainty in the data should additional monitoring or additional investigation be required?). **Response:** This section currently provides the rationale for recommending that no further action be performed for soil and groundwater. The presentation of this rationale includes the existing discussion of risk associated with soil and groundwater exposure and the current and anticipated future use scenarios. This rationale was reviewed with DEQ in the 27 June 2001 conference call. As agreed in the 27 June conference call, a reference to the planned verification groundwater sampling for PAH analysis using lower detection limits will be added.
11.	Section 4.2. (Specific Comment 8)	**Comment:** The RAOs should include the prevention or elimination of potential exposure from soil and groundwater via the indoor or outdoor air inhalation pathway. It is not clear why there are no remedial action objectives for soil, when remediation of residual soil contamination at Site 11 is in-

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cluded in the EE/CA and Remedial Design documents. In other parts of the FS, the EE/CA activities are ignored as a conservative assumption, but in this case it seems like the EE/CA's remediation of Site 11 soil is assumed successful and complete. The need for the RAO's to also address soil at sites 2 and 9 should be clarified.

Response: Discussion of the indoor air inhalation pathway was included in Section 4.0 of the *Draft Final Feasibility Study* based on DEQ's March 1, 2001 comments on the *Final Remedial Investigation Report*. The indoor air inhalation pathway was not developed into a remedial action objective due to the high concentrations of the contaminants of concern that would be required to create an unacceptable risk. The results of the indoor air inhalation evaluation are presented in Table 4-6.

An RAO pertaining to soil will be added to Section 4.2. This RAO will be used to evaluate remediation of soil at IRP Site 11. However, as discussed in Sections 3.2.4 and 3.9.4, further evaluation or remediation of soil at IRP Sites 2 and 9 is not recommended and therefore an RAO specific to these sites is not necessary. The Section 4.2 text will be revised accordingly.

12. Table 4-6 (Specific Comment 9)

Comment: Reference citations on the table should be included in the document's References section.

Response: The document will be revised based on this comment.

13. Table 4-7. (Specific Comment 10)

Comment: This table indicates that zero valent iron oxidation was screened out due to the conclusion that the "slowness and variability of groundwater flow at the Base are not compatible with this type of technology." Why doesn't this apply to the other in situ treatment technologies? The plume distribution at IRP Area 2 suggests that groundwater flow conditions are not incompatible with zero valent iron oxidation.

Response: The important difference between the technologies in

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question is the location and spacing of the application. Generally, a zero valent iron system involves a single reactive barrier wall or a series of several parallel walls installed perpendicular to the groundwater flow. At IRP Site 2 this technology would be relatively feasible due to the generally consistent groundwater flow. However, this flow is considered slow and it may take an extended period for some groundwater to reach the nearest reactive barrier wall. This extra time might increase the potential for downward migration of impacted groundwater between barrier walls. The remedial technologies evaluated in the FS are implemented with a much closer spacing (i.e., shorter contact distance). The influence of these technologies on each unit of groundwater within the treatment area is expected to occur much sooner.

14. Section 4.5.5. (Specific Comment 11)

Comment: A deep zone horizontal vapor extraction pipe is proposed between the horizontal deep and shallow zone ozone sparging pipes. It is not clear how vapors would be collected under saturated conditions. Vapor recovery pipes should be located above the seasonal high water table.

Response: This passive vapor collection well is intended to provide a path for the escape of injected vapor from deeper ozone sparging, rather than typical (active) soil vapor extraction. This will be clarified in the revised document.

15. Section 5. (Specific Comment 12)

Comment: This section does not address potential adverse impacts to groundwater quality from the injection of potassium permanganate or sodium persulfate. The ANG has stated that it will meet the substantive requirements associated with DEQ's Water Quality Program permits. The FS must clearly demonstrate that:

- No activities will be conducted that exacerbate existing groundwater contamination or that could cause an adverse impact on existing or potential beneficial uses of groundwater.

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- Activities will include an adequate monitoring and reporting program to allow DEQ and the public to confirm that the activities are not having an adverse impact on the environment.

Response: These issues will be discussed further in the revised document. The "Compliance with ARARs" discussion for alternatives relying on the injection of material will be revised to include discussion of substantive permit requirements.

16. Section 4.5.4. (Specific Comment 13)

Comment: The three different injection zones described for Site 2 Alternatives 3, 4, and 5 should be shown on a figure.

Response: These figures will be revised to show the different injection zones.

17. Table 5-1. (Specific Comment 14)

Comment: Ratings in the table do not all match descriptions in the text. For example, see comment under Section 5.4.1.5.

Response: The document will be revised based on this comment.

18. Figures 5-6 through 5-10. (Specific Comment 15)

Comment: It is DEQ's opinion that additional monitoring wells would be required to adequately monitor the effectiveness of any of the proposed alternatives. Additional wells should be placed near the estimated southeast and northwest limits of the estimated VOC hot spot.

Response: The location of the monitoring wells currently proposed for IRP Site 9 will be adjusted to accommodate this comment. However, additional monitoring wells beyond the current number will not be added to the remedial alternatives for IRP Site 9.

19. Figures 5-11 through 5-15. (Specific Comment 16)

Comment: It is DEQ's opinion that additional monitoring wells would be required to adequately monitor the effectiveness of any of the proposed alternatives. Additional shallow, deep, and CRSA wells should be installed to demonstrate that implementa-

No.	Page	Comment/Response
		tion of any of the in situ treatment alternatives are not adversely impacting groundwater quality. **Response:** The network of proposed and existing monitoring wells (23 wells total) will allow comprehensive monitoring of both the treatment effectiveness and the vertical and lateral migration of contaminants, injected treatment chemicals, or by-products of treatment. Several existing and proposed Deep Zone and CRSA wells will be monitored for possible harmful byproducts of reactions.
20. (Specific Comment 17)	Section 5.4.1.5.	**Comment:** Site 11 Alternative 4 is one of the most expensive alternatives, not the least expensive. Correspondingly, the cost reasonableness is not high. **Response:** The document will be revised to reflect this comment.
21. (Specific Comment 18)	Section 6.1.6.	**Comment:** See comment no. 7. **Response:** A reference to the planned verification groundwater sampling for PAH analysis using lower detection limits will be added. The recommendation for no further remedial action at this site will remain unchanged.
22. (Specific Comment 19)	Section 6.1.10.	**Comment:** This section should reference the Site 11 soil remediation described/planned in the EE/CA. **Response:** The soil remediation planned in the EE/CA (remediating soil remaining following the 1999 soil removal action) is referenced in the third paragraph of this Section. This reference will be revised based on the revisions to the EE/CA and subsequent remedial design documents.
23. (Specific Comment 20)	Section 6.2.2.	**Comment:** This section states that institutional controls may not be reliable. Where residual risk exceeds acceptable levels, they can be controlled by engineering or institutional controls. If however, these controls are not implementable or reliable, the FS

No.	Page	Comment/Response

will need to identify and recommend alternative remedies which achieve the RAO's.

Response: The uncertainty of deed or zoning controls was discussed to show that the reliability of these controls depends on the coordination with all parties. This should not be a concern, as the property will be occupied long-term either by the Portland ANGB or by Port-owned airport facilities. This will be discussed further in the revised document.

State of Oregon
Department of Environmental Quality

Memorandum

To: Oregon Air National Guard – 142nd Fighter I.G. **Date:** August 28, 2002
ECSI No. 637

From: Matt McClincy and Rod Struck Voluntary Cleanup, Northwest Region

Subject: Comments Oregon Air National Guard – 142nd Fighter Interceptor Group Portland International Airport Portland, Oregon

This memorandum presents the Oregon Department of Environmental Quality (DEQ) review comments on the July 2002 *Environmental Restoration Program Draft Proposed Plan* for the 142nd Fighter Wing Portland Air National Guard Base Portland International Airport in Portland, Oregon. The draft plan was prepared for the Air National Guard by Environmental Resources Management.

Section 1.0 Introduction (Second Paragraph) – DEQ would like to clarify the mechanics of the referenced consultation for selection of the final remedies.

Does DEQ have suggested language that it would like to see added to the document to address this comment?

Section 3.0 Site Characteristics (Fourth Bullet) – If the remaining contaminants in soil near the oil-water separator at IRP-11 have the potential to impact the beneficial use of groundwater, this soil contamination is to be considered a hot spot per DEQ guidance.

Text will be added to indicate that the residual contamination constitutes a hot spot per DEQ guidance.

Section 6.0 Remedial Action Objectives – The remedial action objectives (RAOs) should specify the individual contaminants, the media of interest and the exposure pathways (i.e., exposure routes and scenarios). The RAOs should be followed by proposed cleanup levels for each contaminant of concern by media.

Chemical-specific, numeric remediation goals corresponding to the RAOs listed in Section 6.0 will be presented in the ROD; the text in Section 6.0 will be revised to indicate this. Remediation goals for groundwater will be based on a drinking water beneficial-use scenario. It is anticipated that numeric remediation goals for the treatment of groundwater hot spots will correspond to pre-calculated "significant adverse effect levels" listed in Table 2-1 of DEQ's Final Pre-Calculated Hot Spot Look-Up Tables *(October 1998). Numeric remediation goals for the prevention of off-site migration and on-site exposure to groundwater containing VOCs above 10^{-6} risk concentrations will correspond to USEPA Region 9 PRGs for tap water.*

The ANG does not plan to develop numeric remediation goals for soil. The objective of treating residual soil contamination at ERP Site 11 is to prevent potential future impacts to the beneficial use of groundwater, which will be assessed through long-term groundwater monitoring.

RAOs should also prevent trench worker exposure to subsurface soil and groundwater contamination (via ingestion, dermal contact or inhalation) that poses a hazard index greater than 1 or a lifetime excess cancer risk greater than one in a million for individual carcinogens. Similar language should be incorporated into the RAOs presented in the document.

The baseline risk assessment determined that risks were acceptable for the construction worker scenario, which includes trench workers. Accordingly, the existing RAOs for groundwater are protective of trench workers. Rather than adding language to Section 6.0 to address this issue, we propose to identify the populations/exposure scenarios that were evaluated in the baseline risk assessment in Section 5.0 (i.e., construction worker, Base worker, reservist, and hypothetical on-site resident). Text will also be added to Section 5.0 indicating that based on the current and planned future industrial use of the property, the only unacceptable human-health risks identified at the site were associated with the potential use of groundwater as drinking water.

Restoration of the beneficial use of groundwater or surface water, as applicable, should also be listed as an RAO.

Although this is a desirable outcome of the remedial actions at the Base it is not included as an RAO, because it may not be technically possible to completely restore contaminated groundwater for unrestricted (drinking-water) use. The existing RAOs listed in Section 6.0 are consistent with the ANG's goal of reducing risks to acceptable levels as defined by Oregon and Federal regulations.

Section 9.0 Preferred Alternative - Since the draft proposed plan recommends the remedy for IRP Sites 1, 2 and 3 that is currently undergoing a full-scale demonstration at IRP Site 2, the document should include an up to date discussion on the apparent effectiveness of the technology and a discussion of the observed effects, if any, on groundwater quality.

The suggested discussion will be added to Section 9.0.

To ensure that the selected alternative is protective, the following additional measures are necessary.

- Implement institutional controls during the active treatment and attenuation monitoring to prevent exposure to impacted groundwater.
- During implementation of the remedy, the performance and effectiveness of the remedial action should be evaluated annually.
- Perform five year reviews after the completion of the remedy to ensure that it remains protective.

These additional measures will be added to the Section 9.0 text.

"MCCLINCY Matt"
<MCCLINCY.Matt@deq.state.or.us>
01/15/2003 05:03 PM

To: "Michael Grimm" <Michael.Grimm@ang.af.mil>
cc: "Rob Leet" <Rob_Leet@ermwest.com>, "STRUCK Rodney" <Struck.Rodney@deq.state.or.us>, "Stan Jones" <joness@portptld.com>
Subject: Responses to ODEQ Comments on the Draft Proposed Plan

Thank you for the December 19, 2002 responses to ODEQ comments on the July 2002 Environmental Restoration Program Draft Proposed Plan for the Portland Air National Guard Base. The following responses require additional discussion.

Section 1.0 Introduction (Second Paragraph) – DEQ would like to clarify the mechanics of the referenced consultation for selection of the final remedies.

Does DEQ have suggested language that it would like to see added to the document to address this comment?

DEQ is not requesting that additional language be added to the text concerning the reference to the Air National Guard/ODEQ consultation. However, ODEQ would like to clarify the process that the Air National Guard (ANG) intends to follow regarding this coordination. For example, is the ANG planning on drafting responses to comments received and routing for ODEQ review and concurrence.

Restoration of the beneficial use of groundwater or surface water, as applicable, should also be listed as an RAO.

Although this is a desirable outcome of the remedial actions at the Base it is not included as an RAO, because it may not be technically possible to completely restore contaminated groundwater for unrestricted (drinking-water) use. The existing RAOs listed in Section 6.0 are consistent with the ANG's goal of reducing risks to acceptable levels as defined by Oregon and Federal regulations.

Section 6.0 already lists the treatment of groundwater hot spots of contamination to concentrations below significant adverse effect levels (as defined by ODEQ) as a RAO. Since the significant adverse effect level is that level which impairs the identified beneficial use of the water, the goal of restoring the beneficial use of the groundwater would be achieved once the identified treatment goal has been achieved. Consequently, ODEQ does not see the addition of the restoration of the beneficial use of groundwater as an RAO to be any more burdensome than the RAOs already identified. A suggested modified RAO could read: Restore the beneficial use of site groundwater by treating groundwater hot spots to concentrations below significant adverse effect levels (as defined by ODEQ).

Please call me at 503-229-5538 if you have any questions.

Matt McClincy
Oregon Department of Environmental Quality
Northwest Region
2020 SW Fourth Ave., Suite 400
Portland, Oregon 97201-4987
Phone 503-229-5538
Fax 503-229-6945

"Jones, Stan"
<joness@portptld.com
>

04/07/2003 04:12 PM

To: "'Rob.Leet@erm.com'" <Rob.Leet@erm.com>, "Jones, Stan" <joness@portptld.com>
cc: 'MCCLINCY Matt' <MCCLINCY.Matt@deq.state.or.us>, BRODYHEINE Bruce <BRODYHEINE.Bruce@deq.state.or.us>, michael.grimm@ang.af.mil, roger.rein@orport.ang.af.mil, Tim.McCormack@erm.com
Subject: RE: Portland ANGB Final Proposed Plan

Rob,
Thank you for responding. Looks good.

Stan

-----Original Message-----
From: Rob.Leet@erm.com [mailto:Rob.Leet@erm.com]
Sent: Monday, March 31, 2003 10:20 AM
To: joness@portptld.com
Cc: 'MCCLINCY Matt'; BRODYHEINE Bruce; michael.grimm@ang.af.mil; roger.rein@orport.ang.af.mil; Tim.McCormack@erm.com
Subject: RE: Portland ANGB Final Proposed Plan

Stan,

Attached are responses to the Port's/Hart Crowser's comments on the working copy of the Portland ANGB Final Proposed Plan. Please let me know if our responses are satisfactory.

Thank you,

Rob

03/25/2003 03:39 PM
From: "Jones, Stan" <joness@portptld.com>
To: Rob.Leet@erm.com, "Jones, Stan" <joness@portptld.com>
cc: 'MCCLINCY Matt' <MCCLINCY.Matt@deq.state.or.us>, BRODYHEINE Bruce <BRODYHEINE.Bruce@deq.state.or.us>
Subject: RE: Portland ANGB Final Proposed Plan

Rob,
Here are some comments from Herb Clough at Hart Crowser.
Stan

1. Has ANG considered if there is any impact to their evaluation resulting from the recent revision to the toxicity of TCE (toxicity increase of 60 times)?

The revised TCE toxicity does not change the conclusions or recommendations of the evaluation. Cleanup levels for groundwater will be established in the ROD, and will correspond to the most recently published regulatory criteria at the time the ROD is prepared (i.e., ODEQ pre-calculated significant adverse effect levels for the treatment of groundwater hot spots, and USEPA Region 9 tap water PRGs for the prevention of off-site migration and on-site exposure to groundwater containing VOCs above 1E-06 risk concentrations).

2. Section 6.0 - Cleanup levels for groundwater hot spots refer to the 1998 DEQ Lookup tables. These tables were intended to be used more as a screening tool for potential hot spots. Values have changed (e.g., the change to TCE toxicity value), and the assumptions upon which the lookup tables are based may not be consistent with the site. Cleanup levels should be based on the risk assessment calculations using the definition of hot spots (1 in 10,000 excess cancer risk or hazard quotient of 10 for individual chemicals).

Comment noted. See response to Comment 1 above. Proposed cleanup levels for the Portland ANGB have been developed based on discussions with ODEQ that began in late 2000, during preparation of the draft Feasibility Study. ODEQ concurs with the ANG's proposed use of the ODEQ pre-calculated significant adverse effect levels as cleanup levels for groundwater hot spots.

3. Section 7.2 - It would seem that there would be a need for wetland mitigation for alternative 1 as well (although it could be on-site mitigation).

Under Alternative 1 (contaminated sediment removal and off-site disposal), engineering controls would be implemented to protect the environment during the removal action, and the ditch would be restored following the action. These control and restoration measures would be outlined and approved through the permitting process with the Army Corps of Engineers and the Oregon Division of State Lands. There would be no net loss of wetland area as a result of the action.

4. Section 9.1 - We would agree with the conclusions of the technology demonstration. The recent work at the nearby Cadet site showed that the soil oxidant demand was quite high. Based on bench testing the design permanganate concentration used at the Cadet site was about 10 times that used in the technology demonstration at ANG.

Comment noted. We are not familiar with the work at the Cadet site. However, we assume that the oxidant proposed/used at this site is sodium permanganate, as the practical solubility limit of potassium permanganate

at standard temperature and pressure is approximately 3.5 to 4 percent by weight. A sodium permanganate concentration of 20 weight percent (i.e., 10 times the oxidant concentration used in the Portland ANGB technology demonstration) is above the recommended limit for safe application of this compound in the field, according to the manufacturer of the material that we have used. The relatively low concentration of the potassium permanganate solution used in the Portland ANGB technology demonstration (2 percent solution) was chosen based on discussions with ODEQ and Oregon Underground Injection Control program staff, who were concerned about possible negative effects on groundwater quality that might result from permanganate injection.

-----Original Message-----
From: MCCLINCY Matt [mailto:MCCLINCY.Matt@deq.state.or.us]
Sent: Tuesday, March 25, 2003 8:33 AM
To: Rob.Leet@erm.com; joness@portptld.com
Cc: michael.grimm@ang.af.mil; Tim.McCormack@erm.com; BRODYHEINE Bruce
Subject: RE: Portland ANGB Final Proposed Plan

Rob,

I do not have any comments on the revised working draft of the Final Plan. DEQ comments were either adequately addressed or reasonably deferred to the ROD.

Matt

-----Original Message-----
From: Rob.Leet@erm.com [mailto:Rob.Leet@erm.com]
Sent: Tuesday, March 18, 2003 12:22 PM
To: MCCLINCY Matt; joness@portptld.com
Cc: michael.grimm@ang.af.mil; Tim.McCormack@erm.com
Subject: Portland ANGB Final Proposed Plan

Gentlemen,

Attached for your review is a working draft of the Portland ANGB Final Proposed Plan text. This version incorporates the ANG responses to DEQ's comments on the draft document, and presents remedial alternatives and recommendations for ERP Site 4. Basically, we propose two alternatives for Site 4, both of which are considered equally effective: contaminated sediment removal & off-site disposal (Alternative 1), and ditch filling/capping (Alternative 2). We indicate that the remedy that ultimately gets implemented will depend on ANG funding and contracting

issues.

Please note that the table of contents has not yet been updated. Also, let me know if you would like to see the figures and tables - I can fax or e-mail them. There were only minor changes to the figures and tables: Table 1 was updated to reflect the identified ecological risk at Site 4, and a figure showing contaminants of potential ecological concern in Site 4 sediment was added.

If possible, we would like to receive your comments on this working draft by the end of next week, so that we can finalize the Proposed Plan and release it to the public.

Thank you,

Rob

(See attached file: PANGB Final Proposed Plan_WD.doc)

10002

Oregon
Theodore Kulongoski, Governor

Department of Environmental Quality
Northwest Region Portland Office
2020 SW 4th Avenue, Suite 400
Portland, OR 97201-4987
(503) 229-5263
FAX (503) 229-6945
TTY (503) 229-5471

May 27, 2003

Michael Grimm
Environmental Division
ANG/CEVR
3500 Fetchet Avenue
Andrews AFB, MD 20762

Re: Portland Oregon Air National Guard Base
DEQ Comments - Final Proposed Plan
ECSI Site No.1372

Dear Mr. Grimm:

The Oregon Department of Environmental Quality (DEQ) Cleanup Program has reviewed the April 2003 "*Environmental Restoration Program Final Proposed Plan*" for the Portland, Oregon Air National Guard Base. DEQ agrees that the Final Proposed Plan meets the requirements of Oregon's cleanup laws based upon achieving the stated remedial action objective at each site. DEQ looks forward to working with you during implementation and verification of the effectiveness of the proposed actions.

Please contact me at (503) 229-6915 or e-mail me at brodyheine.bruce@deq.state.or.us if you have any questions or concerns with this request.

Sincerely,

Bruce Brody-Heine

Bruce Brody-Heine,
Project Manager/Hydrogeologist
Cleanup/Portland Harbor

cc: Matt McClincy, DEQ NWR
Roger Rein, Lt. Col., ORANG
Rob Leet, ERM
Stan Jones, Port of Portland
DEQ ECSI File No. 1372

APPENDIX B

MINUTES OF RAB AND PUBLIC INFORMATION MEETINGS

MEETING MINUTES

Draft Final Feasibility Study Report Review Meeting

Meeting Date and Location:

27 June 2001 via teleconference

Attendees:

Name	Affiliation	Phone
Michael Grimm	ANG/CEVR	(301) 836-8789
Aaron Etnyre	Montgomery Watson	(248) 449-3414
Chad Drummond	Montgomery Watson	(248) 449-3414
Stan Jones	Port of Portland	(503) 460-4679
Matt McClincy	Oregon DEQ	(503) 229-5538
Rod Struck	Oregon DEQ	(503) 229-5538
Tom Gainer	Oregon DEQ	(503) 229-5538
Tim McCormack	ERM	(425) 462-8591
Rob Leet	ERM	(425) 462-8591
Chris Bailey	ERM	(425) 462-8591

Meeting commenced at 10:00 a.m. PDT.

A teleconference meeting was held on 27 June 2001 to discuss comments made by the Oregon Department of Environmental Quality (DEQ) on the May 2001 *Draft Final Feasibility Study* for the Portland Air National Guard Base (ANGB) submitted by ERM. In addition, specific comments made by DEQ on the May 2001 *Draft 2001-2002 Groundwater Monitoring Work Plan* submitted by Montgomery Watson and the June 2001 *Draft Monitoring Well Installation Work Plan Addendum* submitted by ERM were addressed as they related to completion of the Feasibility Study.

Details of the meeting are presented below.

Introduction:

Following the introduction of meeting attendees, Rob Leet opened by clarifying the purpose of the meeting. The purpose of the meeting was to address specific comments that DEQ made on the Draft Final Feasibility Study and to discuss recent communication between DEQ and ANG regarding IRP program schedule and additional site characterization issues. Specific comments made by DEQ on the *Draft 2001-2002 Groundwater Monitoring Work Plan* submitted by Montgomery Watson and the *Draft Monitoring Well Installation Work Plan Addendum* submitted by ERM were also addressed as they relate to completion of the Feasibility Study.

Project Schedule:

The project schedule for the Portland ANGB was discussed. The primary components of the schedule discussed were the submittal of the Final Feasibility Study, the installation and sampling of the nine monitoring wells planned in the *Draft Monitoring Well Installation Work Plan Addendum*, and installation of additional monitoring wells proposed in the Interim Remedial Action Construction (IRAC) program at IRP Site 2 and the IRP Site 11 EE/CA remedial action.

ERM stated that the Final Feasibility Study is expected to be submitted in early July, prior to installation of any new monitoring wells. The nine wells proposed in the *Draft Monitoring Well Installation Work Plan Addendum* are scheduled to be installed later in July. The seven additional monitoring wells planned for the IRAC program at IRP Site 2 will be installed immediately prior to implementation of that interim action, which is tentatively planned for early fall 2001. Similarly, the four monitoring wells planned for the IRP Site 11 EE/CA remedial action will be installed immediately prior to implementing the Site 11 remedial action. The remaining monitoring wells proposed in the Feasibility Study that haven't already been installed will be installed immediately prior to implementation of the final remedy at the respective IRP sites.

Location of Proposed Monitoring Wells:

For clarification, ERM faxed to the meeting participants a series of sketches showing the proposed monitoring wells at IRP Sites 2, 9, and 11. Two sketches were submitted for each of the three IRP sites, one showing the monitoring wells proposed in the *Draft Monitoring Well Installation Work Plan Addendum*, the *Draft Final Feasibility Study*, and the *Final Addendum to the IRAC Work Plan*, and one showing the locations of wells requested by DEQ in their comments on the *Draft Monitoring Well Installation Work Plan Addendum.*

DEQ indicated that they needed time to review the faxed figures before they could discuss details regarding the the proposed well locations in comparison to the wells requested in their comments on the *Draft Monitoring Well Installation Work Plan*

Addendum. Generally, DEQ is comfortable with the overall number of proposed monitoring wells provided that they are installed prior to the respective phases of work. DEQ agrees that installation of additional wells is not necessary prior to completion of the Feasibility Study and that it is not necessary to install all of the proposed wells prior to implementing the interim actions at IRP Sites 2 and 11.

Michael Grimm requested that ERM produce a figure showing all of the current proposed monitoring wells, including a key showing the respective phases during which the wells will be installed. ERM agreed to provide the project team with this figure for each of the IRP sites.

DEQ asked when remedial action would likely occur at IRP Site 9. Michael Grimm responded stating that remedial action will not be performed at this site prior to the year 2003. The final remedy will be performed at this time and no interim remedial action is expected.

Installation of Deep Zone monitoring wells at IRP Site 9 was discussed. Rob Leet stated that direct-push samples of Deep Zone groundwater at IRP Site 9 indicated that no detectable levels of contaminants were present and that Deep Zone wells are unnecessary. DEQ agreed to wait until the proposed Shallow Zone well in the source area at IRP Site 9 is installed and sampled to further evaluate the need for a Deep Zone well.

Additional PAH Sampling:

In comments on the Feasibility Study and other documents, DEQ had stated that there is uncertainty associated with the risks calculated for IRP Site 7 related to polycyclic aromatic hydrocarbons (PAHs) in soil and groundwater, due to the high method reporting limits used. This comment was made on the *Draft Final Feasibility Study* as well as the *Final Remedial Investigation Report*.

With respect to PAHs in groundwater, Rob Leet stated that DEQ had previously provided a similar comment related to groundwater at IRP Sites 9 and 11 and had not mentioned IRP Site 7. The results of sampling groundwater at IRP Sites 9 and 11 for PAHs using lower reporting limits (Method 8270-SIM) indicated that PAHs were not present. ERM proposed testing one round of groundwater samples collected from IRP Site 7 monitoring wells for PAHs using the lower reporting limits, to verify the assumptions made in the risk assessment. Aaron Etnyre of Montgomery Watson asked for confirmation that DEQ would be satisfied with one round of samples provided that the results indicate that PAHs are not present at unacceptable concentrations; DEQ concurred. Montgomery Watson will perform the sampling in July 2001. ERM stated that the Feasibility Study would be revised to indicate that an additional round of

groundwater samples from Site 7 will be analyzed by Method 8270-SIM to verify lack of risk.

With respect to soil sample PAH results, Rob Leet stated that there were a number of PAH detections below method reporting limits (i.e., "J"-flagged results) in samples collected from IRP Site 7 during the Remedial Investigation. Consequently, all detected PAHs were carried through the Site 7 risk assessment. The risk assessment concluded that benzo(a)pyrene poses an unacceptable risk under a hypothetical on-site residential scenario. However, since future land use is industrial, no further action is necessary. DEQ accepted this explanation and agreed that no further action is necessary for Site 7 soils.

Other Feasibility Study Issues:

The primary remaining issue discussed regarding production of the Final Feasibility Study was the IRP Site 4 ecological risk assessment. ERM stated that a Level II (screening) assessment would be performed for Site 4, and a Statement of Work for this task is currently being created. The Final Feasibility Study will be revised to include a brief discussion of the proposed Level II ecological assessment.

Administrative Issues:

Several administrative issues were briefly discussed. Stan Jones of the Port of Portland as well as DEQ stated that the project schedules that they had were outdated and that they would like to receive updated schedules on a regular basis. ERM had previously agreed to send an updated project schedule to all involved parties on a biweekly basis. A current schedule will be submitted by 29 June. DEQ also reminded the project team that they wish to receive three copies of all deliverables to facilitate their technical reviews. (Rob Leet subsequently received clarification from Matt McClincy that DEQ would like three copies of draft documents, but only two copies of final documents are needed.)

MEETING MINUTES

Restoration Advisory Board Meeting
Portland Air National Guard Base, Portland, Oregon
30 October 2001

Meeting Time and Location:

1500-1630
Port of Portland Aviation Environmental/Ground Transportation Building (Building 7120), Portland International Airport

Meeting Attendees:

Restoration Advisory Board Members
Erwin Bergman, Cully Neighborhood
Herb Wagner, PPS
Frank Wildensee, BES
Randy Albright, PBWW
Guy Neal, PBS (community co-chairman)
Matt McClincy, ODEQ
Rod Struck, ODEQ
Stan Jones, Port of Portland
Lt. Col. Roger Rein, PANGB
Lt. Col. John McAllister, PANGB (military co-chairman)

Other Attendees
Arun Chemburkar, ERM
Erik Ipsen, ERM
Chris Bailey, ERM
Rob Leet, ERM
Doug Barber, Montgomery Watson
Aaron Etnyre, Montgomery Watson
Chad Drummond, Montgomery Watson

A Restoration Advisory Board (RAB) meeting was held on 30 October 2001 to discuss the status of the Installation Restoration Program (IRP) at the Portland Air National Guard Base (PANGB). Details of the meeting are presented below. A copy of the agenda and presentation materials from the meeting are attached. Lt. Col. Roger Rein's meeting minutes also are attached.

Roger Rein opened the meeting by welcoming everyone and briefly summarizing the purpose and goals of the RAB. He introduced Lt. Col. John McAllister, the new Base Commander, as the military co-chairman and then asked that each attendee introduce himself. After the introductions, Roger Rein announced that a Feasibility Study (FS) addressing all of the IRP sites has been completed, and briefly described the purpose of the document. The FS is available for public review, and the PANGB requests input from the RAB on the FS recommendations. Additionally, extra copies of the RAB promotional video produced last year are available free upon request; the video is on CD-ROM.

Following Roger Rein's opening remarks, ERM gave presentations on:

- The overall environmental conditions/risks at the Base, the IRP schedule, and key milestones;
- The FS process and the recommended actions for each IRP site;
- The purpose, scope, schedule, and preliminary results of the IRP Site 2 Interim Remedial Action Construction (IRAC); and
- The purpose, scope, and schedule of the IRP Site 11 Engineering Evaluation/Cost Analysis (EE/CA).

Several questions were asked during and after the presentations. These are summarized below.

The RAB asked when the remedial action objectives (RAOs) would be achieved: upon completion of the Site 2 and 11 interim remedial actions (IRAs), or later, as part of the final remedy? If we are close to meeting the RAOs when an IRA is nearly completed, shouldn't the IRA be continued until the RAOs are achieved? ERM and Roger Rein responded that this would be done to the extent possible, dependant on funding. However, if RAOs are not fully achieved through the IRAs, they will ultimately be addressed as part of the final remedy.

The RAB asked why the proposed Site 2 groundwater treatment area shown in the IRAC work plan addendum is smaller than the treatment area shown in the FS. ERM responded that the goal of the Site 2 IRAC program is to reduce contaminant concentrations in the area of highest concentrations (i.e., near the presumed source area). This area is smaller than the area of the entire dissolved plume. The goal of the final remedy proposed in the FS is to treat the entire plume.

The RAB asked whether water resources permits had been obtained for the permanganate injection wells. ERM and PANGB explained that the wells are

being installed under Oregon's Underground Injection Control (UIC) program, not the Water Resources program. The substantive requirements of the UIC program will be met.

The RAB asked a few technical questions about the permanganate injection technology (e.g., will natural attenuation be hindered in the treatment zone? will precipitation/mobilization of metals be a problem?). The RAB's main concern is that in treating the existing contamination using this technology, other water quality problems might result. ERM responded that water quality may be impacted temporarily, but the impacts are expected to minimal relative to the contamination being treated. The temporary impacts should diminish with time as the aquifer chemistry re-equilibrates. The Oregon Department of Environmental Quality (ODEQ) concurred with this assessment.

Randy Albright indicated that he is interested in knowing the results of the groundwater IRAC and EE/CA projects, as he knows of several contaminated sites where this technology may be applicable. ERM said that monthly progress reports would be submitted to ODEQ during the IRAC full-scale technology demonstration; ERM will add Randy to the mailing list for the monthly reports. The RAB asked whether the monthly reports could be posted on a web site. Roger Rein said this should be possible; he will discuss with the ANG IRP office at Andrews Air Force Base. After the meeting, Roger Rein expressed an interest in having ERM assist with the web site posting.

The RAB asked whether the terror attacks on the World Trade Center towers in New York City on 11 September 2001 would affect the scope or schedule of IRP work (due, for example, to security restrictions or associated operations at the Base). John McAllister doesn't think the Base activities will affect the IRP work.

The RAB requested quarterly updates on the status of IRP activities at the Base; flyers were suggested as the format. Roger Rein noted this request and will forward it to the ANG IRP office.

The community co-chairman, Guy Neal, asked how interaction with the public regarding the IRAC at Site 2 and the EE/CA at Site 11 has taken place. It was stated that the Base has purchased newspaper ads in the East County News and the Oregonian. Notifications have been sent to everyone on the ODEQ-provided mailing lists. A maximum of 2 persons have requested a public meeting (offered in the notifications). In the event that 10 or more requested a public meeting, one would be held.

The RAB indicated that they would like to hold the next RAB meeting in the spring of 2002.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 142D FIGHTER WING (ACC)
PORTLAND AIR NATIONAL GUARD BASE OREGON

31 OCT 01

MEMORANDUM FOR Record

FROM: 142 FW/EM
6801 Cornfoot Rd
Portland ANGB, Oregon 97218-2797

SUBJECT: RAB Meeting Notes

1. The following notes were taken during the 30 OCT 01 Restoration Advisory Board (RAB) meeting:
   a. Frank Wildensee (ref. site 2): Could you use natural attenuation in combination with CHEMOX?
      1) Response: Chemical oxidation does not work well in the same zone as natural attenuation. However, the remaining contamination at the outlying areas (after the IRAC) could be remediated with natural attenuation.
   b. Guy Neal (ref. site 2): Could you progress to a 3rd injection if still needed?
      1) Response: The IRAC would conclude after the 2nd injection and further cleanup would take place under the remaining steps of the normal IRP process (ROD, RD/RA).
   c. Randy Albright (ref. site 2): Will the full scale technology demonstration (IRAC phase 2) consider evaluation of soil interference? Specifically, will interference of manganese and iron in soil with the potassium permanganate be measured?
      1) Response: Measurement would only be made for the total soil demand for potassium permanganate.
   d. Randy Albright (ref. site 2): If only limited additional cleanup was needed for site closure, while IRAC fieldwork was still in progress, could the IRAC be extended to fully remediate the site?
      1) Responses: One responder stated that no matter how small the remaining contamination (assuming this could be ascertained during IRAC, phase 2, field work) it would have to be addressed by the remaining steps of the IRP (ROD, RD/RA). One responder stated that the RAB would address this concern with the ANG program manager, Michael Grimm.
   e. Randy Albright (ref sites 2 and 11): Will the base be obtaining a groundwater injection permit for the planned potassium permanganate injections?
      1) Response: The base is not required to obtain these permits but does fulfill the substantive requirements for obtaining these permits (public notification, advertisements, notification to persons on DEQ mailing list, holding public meeting if more than 10 persons request one [note: less than 10 requested a public meeting for both sites]).
   f. Guy Neal: Can work proceed given the restrictions on base?
      1) Response: The base has procedures to allow contractors on base that involves badges and escorts. These in place procedures will be sufficient

for the work planned for site 2. Work at site 11 (planned for fall 2002) may require special procedures (since it is adjacent to aircraft).

g. Guy Neal (ref. IRAC site 2 and EE/CA site 11): How has interaction with the public taken place?
    1) Response: The base has purchased newspaper ads in the East County News and the Oregonian. Notifications have been sent to everyone on DEQ provided mailing lists. A maximum of 2 persons have requested a public meeting (offered in the notifications). In the event that 10 or more requested a public meeting, one would be held.
h. Randy Albright (ref site 2): would like results of this full scale technology demonstration in an early draft so that he can share this with others for possible implementation within the Portland wellfield protection area.
i. Erwin Bergman: would like to have quarterly newsletters on the progress.
j. Randy Albright: would like a RAB sponsored web site to allow RAB members to outreach to interested parties with available technical documents.
k. Stan Jones: complemented the base for listening and reacting quickly to DEQ inputs.
l. Matt McClincy: complemented the base for responding to DEQ comments.

2. The above notes are not intended to represent all concerns voiced during the RAB meeting. ERM-West should consolidate all notes to comprise the "draft" meeting minutes for review.

ROGER C. REIN, LTC, ORANG
Environmental Manager

RESTORATION ADVISORY BOARD (RAB), PORTLAND AIR NATIONAL GUARD BASE, MEETING AGENDA
30 OCT 2001, 3:00 PM to 4:30 PM
Meeting Location: Portland International Airport, Aviation Environmental Office (Building 7120)
(see directions below)

1500-1515: Introduce visitors and members

1515-1615: Discuss new business:

BACKGROUND (additional information provided during RAB meeting)	DECISION(S) TO BE MADE	REQUESTED RAB INPUT
Feasibility Study (FS) Contains recommendations for cleanup options.	1. Should we consider any other recommendations (other than those in the FS) prior to selecting a cleanup option or taking no further action?	1. Do RAB members agree with the recommendations in the FS ? a. Is there a different preferred alternative for cleanup (either in the list of options or something not yet considered)? b. Will no-further-action be acceptable at sites: 1, 3, 4, 5, 7, 8, and 10 ? 2. Would RAB members be willing to circulate the public notice for comment on the FS to their respective groups? a. Is there any other outreach that RAB members would like to see?

Site 11 Cleanup **Interim Remedial Action**: scheduled to start (insert date), this represents only phase I of the cleanup effort. Chemical treatment injection and in-place ventilation will be evaluated for cleanup effectiveness in both soil and groundwater.	1. What further action(s), if any, will take place after phase I of the cleanup effort?	1. Given a presentation of "evaluation criteria" for further action, does this criteria address all of the RAB concerns for remaining contamination?
Site 2 Cleanup **Interim Remedial Action:** scheduled to start 1 DEC 2001, this represents phase II of the cleanup effort. The injection of potassium permanganate into contaminated groundwater will be demonstrated on a full-scale basis.	1. What further actions(s), if any, will take place after phase II of the cleanup effort?	1. Given a presentation of "evaluation criteria" for further action, does this criteria address all of the RAB concerns for remaining contamination?

1615-1630: Open Forum:

Directions to PDX Aviation Environmental Building 7120: Head toward the PDX terminal on NE Airport Way (driving West). Stay in the left land and head for the base of the FAA control tower (you cnat't miss it). This is also the way to Long-term parking. At the tower gate, you'll be forced to make a sharp left and will see a stop sigh just ahead. Turn right at the stop sign and find a parking spot. The meeting is in the low building on the West end of the parking area. For questions and further directions call Stan Jones at (503) 460-4679.
-Parking is free (if you don't get a space in the specified lot, please park in the pay structure and give your ticket to Stan Jones for validation)

MEETING MINUTES

Regulatory Review Meeting
Portland Air National Guard Base, Portland, Oregon
30 October 2001

Meeting Time and Location:

1200-1330
Port of Portland Aviation Environmental/Ground Transportation Building (Building 7120), Portland International Airport

Meeting Attendees:

Matt McClincy, ODEQ
Rod Struck, ODEQ
Stan Jones, Port of Portland
Roger Rein, PANGB
Arun Chemburkar, ERM
Erik Ipsen, ERM
Chris Bailey, ERM
Rob Leet, ERM
Doug Barber, Montgomery Watson
Aaron Etnyre, Montgomery Watson
Chad Drummond, Montgomery Watson
Michael Grimm (via telephone)

A Regulatory Review meeting was held on 30 October 2001 to discuss the status of the Installation Restoration Program (IRP) at the Portland Air National Guard Base (PANGB). Details of the meeting are presented below. A copy of the agenda and handout materials from the meeting are attached.

Rob Leet opened the meeting by introducing himself and then providing a brief background of the Installation Restoration Program (IRP) at the Portland Air Nation Guard Base (PANGB). Each attendee then introduced himself.

After the introductions, Chris Bailey provided a status update of the Site 2 Interim Remedial Action Construction (IRAC) project. Chris addressed ODEQ's concerns regarding groundwater quality monitoring. He also presented the preliminary results of recent permanganate impurity sampling. These results indicated that with the exception of chromium, contaminants of concern were not detected in a 2 percent permanganate solution prepared by the laboratory.

Chromium was detected below the Federal Maximum Contaminant Level (MCL). The ODEQ said these results were acceptable, but noted that their regulations do not allow injection of chemical concentrations above MCLs.

Chris then discussed the sampling plan for the IRAC (see attached handouts), including two new monitoring wells added in response to ODEQ comments (one Shallow Zone well and one Deep Zone well). Matt McClincy mentioned that dissolved lead needs to be monitored as well. Chris then discussed the tentative schedule for IRAC implementation (see attached handouts). The direct-push groundwater sampling and monitoring well installation is scheduled to begin the week of 12 November; injections are scheduled to begin in January 2002. Roger Rein indicated that he needs one day notice for any field work in order to schedule a site escort. Roger further indicated that evacuations are not likely at IRP Site 2. Roger would like to provide the exact dates to the RAB, so that they can observe the field work.

Matt McClincy mentioned that overall he is pleased with the monitoring plan and satisfied that the substantive requirements of Oregon's Underground Injection Control Program have been met. He also indicated that this is the first State-approved permanganate injection in Oregon, and he appreciates ANG "stepping up to the plate" to address ODEQ's concerns.

Next, Erik Ipsen provided an update on the Site 11 Engineering Evaluation/Cost Analysis (EE/CA). Erik indicated that the 95 Percent Remedial Design is currently undergoing internal ANG review, but will be provided to the ODEQ and Port of Portland soon. The Final Action Memorandum is also near completion and will likely be submitted the week of 19 November as well. Erik indicated the Action Memorandum will not go out to public comment, due to the lack of substantial public comments on the EE/CA Report. Regarding schedule, Michael Grimm indicated that the EE/CA field work will be contracted when the funds are available.

Matt McClincy stated that he is most interested in the groundwater monitoring plan for the Site 11 work. Erik responded that the Site 11 monitoring will be performed similarly to the Site 2 IRAC monitoring. It is expected that the IRAC will provide valuable information regarding which parameters need to be monitored, and which are not a concern.

Roger Rein asked if cold or wet weather will affect the soil portion of the EE/CA work. Erik indicated that it would not be ideal to operate the soil vapor extraction (SVE) system during high water table conditions because of the

limited unsaturated zone. He added that because the SVE piping is already installed, no new piping installation will be required.

Following the Site 11 discussion, Rob Leet presented a status update of the Remedial Investigation/Feasibility Study (RI/FS) at the PANGB. Matt McClincy mentioned that he would like to schedule a conference call to discuss the Level 1 Scoping Assessment for IRP Site 4. Rob Leet then discussed the specific ODEQ comments and responses to comments on the Final RI.

Regarding ODEQ comment #2, Rod Struck asked if data from the nine new monitoring wells installed in the summer had affected our previous conclusions regarding site conditions or our conceptual model of the site (e.g., vertical gradients between water bearing zones, nature and extent of contamination). Rob responded that the new data have not changed our understanding of the site. Rod also asked why some data points have been consistently left off of the groundwater elevation maps contained in the quarterly monitoring reports. Rob responded that this is due to anomalous water levels observed at some wells. The reason for the anomalies is unclear; they do not follow any particular pattern. Aaron Etnyre stated that Montgomery Watson has also observed these same anomalies. These observations will be discussed further (including possible causes of the anomalies) in the next quarterly monitoring report.

Regarding ODEQ comment #3, Matt McClincy asked whether dredge materials have been used as utility conduit fill at the site. Matt is concerned about utility conduits as possible pathways for contaminant migration at IRP Sites 2 and 9, and he would like ANG to provide additional rationale supporting our contention that this is not a concern. Matt indicated that ODEQ was satisfied with ANG's responses to the remaining comments on the Final RI. Matt also indicated that he would like to be provided with updates and any reports during the IRAC and EE/CA activities.

Stan Jones asked for clarification on the proposed monitoring wells and sampling to be performed at Site 9 as part of the final remedy (ODEQ comment #8). Rob Leet reviewed and explained the ANG's response to comment #8.

Roger Rein asked whether standard laboratory turnaround time is sufficient to ensure protection of human health during the IRAC injections. Matt McClincy indicated that it is sufficient.

Matt inquired further about the sampling schedule during the Site 2 IRAC. Matt would like ERM to collect a round of samples prior to the second round of

injections. Chris indicated that ERM would comply with this request by eliminating one sampling event following the second round of injections and increasing the sampling interval accordingly.

Aaron Etnyre then provided a brief update of recent groundwater monitoring activities. He indicated that 9 new monitoring wells were recently installed at the site. This work included additional Deep Zone sampling and lithologic characterization. Aaron mentioned that at the end of the IRAC field work and EE/CA reporting, Montgomery Watson's oversight contract will terminate.

Roger Rein asked if dilution within the Columbia River Sand Aquifer (CSRA) would theoretically prevent detection of contaminants in this zone. Matt and Rob responded that they did not think this was a concern.

Matt McClincy then made some general closing statements. Matt indicated that the ODEQ is happy with the progress of the ANG's cleanup at the Portland Base.

REGULATORY REVIEW MEETING
PORTLAND AIR NATIONAL GUARD BASE
30 OCTOBER 2001
12:00 PM – 2:00 PM

12:00 – 12:10	Introduction
12:10 – 12:30	Site 2 – IRAC (Arun Chemburkar/Chris Bailey): • Response to ODEQ comments on the Final Workplan Addendum • Permanganate sampling results • Monitoring program • Schedule • Other issues
12:30 – 12:50	Site 11 – EE/CA (Erik Ipsen): • 95% Remedial Design • Action Memorandum • Schedule • Other issues
12:50 – 1:10	RI/FS (Rob Leet) • Site 4 Risk Assessment • Response to ODEQ comments on the Final Remedial Investigation Report • Data gaps update
1:10 – 1:30	Groundwater Monitoring Program Update (Aaron Etnyre)
1:30 – 2:00	Questions / Other Issues

MEETING MINUTES

Public Information/Restoration Advisory Board Meeting
Portland Air National Guard Base, Portland, Oregon
6 November 2002

Meeting Time and Location:

1730–1930 hours
Port of Portland Commission Room
121 NW Everett Street, Portland, Oregon

Meeting Attendees:

Restoration Advisory Board Members
Frank Wildensee, City of Portland Bureau of Environmental Services
Randy Albright, City of Portland Water Bureau
Guy Neal, PBS Environmental (community co-chairman)
Matt McClincy, Oregon Department of Environmental Quality (ODEQ)
Rod Struck, ODEQ
Stan Jones, Port of Portland
Lt. Col. Roger Rein, Portland ANG Base (PANGB) Environmental Manager

Other Attendees
Helen Sherman Cohen, Columbia Slough Watershed Council
Jay Mower, Columbia Slough Watershed Council
Alice P. Blatt, Columbia Slough Watershed Council
Cameron and Marie McNiven, Wilkes Community Group
Kerry Brown, Wilkes Community Group
Susan Barthel, City of Portland
Ry Thompson, City of Portand
Herb Clough, Hart Crowser
Erik Ipsen, Environmental Resources Management (ERM)
Chris Bailey, ERM
Rob Leet, ERM

A Public Information and Restoration Advisory Board (RAB) meeting was held on 6 November 2002 at the Port of Portland Commission Room in downtown Portland. The meeting was held in response to a written request for a public information meeting submitted by members of the Wilkes Community Group, the Columbia Slough Watershed Council, and other local community members

(letter attached). The community requested the meeting to hear experts explain, in lay terms, the proposed groundwater interim remedial action (IRA) at Environmental Restoration Program (ERP) Site 11, and how the proposed action meets Oregon's cleanup standards. A secondary purpose of the meeting was to provide the RAB with an update on the Proposed Plan and the initial results of the chemical oxidation technology demonstration at ERP Site 2. A meeting outline and a summary of the questions and answers discussed at the meeting are provided below. Copies of the meeting request letter, meeting announcement, and presentation slides are attached.

Meeting Outline (see presentation slides)

- Welcome and introductions – Lt. Col. Roger Rein (5 minutes)
- Meeting purpose and agenda – Rob Leet (5 minutes)
- ODEQ's oversight role at the PANGB; overview of site cleanup process in Oregon – Matt McClincy (10 minutes)
- Background of ERP work at the PANGB; history and characteristics of ERP Site 11 – Rob Leet (20 minutes)
- Description of proposed ERP Site 11 groundwater IRA and schedule for implementation – Erik Ipsen (35 minutes)
- Methods and initial results of ERP Site 2 chemical oxidation technology demonstration – Chris Bailey (15 minutes)

Questions and Answers

Question: Stan Jones suggested that ERM explain to the audience the reason that downward migration of contaminants is of particular concern at this site. Rob Leet explained that contaminated groundwater can flow both vertically (upwards or downwards) and horizontally due to natural pressure gradients in the subsurface, thus spreading the contamination to areas previously uncontaminated. Stan Jones added that the chlorinated hydrocarbons detected in groundwater at the ANGB are heavier than water, and thus tend to "sink" in groundwater. He suggested that this is another mechanism for contaminant migration at the PANGB.

Answer: Rob Leet explained that the "sinking" mechanism of contaminant migration is a characteristic of dense non-aqueous phase liquids (DNAPLs) or very high concentrations of chlorinated compounds. DNAPLs have not been detected at the PANGB, nor are they expected based on the low dissolved concentrations observed. Consequently, density-driven contaminant migration is not anticipated at the PANGB; contaminants at this site migrate primarily by being carried with groundwater along natural pressure gradients.

Question: Are the chemicals that caused the contamination still being used at the Base? What measures have been taken to prevent future contamination?

Answer: Lt. Col. Rein explained that the ANG does still use some hazardous chemicals on the Base, and he explained the Base's "pharmacy program." Base workers that use hazardous chemical products must purchase the products at the Base "Haz-Mart." Chemical dispensing, use, storage, and disposal is carefully controlled and tracked. This innovative program, combined with increased worker awareness of chemical hazards and potential environmental impacts, is expected to prevent future chemical releases to the environment.

Question: Matt McClincy asked ERM to describe the potential exposure routes for the contaminants identified at the Base.

Answer: Rob Leet briefly described the potential exposure routes: inhalation, ingestion, and dermal absorption. These routes were evaluated in the baseline risk assessment under various potential exposure scenarios. The unacceptable human health risks identified in the risk assessment were associated primarily with the possible future ingestion of dissolved contaminants in groundwater under a residential exposure scenario.

Question: What is the reason for the "rebound" of contaminant concentrations observed in some of the ERP Site 2 IRA monitoring wells after the initial reductions that are attributed to chemical oxidation?

Answer: There are several possible explanations for the observed rebound. It may reflect normal fluctuations in dissolved contaminant concentrations that have been observed historically at the site. These contaminant fluctuations are most likely a result of water level fluctuations in the "smear zone;" i.e., zones of soil contamination that are alternately saturated and unsaturated when the water table rises and falls in response to regional precipitation patterns.

The rebound may also be partly or wholly due to incomplete saturation and oxidation of the contaminated zone by the injected potassium permanganate solution. As with any remediation technology that relies on direct contact between the contaminant and the treatment medium, the effectiveness of in situ chemical oxidation is largely a function of the ability to effectively deliver the oxidant to the contaminants in the subsurface. Effective oxidant delivery is, in turn, dependant on injection spacing, frequency, volume, and pressure, as well as the physical properties of the subsurface that control fluid flow. Limitations in oxidant delivery can be overcome to some extent by varying the injection spacing, frequency, volume, and/or pressure.

Finally, the rebound may be partly or wholly caused by the gradient-driven displacement of treated groundwater by upgradient, untreated groundwater. This can be overcome by expanding the treatment program to cover upgradient areas currently not targeted by the technology demonstration.

Question: Will chemical oxidation completely destroy all of the contaminants?

Answer: The ANG's goal is to destroy as much contaminant mass as possible using chemical oxidation. However, due to the delivery limitations described previously, the ANG does not expect that every contaminant molecule will be destroyed. It is anticipated that groundwater monitoring will be continued following active treatment, to monitor the natural attenuation of residual contamination and ensure that risks do not increase. Target cleanup levels for individual compounds will be established in the Record of Decision.

Question: What are the toxic effects of the contaminants identified in groundwater?

Answer: The contaminants have various toxic effects. Some are known carcinogens. Some affect the functioning of internal organs such as the liver, kidneys, central nervous system, and lungs. The severity of these effects depends upon the exposure dose, which is a function of the exposure route, chemical concentration, and exposure duration.

Question: ERM mentioned in its presentation that potassium permanganate is used in the drinking water and wastewater industries. How is it used?

Answer: Potassium permanganate is used at very low concentrations in some treatment systems to remove potentially harmful contaminants from drinking water and wastewater.

Question: Please clarify how the ERP work at the Base is being funded. Federal Superfund? State funds? Oregon ANG?

Answer: The ANG/National Guard Bureau is funding the ERP work. Although the ANG's ERP process for investigating and remediating contaminated sites is modeled after the Federal Superfund program, the PANGB is *not* a Superfund site. The ANG is conducting the work as an independent cleanup, in accordance with Oregon Cleanup Rules and with ODEQ oversight.

Other Discussion Topics

During the question and answer session, Randy Albright of the Portland Water Bureau presented the Bureau's latest groundwater modeling results for the City's Columbia South Shore Well Field, located approximately 1.5 miles east of PANGB. The City used the most recent version of their Deep Aquifer Yield model to predict the 30-year capture zone for the active production wells in the well field. Based on the predicted capture zone, the City defined a new wellhead protection boundary for the well field. The western limit of the wellhead protection boundary is approximately 1 mile east of PANGB. Randy stated that since the PANGB is not within the wellhead protection boundary, there is no identified exposure pathway between the Base and the City's production wells. Accordingly, the City does not consider the shallow groundwater contamination at the PANGB to pose a risk to the well field.

September 19, 2002

Mr. Roger Rein
Oregon Air National Guard
142nd Fighter Wing
6801 NE Cornfoot road
Portland, OR 97218-2797

Re: Request for public meeting

Dear Mr. Rein:

We, the undersigned, request a public information meeting and public hearing in regard to the planned interim remedial action for groundwater and residual contamination in soil at ERP Site 11 at the Portland Air National Guard Base, located at 6801 NE Cornfoot Road, Portland, as provided for in ORS 465.320.

The collective signers of this letter have a primary and underlying reason for the request. All of the signers specifically have an avocational interest in the well-being of the Columbia Slough and the bordering neighborhoods, as well as multiple and diverse interests regarding the physical environment of the Columbia Slough watershed.

Your document describing the proposed interim action, while well-written and thorough, is primarily developed for the professionals who will carry out the interim action, and related governmental entities. To fathom the jargon is a daunting task for lay people. Therefore, our primary interest is in having experts explain the proposal in lay terms, as well as how it meets Oregon's cleanup standards (we refer specifically to ORS 465.200 through 465.455 and 465.900), followed by an opportunity to comment on the proposal. Basically, we are interested to have an informational presentation followed by an opportunity to give public comment.

We strongly feel the need for such a public education presentation, not only for ourselves, but also for other "information hungry" individuals. We trust that this can be arranged.

Please note 15 additional signatures on the attached page.

Very truly yours,

Helen Sherman Cohen

Helen Sherman Cohen
3264 NE 158th avenue
Portland, Oregon 97230-4413

Cc: Wilkes Community Group
East Portland Neighborhood Office
Columbia Slough Watershed Council
Amy Chomowicz and Nancy Hendrickson, Bureau of Environmental Services
Commissioner Dan Saltzman, City of Portland

Planned Interim Remedial Action for Groundwater at Environmental Restoration Program (ERP) Site 11 Portland Air National Guard Base

Print Name	Address	Zip Code	Signature
Kerry Hobson Brown	3546 NE 152nd AV.	97230	Kerry Hobson Brown
Steve Brown	3546 N.E. 152	97230	
GREGG B REITER	15324 NE SANDY		
[illegible]	15304 NE [illegible]		
BEVERLY YETT	3321 NE 162	97230-5212	
BEN H. YETT	332[illegible] NE 162	97230-[illegible]	
H BERNSTEIN	12344 NE MULTNOMAH	97230	H Bernstein
[illegible] Bergman	5330 NE Holman	97218	
Paulette Rossi	3710 NE 147	97230	Paulette Rossi
Gary M Witteman	14311 NE Failing	97230	Gary M Witteman
[illegible]	14311 N.E. Failing	97230	
LOSS MONN	16443 NE Fifth Circle	97230	
[illegible]	3306 NE 155th	97230	
CAMERON McNIVEN	14709 N.E. Schuyler St.		
MARIE McNIVEN	14709 NE. Schuyler		

NOTICE OF PUBLIC INFORMATION MEETING
Portland Air National Guard Base
Environmental Restoration Program (ERP) Site 11
Interim Remedial Design

What: *Information meeting to discuss the proposed groundwater cleanup*
When: *November 6, 2002 - 5:30 to 7:30 P.M.*
Where: *Port of Portland Commission Room*
121 NW Everett St, Portland, Oregon (directions and map on back)

The Air National Guard (ANG) has completed an Interim Remedial Design – 95 Percent Submittal for an interim remedial action to treat contaminated groundwater and residual contamination in soil at ERP Site 11 at the Portland ANG Base. The Base is located at 6801 N.E. Cornfoot Road, just south of the Portland International Airport.

Groundwater and soil at ERP Site 11 contain chlorinated volatile organic compounds and petroleum hydrocarbons at concentrations above Oregon risk-based criteria. Based on the conclusions of an Engineering Evaluation/Cost Analysis (EE/CA), the ANG is planning to conduct an interim remedial action that will mitigate groundwater contaminants through the injection of potassium permanganate. Potassium permanganate is an oxidant commonly used to treat drinking water. No degradation of groundwater quality is expected to result from the permanganate injection, and groundwater monitoring will be performed to confirm this expectation.

The 95 Percent Submittal describes the planned interim remedial action. It can be accessed through the ANG website at http://www.orport.ang.af.mil/units/142fw/142em.html. The public comment period on the 95 Percent Submittal has been extended until November 13, 2002.

At the public's request, the ANG and its consultant, Environmental Resources Management (ERM), are holding an Information Meeting to discuss the design submittal and the proposed remedial action. This meeting will provide an open, informal discussion of the issues in easy-to-understand terms. This is *not* a public hearing. Participants are encouraged to come prepared to discuss their questions or concerns. Comments on the proposed action may be submitted in writing at the meeting, or until November 13, 2002 at the address provided below.

Agenda

5:30 p.m.	Welcome and Introduction – Lt. Col. Roger Rein (ANG)
5:40 p.m.	Site Background – Matt McClincy (Oregon Department of Environmental Quality) and Rob Leet, (ERM)
6:00 p.m.	Description of the Proposed Remedial Action & Schedule for Implementation – Erik Ipsen (ERM)
6:40 p.m	Site 2 Chemical Oxidation Demonstration Results – Chris Bailey (ERM)
7:00 p.m.	QUESTIONS

Comments or questions, and requests to review a hard copy of the 95 Percent Submittal, should be directed to:

Lt. Col. Roger Rein,
Environmental Manager
Oregon ANG Base
6801 N.E. Cornfoot Road
Portland, Oregon 97218
Telephone (503) 335-4462
roger.rein@orport.ang.af.mil

MEETING MINUTES

Restoration Advisory Board Meeting
Portland Air National Guard Base, Portland, Oregon
30 April 2003

Meeting Time and Location:

1530–1700 hours
Building 170, Portland Air National Guard Base (ANGB)

Attendees:

Guy Neal, PBS Environmental (community co-chairman)
Lt. Col. John McAllister, Portland ANGB Commander (military co-chairman)
Frank Wildensee, City of Portland Bureau of Environmental Services
Erwin Bergman, Cully Neighborhood
Helen Sherman Cohen, Columbia Slough Watershed Council
Jay Mower, Columbia Slough Watershed Council
Matt McClincy, Oregon Department of Environmental Quality (ODEQ)
Bruce Body-Heine, ODEQ
Stan Jones, Port of Portland
Lt. Col. Roger Rein, Portland ANGB Environmental Manager
Tab Abraham, Portland ANGB Civil Engineer
Chris Bailey, Environmental Resources Management (ERM)
Rob Leet, ERM

A Restoration Advisory Board (RAB) meeting was held on 30 April 2003 at the Portland ANGB. The purpose of the meeting was to provide the RAB with an update on recent work and proposed cleanup actions at the Base. The meeting agenda and a summary of the questions/comments discussed at the meeting are provided below. Copies of the presentation slides are attached. Also attached are the public notice announcing the availability of the Proposed Plan document for public review, and a memorandum from the Port of Portland to the Base describing the work the Port has done at the Portland Airport to reduce the potential for wildlife strikes to aircraft. These items are discussed further below.

Meeting Agenda (see presentation slides):

- Building 170 health risk evaluation
- Brief review of Environmental Restoration Program (ERP) status and Schedule

- Proposed Plan for cleanup of ERP Sites 1, 2, 3, 4, 9, and 11
- ERP Site 11 groundwater interim remedial action
- Full-scale chemical oxidation technology demonstration at ERP Site 2
- Questions

Questions/Comments:

Q: Stan Jones asked whether ERM thought it was surprising that no vinyl chloride (VC) was detected in the vapor flux and ambient air samples collected during the Building 170 investigation, given that VC has been detected in groundwater at relatively high concentrations, while other compounds that were detected in the ambient air samples and attributed to flux through the building slab haven't been detected at high concentrations in groundwater.

A: Rob Leet replied that it was surprising, but pleasing, that VC wasn't detected in the vapor flux/ambient air samples. The reason VC was not detected is unclear; it is possible that a localized residual soil contamination source not containing VC exists beneath Building 170, and it is this source that is causing the apparent flux of volatile organic compounds into the building. Roger Rein states that this was an initial screening evaluation, and that additional sampling may be done at other times of the year to verify the results of this study.

Q: Jay Mower asked whether the duration of the ERP investigation and cleanup work at the Portland ANGB is typical for environmental cleanup sites, or has the work has taken longer than 'normal?'

A: Rob Leet replied that the duration is typical for large, complicated sites such as the Portland ANGB. The relatively long duration is partly a function of the site complexity and partly because the ANG's ERP work is carried out within the framework of the Superfund program, which has formal processes and procedures that must be followed to ensure sites are sufficiently characterized and risks are not underestimated. Matt McClincy confirms that the duration of the ERP work is typical for large sites in Oregon with multiple areas of concern and similar complexity. Roger Rein emphasized, however, that the Base is different from some other sites, in that the ANG has responded to RAB input by conducting interim remedial actions to address immediate potential risks.

Q: Helen Sherman Cohen asked whether the pace of the investigations/cleanup could be stepped up if potential human health impacts are expected, such as in Building 170.

A: Matt McClincy confirmed that ODEQ could request or require ANG to accelerate the ERP work if conditions warrant.

C: During the presentation on the Proposed Plan, Roger Rein indicated that the title of the document is actually "Proposed Plan;" this is not a generic term for the document. The Proposed Plan is available for review on the Base's Environmental Office web site; hard copies of the document are available from Roger. There is an option for a public information meeting to discuss the Proposed Plan if requested by 10 or more people, or by a group representing 10 or more people, during the public comment period. The public notice announcing the availability of the Proposed Plan for public review was published in the Sunday Oregonian on 27 April 2003; a copy of the notice is attached to these minutes. The public comment period for the Proposed Plan ends 27 May 2003.

Q: Erwin Bergman asked what the goal is for monitored natural attenuation (MNA) treatment; are there specific, predetermined criteria for determining whether MNA is successful?

A: Rob Leet replied that the ANG's goal is to achieve the Remedial Action Objectives presented in the Proposed Plan. There are no predetermined success criteria; the effectiveness of MNA will be evaluated based on ongoing groundwater monitoring and discussions with ODEQ. If contaminant concentrations show continued reductions at acceptable rates, MNA will be considered successful.

C: Regarding ERP Site 4, Roger Rein pointed out that the Port of Portland recently sent a memorandum to the Base (attached) outlining the work the Port has done at the airport to reduce the potential for wildlife strikes to aircraft. The work consists mainly of removing wetlands on Port-owned property and replacing open drainage ditches with buried culvert pipe. The memorandum emphasizes the importance of undertaking similar work at the Portland ANGB.

C: Roger Rein indicated that since Site 4 is a jurisdictional wetland, the mitigation requirements for filling/piping the Main Drainage Ditch would be (1) 1.5 acres created per acre eliminated for wetlands replacement; (2) 3 acres

enhanced per acre eliminated for wetlands enhancement; or (3) a fee of $48,000 per acre eliminated.

C: Erwin Bergman indicated that the City of Portland might receive a grant from the U.S. Department of Fish and Wildlife to enhance urban habitats for migratory birds; this is counter to the wildlife strike reduction goals of the Port.

Q: Given the ANG's plan to select the Site 4 remedy based on which alternative (contaminated sediment removal or ditch filling/capping) receives funding first, Matt McClincy asked what the ANG would do if funding for sediment removal was received first, knowing that this alternative is inconsistent with the Port's goal of removing wetlands/wildlife attractants.

A: Roger Rein replied that funding for stormwater conveyance projects is currently unavailable. Tab Abraham stated that the Site 4 ditch filling project likely would be funded in Fiscal Year 2006/07 at the earliest, and the funding amount would be approximately $1MM. Rob Leet indicated that if funds became available for sediment removal within the next year or two, it is possible that contaminated sediment removal would be implemented in order to meet the overall schedule goals of the ANG ERP.

C: Roger Rein indicated that the ANG might produce a promotional video of the Site 11 groundwater interim action (i.e., horizontal well installation, permanganate injection), similar to the video that was produced for the 1999 soil removal action.

C: Tab Abraham indicated that the end of August 2003 will be a busy time at ERP Site 11 due to planned construction activities in the area of the flight apron; our horizontal well installation work shouldn't be affected, however.

Q: Guy Neal asked how long potassium permanganate usually lasts after it is injected in the subsurface. Could the observed contaminant rebound in some of the Site 2 monitoring wells be the result of the permanganate being consumed/used up?

A: Chris Bailey replied that potassium permanganate typically persists for weeks to months in the subsurface. The observed contaminant rebound is most likely due to the limited number of injection events (two) completed during the Site 2 Interim Remedial Action Construction (IRAC) project, as well as the limited area and quantity of the injections.

Q: Erwin Bergman asked how much potassium permanganate solution is injected in each temporary boring, and how fast (injection rate).

A: Chris Bailey replied that approximately 200 to 500 gallons is injected at each location, at a rate of 5-10 gallons per minute. If the solution is rejected by the surrounding formation (i.e., if the formation can't accept the injected solution as fast as it's being pumped into the borehole), the injection is slowed or stopped as appropriate.

Q: Roger Rein asked if anyone had ideas for how to use annual RAB funds available from ANG. Suggestions included: (1) produce video clips for the Base web site; (2) produce a 3-dimensional graphic depicting the extent of contamination at the Base; (3) enhance the Base web site with "low-tech" (i.e., minimal science/engineering content) materials to help explain the cleanup actions.

Q: Stan Jones asked whether ERM/ANG has considered using sodium permanganate instead of potassium permanganate, which could potentially achieve the same treatment results with fewer injections at higher permanganate concentrations (due to its higher solubility).

A: Chris Bailey replied that sodium permanganate has been considered, and we agree that it may be an appropriate choice if higher oxidant concentrations are deemed necessary to achieve treatment objectives. The Draft Site 2 IRAC Technology Demonstration report includes a recommendation to that effect. Matt McClincy mentioned that sodium permanganate is being used for in situ chemical oxidation at the Cadet site in Portland; details about that site can be found on ODEQ's web site.

Q: Erwin Bergman asked whether the injection locations are wells that can be revisited/reused for multiple injections.

A: Chris Bailey replied that the Site 2 injection locations are one-time, direct-push borings, while the Site 11 locations are wells that can be reused. Direct-push injections are the simplest application method, and allow the injection locations to be adjusted as necessary to target areas that need treatment the most. Direct-push injection wasn't feasible at Site 11 due to the Base requirement that aircraft operations on the active flight apron not be significantly impacted.

PUBLIC NOTICE

Oregon Air National Guard

NOTICE OF AVAILABILITY

Environmental Restoration Program (ERP)
Proposed Plan for the
Portland Air National Guard Base

The Air National Guard (ANG) has completed a Proposed Plan describing the remedial actions the ANG is planning to implement to address contaminated soil, groundwater, and sediment at ERP Sites 1, 2, 3, 4, 9, and 11 at the Portland ANG Base. The Portland ANG Base is located at 6801 N.E. Cornfoot Road, just south of the Portland International Airport. Through extensive sampling and risk evaluation studies, the ANG has determined that the subject ERP sites present unacceptable potential risks to human health or the environment (as defined by Oregon regulations). Four other sites investigated (ERP Sites 5, 7, 8, and 10) were found to pose no unacceptable risks, therefore no further action is planned at these sites.

Contaminants present above Oregon acceptable risk-based levels at ERP Sites 1, 2, 3, 4, 9, and 11 include chlorinated volatile organic compounds, semivolatile organic compounds, petroleum hydrocarbons, polychlorinated biphenyls, and/or metals. The ANG proposes to remediate contaminated groundwater at Sites 1, 2, 3, 9, and 11 using in situ chemical oxidation technology. The proposed oxidants, potassium permanganate and sodium persulfate, have been used successfully to treat contaminated groundwater at other sites similar to the Portland ANG Base, and are not expected to degrade groundwater quality at the Base. Contaminated soil at Site 11 will be treated using soil vapor extraction and enhanced bioremediation technologies. Groundwater monitoring will be performed to verify that the groundwater and soil remedial actions are effective. Contaminated sediments at Site 4 will either be capped with clean fill or removed and disposed off-site to prevent potential ecological exposures.

The Proposed Plan describes the site risks and the planned remedial actions. It also describes the process the ANG followed in selecting the remedies. The Plan can be accessed through the ANG website at http://www.orport.ang.af.mil/units/142fw/142em.html. A hard copy of the document is also available for review at the address provided below.

The ANG invites your comments on the Proposed Plan. Comments may be submitted during a 30-day public comment period beginning April 28, 2003 and ending May 27, 2003. A public meeting will be held to receive verbal comments if requested by ten or more people or a group representing ten or more people.

Comments or questions, and requests to review a hard copy of the Proposed Plan, should be directed to:

Lt. Col. Roger Rein, Environmental Manager
Oregon Air National Guard Base
6801 N.E. Cornfoot Road
Portland, Oregon 97218
Telephone (503) 335-4462
roger.rein@orport.ang.af.mil

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PORT OF PORTLAND

MEMORANDUM

Date: April 4, 2003

To: Lt. Col. Kyle Hook, Chief of Safety
Oregon Air National Guard

From: Sharon Gordon, Wildlife Specialist
Port of Portland

Re: Wetlands and Wildlife at PDX

Portland International Airport (PDX) has a serious issue with wildlife strikes to aircraft. PDX is located on a major migratory flyway, and is immediately adjacent to the Columbia River. In addition, suitable and attractive habitat for wildlife is found on the perimeter of the airport at golf courses, environmental zones, and open fields surrounding the airfield. In short, PDX will always have wildlife species in the immediate vicinity and the challenge is to deter them from the airfield.

The Port of Portland has had a formal Wildlife Hazard Management Program since 1997, which includes an aggressive hazing program and a program to modify habitat that is documented to be highly attractive to wildlife species of concern at PDX. Part of the habitat modification program is a systematic identification and removal of wetlands on the airfield that are attractive to wildlife. The Port's goal is to address any wetlands that exist on the airfield and to monitor wet areas so that no new wetlands form.

Airfield Safety Improvements Project:

In 1998, the Port contracted with Beak Consultants to do a delineation of all wetlands on the airfield. After doing the required Biological Assessment in 1999, an "Airfield Safety Improvement Project" was designed to improve drainage on the airfield, fill all existing wetlands, and pipe open ditches. The stated purpose of this project was to reduce the attractiveness of the airfield to wildlife, and to allow emergency equipment better access to runways. A total of 8.3 acres of jurisdictional wetland was consequently filled in the summer of 2000. The construction schedule for this project was designed to span several years, and is almost complete. An outline of the project is as follows:

- Runway 3/21: A total of 7.54 acres of jurisdictional wetlands were filled at the south end of runway 3/21 to alleviate the wildlife attracted to this wetland and to allow aircraft rescue and fire fighting equipment to access the runway. The Port filled and graded all ground surfaces of the runway safety area and areas between the runway and the perimeter road. The purpose of this work was to: ". . . reduce wildlife habitat for those species that pose a significant risk to aircraft and passenger safety." (Beak 1999 page 7)
- Runway 10R/28L: The Port removed ditches with standing water in three wetlands near this runway, which were confined to the bottom of drainage ditches. Culverts were placed in the ditches and linked with existing culverts. Fill was placed over the culverts and the site was graded to provide a smooth, well-drained surface. The purpose of this work was to "reduce the attractive wildlife habitat." (Beak 1999 page 7)
- Runway 10L/28R: The Port filled three wetlands off the east end of this runway "to reduce wildlife from frequenting the area." (Beak 1999 page 7)
- Mitigation Site: A parcel of land was purchased by the Port to mitigate for the impacts to jurisdictional wetlands filled as part of this project.

SW Quad Drainage Improvement Project:

An undeveloped parcel of land owned by the Port, just off the airfield to the southwest, has also been a wildlife and wetland concern over the years. In the early 1990's approximately 64 acres of wetlands at this site were filled with approximately 900,000 cubic yards of sand dredged from the Columbia River in an attempt to reduce its attractiveness to waterfowl. A large construction project was completed in 2000 to add perforated pipes to the area to make it drain more effectively. An additional project is planned for 2004 to fill the remaining ditches and drainage canals in the area. Each of these projects is an additional step in reducing the attractiveness of this area to species of concern in order to lower the occurrence of bird strikes at PDX.

Ongoing Projects:

To prevent large-scale and costly projects like the ones outlined above, the Port regularly monitors the airfield for areas of standing water that attract wildlife. Each summer, in conjunction with other runway construction, identified areas are graded, drains are constructed, or fill is added to reduce the amount of standing water on the airfield. Some of the recent work includes:

- Summer 2001 – Taxiway C west end drainage work; grading north of 10L; fill added near the Sheraton Hotel; catch basins constructed south of the 10R overrun.
- Summer 2002 – Drainage work off of perimeter road east of A1.
- Summer 2003 – Planned correction of work east of A1; improved drainage at the taxiway C west end barrier pit area; and drainage correction east of B8.
- Summer 2004 – Planned work to complete the piping of an open ditch north of taxiway B at B1.

Oregon Air National Guard Cooperation:

During the time that these major habitat modification projects were underway at PDX, the Oregon Air National Guard has not directly participated in removing wetlands from the property under their lease at PDX. In a recent cooperative effort, Port Wildlife staff has been granted security access to the base under a formal operating instruction [PIA Instruction 91-212, 2 May, 2002] to facilitate hazing of waterfowl from the area on a regular basis. This is a reactive, short-term solution to the immediate problem, and this labor-intensive program will have to be continued as long as there is attractive habitat on the base to draw birds to the area. A more permanent solution would be to modify the open water features and associated wetlands and riparian vegetation that attract waterfowl to the site in the first place. This area has been identified by the USDA/Wildlife Services as the area of highest priority for corrective action based on its close proximity to the aircraft operating area and its high amount of wildlife habitat [reference: Wildlife Habitats and Hazards at the Portland Air National Guard Facility, USDA/WS, April 6, 2001]. This habitat modification would be consistent with the base's BASH plan [142 FW BASH Plan 91-212], and the ongoing wildlife hazard management program at PDX.

Summary:

The Port of Portland has committed extensive time and resources over the last decade toward removing open water features and associated wetlands from the airfield because we believe that this is an area where we can make a significant difference in the attractiveness of the airfield to wildlife. The effectiveness of these projects, however, is limited if suitable habitat for waterfowl remains on immediately adjacent properties, including those leased from PDX by the Oregon Air National Guard. These areas provide refugia for the very species of wildlife that represent a significant hazard to both civilian and military air traffic at PDX.