



U.S. Army
Corps of Engineers
Omaha District



FINAL SITE INSPECTION REPORT

Boardman Air Force Range

Morrow County, OR

FUDS Property No. F10OR0160

Site Inspections at Multiple Sites, NWO Region
Formerly Used Defense Sites
Military Munitions Response Program

Contract No. W912DY-04-D-0010
Delivery Order No. 003

September 2007



Shaw Environmental, Inc.
7604 Technology Way, Suite 300
Denver, CO 80237

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as official department of the Army position, policy, or decision, unless so designated by other documentation.

FINAL

SITE INSPECTION REPORT
Boardman Air Force Range
FUDS Property No. F10OR0160

Formerly Used Defense Sites
Military Munitions Response Program

September 2007

Submitted to:

U.S. Department of the Army
U.S. Army Corps of Engineers, Omaha District

Prepared by:

Shaw Environmental, Inc.
7604 Technology Way, Suite 300
Denver, Colorado 80237

Contract No. W912DY-04-D-0010
Delivery Order No. 003

Prepared/Reviewed by:

Shaw Technical Lead:	Dale Landon
Shaw Project Chemist:	Tim Roth
Shaw Quality Control:	Paul Sadowski
Shaw Project Manager:	Peter Kelsall

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

Table of Contents

List of Figures	v
List of Tables	vi
List of Appendices	vii
List of Acronyms	viii
Glossary of Terms	xi
Executive Summary	ES-1
1.0 Introduction	1-1
1.1 Project Authorization	1-1
1.2 Site Name and Location	1-1
1.3 Purpose, Scope, and Objectives of the Site Inspection	1-2
1.4 Munitions Response Site Prioritization Protocol	1-3
2.0 Property Description and History	2-1
2.1 Historical Military Use	2-1
2.2 Munitions Information	2-2
2.3 Ownership History	2-2
2.4 Physical Setting	2-2
2.4.1 Topography and Vegetation	2-2
2.4.2 Land Use	2-2
2.4.3 Nearby Population	2-3
2.4.4 Climate	2-3
2.4.5 Area Water Supply	2-3
2.4.6 Surface Water	2-3
2.4.7 Geologic and Hydrogeologic Setting	2-4
2.4.7.1 Bedrock Geology	2-4
2.4.7.2 Overburden Soils	2-4
2.4.7.3 Hydrogeology	2-4
2.4.8 Sensitive Environments	2-4
2.5 Previous Investigations for MC and MEC	2-5
2.5.1 Archives Search Report	2-5
2.5.2 ASR Supplement	2-5
2.5.3 Other Investigations	2-6
2.6 Other Land Uses that May Have Contributed to Contamination	2-8
2.7 Past Regulatory Activities	2-8
2.8 Previous MEC Finds	2-8
3.0 SI Tasks and Findings	3-1
3.1 Technical Project Planning	3-1
3.2 Additional Records Research	3-4
3.2.1 Coordination with State Historic Preservation Office	3-4
3.2.2 Coordination with Natural Resources Offices	3-4
3.2.3 Historical Aerial Photographs	3-4
3.2.4 Environmental Database Search	3-5
3.2.5 Rights of Entry	3-5

Table of Contents(Cont.)

3.3	Field Work	3-5
3.4	Sampling and Analysis	3-5
3.5	Laboratory Analysis and Data Quality Review.....	3-6
3.6	Screening Values	3-6
3.6.1	Background Data.....	3-6
3.6.2	Human Health Screening	3-8
3.6.3	Ecological Screening.....	3-8
3.7	Variances from the SSWP	3-8
3.8	Second TPP Meeting.....	3-8
4.0	Target No. 1.....	4-1
4.1	History and Land Use	4-1
4.2	Previous Investigations.....	4-1
4.3	MEC Evaluation.....	4-2
4.3.1	Field Observations and Historical Evidence of MEC	4-2
4.3.2	MEC Risk Assessment.....	4-2
4.4	Munitions Constituents Evaluation.....	4-3
4.4.1	Terrestrial Pathway.....	4-3
4.4.1.1	Comparison to Background Data	4-3
4.4.1.2	Comparison to Human Health Screening Values	4-4
4.4.1.3	Comparison to Ecological Screening Values.....	4-4
4.4.2	Surface Water Pathway.....	4-4
4.4.3	Groundwater Pathway.....	4-4
4.4.3.1	Comparison to Background.....	4-5
4.4.3.2	Comparison to Human Health Screening Values	4-5
4.4.4	Air Pathway	4-5
5.0	Target No. 2.....	5-1
5.1	History and Land Use	5-1
5.2	Previous Investigations.....	5-1
5.3	MEC Evaluation.....	5-1
5.3.1	Field Observations and Historical Evidence of MEC	5-2
5.3.2	MEC Risk Assessment.....	5-2
5.4	Munitions Constituents Evaluation.....	5-3
5.4.1	Terrestrial Pathway.....	5-3
5.4.1.1	Comparison to Background Data	5-3
5.4.1.2	Comparison to Human Health Screening Values	5-3
5.4.1.3	Comparison to Ecological Screening Values.....	5-4
5.4.2	Surface Water Pathway.....	5-4
5.4.2.1	Comparison to Background Data	5-4
5.4.2.2	Comparison to Human Health Screening Values	5-4
5.4.2.3	Comparison to Ecological Screening Values.....	5-5
5.4.3	Groundwater Pathway.....	5-5
5.5	Air Pathway	5-5

Table of Contents(Cont.)

6.0	Carty Reservoir Bomb Target	6-1
6.1	History and Land Use	6-1
6.2	Previous Investigations.....	6-1
6.3	MEC Evaluation.....	6-1
6.3.1	Field Observations and Historical Evidence of MEC	6-2
6.3.2	MEC Risk Assessment.....	6-2
6.4	Munitions Constituents Evaluation.....	6-2
6.4.1	Terrestrial Pathway.....	6-3
6.4.1.1	Comparison to Background Data	6-3
6.4.1.2	Comparison to Human Health Screening Values	6-3
6.4.1.3	Comparison to Ecological Screening Values.....	6-3
6.4.2	Surface Water Pathway.....	6-3
6.4.2.1	Comparison to Background Data	6-4
6.4.2.2	Comparison to Human Health Screening Values	6-4
6.4.2.3	Comparison to Ecological Screening Values.....	6-4
6.4.3	Groundwater Pathway.....	6-4
6.4.4	Air Pathway	6-4
7.0	Range Complex No. 1.....	7-1
7.1	History and Land Use	7-1
7.2	Previous Investigations.....	7-1
7.3	MEC Evaluation.....	7-2
7.3.1	Field Observations and Historical Evidence of MEC	7-2
7.3.2	MEC Risk Assessment.....	7-3
7.4	Munitions Constituents Evaluation.....	7-3
7.4.1	Terrestrial Pathway.....	7-3
7.4.1.1	Comparison to Background Data	7-4
7.4.1.2	Comparison to Human Health Screening Values	7-4
7.4.1.3	Comparison to Ecological Screening Values.....	7-4
7.4.2	Surface Water Pathway.....	7-4
7.4.3	Groundwater Pathway.....	7-5
7.4.3.1	Comparison to Background.....	7-5
7.4.3.2	Comparison to Human Health Screening Values	7-5
7.4.4	Air Pathway	7-5
8.0	Demolition Area No. 2.....	8-1
8.1	History and Land Use	8-1
8.2	Previous Investigations.....	8-1
8.3	MEC Evaluation.....	8-1
8.3.1	Field Observations and Historical Evidence of MEC	8-1
8.3.2	MEC Risk Assessment.....	8-1
8.4	Munitions Constituents Evaluation.....	8-2
8.4.1	Terrestrial Pathway.....	8-2
8.4.1.1	Comparison to Background Data	8-2
8.4.1.2	Comparison to Human Health Screening Values	8-2

Table of Contents(Cont.)

	8.4.1.3 Comparison to Ecological Screening Values.....	8-3
	8.4.2 Surface Water Pathway.....	8-3
	8.4.3 Groundwater Pathway.....	8-3
	8.4.3.1 Comparison to Background.....	8-3
	8.4.3.2 Comparison to Human Health Screening Values.....	8-4
	8.4.4 Air Pathway.....	8-4
9.0	Impact Area.....	9-1
9.1	History and Land Use.....	9-1
9.2	Previous Investigations.....	9-1
9.3	MEC Evaluation.....	9-1
	9.3.1 Field Observations and Historical Evidence of MEC.....	9-1
	9.3.2 MEC Risk Assessment.....	9-1
9.4	Munitions Constituents Evaluation.....	9-2
	9.4.1 Terrestrial Pathway.....	9-2
	9.4.1.1 Comparison to Background Data.....	9-2
	9.4.1.2 Comparison to Human Health Screening Values.....	9-2
	9.4.1.3 Comparison to Ecological Screening Values.....	9-2
	9.4.2 Surface Water Pathway.....	9-3
	9.4.2.1 Comparison to Background Data.....	9-3
	9.4.2.2 Comparison to Human Health Screening Values.....	9-3
	9.4.2.3 Comparison to Ecological Screening Values.....	9-3
	9.4.3 Groundwater Pathway.....	9-3
	9.4.3.1 Comparison to Background.....	9-4
	9.4.3.2 Comparison to Human Health Screening Values.....	9-4
	9.4.4 Air Pathway.....	9-4
10.0	Summary and Conclusions.....	10-1
10.1	Target No. 1.....	10-1
10.2	Target No. 2.....	10-2
10.3	Carty Reservoir Bomb Target.....	10-3
10.4	Range Complex No. 1.....	10-4
10.5	Demolition Area No. 2.....	10-5
10.6	Impact Area.....	10-5
11.0	Recommendations.....	11-1
11.1	Target No. 1.....	11-1
11.2	Target No. 2.....	11-1
11.3	Carty Reservoir Bomb Target.....	11-1
11.4	Range Complex No. 1.....	11-2
11.5	Removal Actions.....	11-2
11.6	Munitions Response Areas.....	11-2
11.7	MRSP Scoring.....	11-3
12.0	References.....	12-1

List of Figures

Figure 1-1	Site Location
Figure 2-1	Original Site Layout
Figure 2-2	Current Aerial Photograph
Figure 2-3	Parcel Ownership
Figure 2-4	Current Topographic Map
Figure 2-5	Census Data within 4-Mile Radius
Figure 2-6	Sensitive Receptor Locations
Figure 2-7	Groundwater Well Locations
Figure 2-8	Regional Surface Water Drainage
Figure 2-9	PA/SI Sample Locations
Figure 2-10	Reported MEC Finds
Figure 3-1	Site Inspection Areas of Concern
Figure 3-2	Background Sample Locations and Reconnaissance
Figure 4-1	Target No. 1 and Carty Reservoir Bomb Target Reconnaissance
Figure 4-2	Target No. 1 and Carty Reservoir Bomb Target Sample Locations and Metals Results
Figure 4-3	Target No. 1 and Carty Reservoir Bomb Target Sample Locations and Explosives Results
Figure 4-4	Target No. 1 and Carty Reservoir Bomb Target PA/SI Groundwater Sample Results
Figure 5-1	Target No. 2 Reconnaissance
Figure 5-2	Target No. 2 Sample Locations and Metals Results
Figure 5-3	Target No. 2 Sample Locations and Explosives Results
Figure 5-4	Target No. 2 PA/SI Surface Water Perchlorate and Sediment Metals Sampling Results
Figure 7-1	Range Complex No. 1 Reconnaissance
Figure 7-2	INPR Site No. 1 Range Complex No. 1 Sample Locations and Metals Results
Figure 7-3	INPR Site No. 1 Range Complex No. 1 Sample Locations and Explosives Results
Figure 7-4	Demolition Area Range Complex No. 1 Sample Locations and Metals Results
Figure 7-5	Demolition Area Range Complex No. 1 Sample Locations and Explosives Results
Figure 7-6	Demolition Area Range Complex No. 1 Reconnaissance
Figure 7-7	Turret Gunnery Range Complex No. 1 Sample Locations and Metals Results
Figure 8-1	Demolition Area No. 2 Reconnaissance
Figure 8-2	Demolition Area No. 2 Sample Locations and Metals Results
Figure 8-3	Demolition Area No. 2 Sample Locations and Explosives Results
Figure 9-1	Impact Area Reconnaissance
Figure 9-2	Impact Area Sample Locations and Metals Results
Figure 9-3	Impact Area Sample Locations and Explosives Results
Figure 11-1	Munitions Response Sites

List of Tables

Table 2-1	Munitions Information
Table 2-2	Army Checklist for Important Ecological Places
Table 2-3	Summary of Weston 2004 PA/SI Sampling
Table 2-4	Locations of Confirmed MEC Finds
Table 3-1	Summary of Samples Collected for Site Inspection
Table 3-2	Background Screening Values Soil, Sediment and Groundwater
Table 3-3	Human Health Screening Values for Soil/Sediment and Groundwater
Table 3-4	Ecological Screening Values for Soil and Sediment
Table 4-1	Comparison of Target No. 1 Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 4-2	Comparison of Target No. 1 Groundwater Analytical Detections to Background, Human Health and Ecological Screening Values
Table 5-1	Comparison of Target No. 2 Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 5-2	Comparison of Target No. 2 Sediment Analytical Detections to Background, Human Health and Ecological Screening Values
Table 6-1	Comparison of Carty Reservoir Bomb Target Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 6-2	Comparison of Carty Reservoir Bomb Target Sediment Analytical Detections to Background, Human Health and Ecological Screening Values
Table 7-1	Comparison of INPR Site No. 1 – Range Complex No. 1 Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 7-2	Comparison of Demolition Area – Range Complex No. 1 Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 7-3	Comparison of Turret Gunnery Range – Range Complex No. 1 Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 8-1	Comparison of Demolition Area No. 2 Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 9-1	Comparison of Impact Area Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 9-2	Comparison of Impact Area Sediment Analytical Detections to Background, Human Health and Ecological Screening Values

List of Appendices

Appendix A	Performance Work Statement (<i>Electronic Only</i>)
Appendix B	Technical Project Planning Session Documentation/Meeting Minutes (<i>Electronic Only</i>)
Appendix C	Interview Documentation
Appendix D	Field Notes and Field Forms
Appendix E	Photodocumentation Log
Appendix F	Analytical Data (<i>Electronic Only</i>)
Appendix G	Analytical Data QA/QC Report
Appendix H	Geographical Information Systems Data
Appendix I	Geophysical Data (<i>Not Used</i>)
Appendix J	Conceptual Site Model
Appendix K	Munitions Response Site Prioritization Protocol Evaluations
Appendix L	Reference Copies

List of Acronyms

°F	degrees Fahrenheit
µg/L	micrograms per liter
ADR	Automated Data Review
AFR	Air Force Range
AOC	area of concern
ARC	Annual Report to Congress
ASR	Archives Search Report
BAIC, Inc.	Boardman Agri-Industrial Complex, Inc.
bgs	below ground surface
CCB	continuing calibration blank
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHE	Chemical Warfare Material Hazard Evaluation
CLP	Contract Laboratory Program
CSM	conceptual site model
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DERP	Defense Environmental Restoration Program
DMM	discarded military munitions
DoD	Department of Defense
DOI	Department of Interior
DQO	data quality objective
EDR	Environmental Data Resources, Inc.
EHE	Explosive Hazard Evaluation
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ER	Engineering Regulation
FR	Federal Register
FS	feasibility study
ft	foot or feet
FUDS	Formerly Used Defense Sites
GP	General Purpose
GPL	GPL Laboratories, LLLP
GPS	Global Positioning System
HE	high explosive
HHE	Health Hazard Evaluation
HRS	Hazard Ranking System
HTRW	hazardous, toxic, or radioactive wastes
IC	Ion Chromatography
ICB	initial calibration blank
IEP	Important Ecological Place
INPR	Inventory Project Report
lb	pound
MC	munitions constituents

List of Acronyms (Cont.)

MD	munitions debris
MEC	munitions and explosives of concern
mm	millimeter
MMRP	Military Munitions Response Program
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSP	Munitions Response Site Prioritization Protocol
NAD	North American Datum
Navy	U.S. Navy
NCP	National Oil and Hazardous Pollution Contingency Plan
NDAI	No Department of Defense Action Indicated
NGVD	National Geodetic Vertical Datum
NWO	Northwest Region (Omaha District Military Munitions Design Center)
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OPRD	Oregon Parks and Recreation Department
OR	Oregon
PA/SI	Preliminary Assessment/Site Inspection
PETN	pentaerythritol tetranitrate
PGE	Portland General Electric
QA/QC	Quality Control/Quality Assurance
RAC	Risk Assessment Code
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROE	rights of entry
RPD	relative percent difference
SDG	sample delivery group
SEDD	Stage Electronic Data Deliverables
Shaw	Shaw Environmental, Inc.
SHPO	State Historic Preservation Office
SI	Site Inspection
SLERA	Screening-Level Ecological Risk Assessment
SOP	standard operating procedure
SOW	statement of work
SOAP	Sampling and Quality Assurance Plan
SSWP	Site-Specific Work Plan
TAL	Target Analyte List
TNT	2,4,6-trinitrotoluene
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
USC	United States Code
UTL	upper tolerance limit

List of Acronyms (Cont.)

UTM	Universal Transverse Mercator
UXO	unexploded ordnance
VSP	Visual Sampling Plan
Weston	Weston Solutions Inc.

Glossary of Terms

Comprehensive Environmental Response, Compensation, and Liability Act of 1980

(CERCLA) – Also known as “Superfund,” this congressionally enacted legislation provides the methodology for the removal of hazardous substances resultant from past / former operations. Response actions must be performed in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (USACE, 2003). CERCLA was codified as 42 USC 9601 et seq., on December 11, 1980, and amended by the Superfund Amendments and Reauthorization Act (SARA) on October 17, 1986.

Defense Sites – Locations that are or were owned by, leased to, or otherwise possessed or used by the Department of Defense (DoD). The term does not include any operational range, operating storage, or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions (10 USC 2710(e)(1)).

Discarded Military Munitions (DMM) – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed consistent with applicable environmental laws and regulations (10 USC 2710(e)(2)).

Explosive Ordnance Disposal (EOD) – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration (10 USC 2710(e)(2)).

Formerly Used Defense Site (FUDS) – Real property that was formerly owned by, leased by, possessed by or otherwise under the jurisdiction of the Secretary of Defense or the components, including organizations that predate DoD. Some FUDS properties include areas formerly used as military ranges (10 USC 2710(e)(2)).

Military Munitions – Ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the U.S. Coast Guard, the U.S. Department of Energy (DOE), and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunitions, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components of the above.

The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, other than non-nuclear components of nuclear devices

that are managed under the nuclear weapons program of the DOE after all required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.) have been completed (10 USC 101(e)(4)(A) through (C)).

Munitions Constituents (MC) – Any materials originating from unexploded ordnance (UXO), DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions (10 USC 2710(e)(3)).

Munitions Debris (MD) – Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal (10 USC 2710(e)(2)).

Munitions and Explosives of Concern (MEC) – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded ordnance as defined in 10 USC 101(e)(5); (B) Discarded military munitions, as defined in 10 USC 2710(e)(2); or (C) Munitions constituents (e.g., TNT, RDX), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard (10 USC 2710(e)(2)).

Munitions Response Site (MRS) – A discrete location within a munitions response area that is known to require a munitions response (32 CFR§179.3).

Munitions Response Site Prioritization Protocol (MRSPP) – The MRSPP was published as a rule on October 5, 2005. This rule implements the requirement established in section 311(b) of the National Defense Authorization Act for Fiscal Year 2002 for the DoD to assign a relative priority for munitions responses to each location in the inventory of DOD defense sites known or suspected of containing UXO, DMM, or MC. The DoD adopted the MRSPP under the authority of 10 USC 2710(b). Provisions of 10 USC 2710(b) require that the Department assign to each defense site in the inventory required by 10 USC 2710(a) a relative priority for response activities based on the overall conditions at each location and taking into consideration various factors related to safety and environmental hazards (70 FR 58016).

Range – A designated land or water area that is set aside, managed, and used for range activities of the DoD. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration (10 USC 101(e)(1)(A) and (B)).

Range Activities – Research, development, testing, and evaluation of military munitions, other ordnance, and weapons systems; and the training of members of the armed forces in the use and handling of military munitions, other ordnance, and weapons systems (10 USC 101(e)(2)(A) and (B)).

Risk Assessment Code (RAC) – An interim risk assessment procedure developed by the U.S. Army Engineering and Support Center, Huntsville (USAESCH), Ordnance and Explosives Directorate (CEHNC-OE) to address explosives safety hazards related to munitions. The RAC score was formerly used by the USACE to prioritize response actions at FUDS. The RAC procedure, which does not address environmental hazards associated with MC, has been superseded by the MRSPP.

Unexploded Ordnance – Military munitions that (A) have been primed, fuzed, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded either by malfunction, design, or any other cause (10 USC 101(e)(5)(A) through (C)).

1 ***Executive Summary***

2 The Department of Defense (DoD) has established the Military Munitions Response Program
3 (MMRP) under the Defense Environmental Restoration Program (DERP) to address DoD sites
4 suspected of containing munitions and explosives of concern (MEC) or munitions constituents
5 (MC). Under the MMRP, the U.S. Army Corps of Engineers (USACE) is conducting
6 environmental response activities at Formerly Used Defense Sites (FUDS) for the Army, the
7 DoD Executive Agent for the FUDS program. Shaw Environmental, Inc. (Shaw) is responsible
8 for conducting Site Inspections (SIs) at FUDS in the northwest region managed by the Omaha
9 District Military Munitions Design Center (NWO).

10 ***SI Objectives and Scope***

11 The primary objective of the MMRP SI is to determine whether a FUDS project warrants further
12 response action related to risks posed by MEC or MC. The SI collects the minimum amount of
13 information necessary to make this determination, as well as it (i) determines the potential need
14 for a removal action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking
15 System (HRS) scoring by the Environmental Protection Agency (EPA); and (iii) collects data, as
16 appropriate, to characterize the release for effective and rapid initiation of the Remedial
17 Investigation (RI) and Feasibility Study (FS). An additional objective of the MMRP SI is to
18 collect the additional data necessary to complete the Munitions Response Site Prioritization
19 Protocol (MRSPP).

20 The scope of the SI reported herein is restricted to evaluation of the presence of MEC and MC
21 related to historical use of the FUDS prior to transfer. Potential releases of hazardous, toxic, or
22 radioactive wastes (HTRW) are not addressed within the current scope. The intent of the SI is to
23 confirm the presence or absence of MEC and/or associated MC contamination.

24 ***Boardman Air Force Range***

25 This report presents the results of an SI conducted at Boardman Air Force Range (AFR), FUDS
26 property number F10OR0160, located approximately 5.5 miles southwest of Boardman, Oregon,
27 in Morrow County. Boardman AFR was commissioned in 1941 and was used primarily as a
28 practice bombing and gunnery range. A small portion was also reported to be used for the
29 demolition of unserviceable/surplus munitions and small arms tracer testing. Boardman AFR
30 was decommissioned in 1963, following discussions between the Navy, the Department of the
31 Interior (DOI), and the State of Oregon, whereupon an agreement was reached where the Navy
32 would consolidate its needs to the eastern half of the original range and release the western half.
33 The land in the western half was transferred to the State of Oregon, Portland General Electric
34 (PGE), and Morrow County.

35 Technical Project Planning

36 The approach for the SI was developed by Shaw in consultation with site stakeholders. A
37 Technical Project Planning (TPP) meeting conducted in July 2006 was attended by
38 representatives from the USACE Omaha Design Center, USACE Seattle District, Oregon
39 Department of Environmental Quality (ODEQ), Oregon State Police, Portland General Electric,
40 Boardman Agri-Industrial Complex, Inc. (BAIC, Inc.), Threemile Canyon Farms, Inland Land
41 Company, The Nature Conservancy, the Boeing Company, and Shaw. The EPA Region 10 was
42 invited to attend but did not respond. The stakeholders agreed to the approach and identified six
43 areas of concern (AOCs) for further evaluation in the SI as follows: Target No. 1, Target No. 2,
44 Carty Reservoir Bomb Target, Range Complex No. 1, Demolition Area No. 2, and Impact Area.
45 Note that Demolition Area No. 2 and the Impact Area were identified during the TPP. The other
46 four AOCs were previously identified in the Archive Search Report (ASR), ASR Supplement,
47 and the DoD Annual Report to Congress.

48 It was also agreed to utilize existing analytical data collected during the *Boardman AFR FUDS*
49 *Preliminary Assessment/Site Inspection Report (PA/SI)* (Weston, 2004) in the evaluation of
50 Boardman AFR.

51 SI Field Activities

52 SI field activities, conducted in February 2007, included a visual reconnaissance at Target No. 1
53 and the Impact Area to look for evidence of MEC. At the other AOCs, fieldwork was limited to
54 sampling for MC because evidence of MEC was available from previous investigations. Prior to
55 sampling, a limited visual reconnaissance, aided by an all-metal detector, was completed for
56 anomaly avoidance during sampling. The objective of the visual reconnaissance was to observe
57 general conditions and to select sampling locations. Samples were collected from surface soil
58 and sediment.

59 SI Recommendations

60 Results of the SI provide the basis for conclusions and recommendations for further actions at
61 each of the AOCs.

62 *Target No. 1*

63 Based on historical evidence and results from the SI field activities, there is potential for MEC at
64 Target No. 1. Analytical results indicate that all soil metals results are below Boardman AFR
65 background values and no explosives were detected. Groundwater analytical results indicate that
66 metals concentrations are similar to background, with the exception of iron, which was above the
67 background value but below the human health screening value. Perchlorate was not detected in
68 the groundwater sample collected from within the AOC. Based on the potential for MEC, a
69 recommendation for a Remedial Investigation/Feasibility Study (RI/FS) limited to further
70 evaluation of the MEC hazard is made for Target No. 1. Additionally, because all analytical
71 results from samples collected in and around this munitions response site (MRS) were either

72 below background concentrations or screening values, Target No. 1 is recommended for No DoD
73 Action Indicated (NDAI) relative to MC and no additional investigations of any potential MC,
74 chemical contamination, or perchlorate are recommended.

75 *Target No. 2*

76 Based on historical evidence and recent MEC finds, there is potential for MEC at Target No. 2.
77 Analytical results indicate that all soil metals results are below Boardman AFR background
78 values and no explosives were detected. While surface water analytical results indicate that
79 perchlorate is present, the upstream sampling locations have the highest perchlorate
80 concentrations, which indicate that the perchlorate is not from Target No. 2 or any other known
81 FUDS AOC. Based on the potential for MEC, a recommendation for a RI/FS limited to further
82 evaluation of the MEC hazard is made for Target No. 2. Additionally, because all analytical
83 results from samples collected in and around this MRS were either below background
84 concentrations or screening values, Target No. 2 is recommended for NDAI relative to MC and
85 no additional investigations of any potential MC, chemical contamination, or perchlorate are
86 recommended.

87 *Carty Reservoir Bomb Target*

88 Based on historical evidence, there is potential for MEC at Carty Reservoir Bombing Target.
89 Analytical results indicate that all soil and sediment metals analytical results are below
90 Boardman AFR background values and no explosives were detected. Surface water was
91 analyzed for perchlorate only and there was no detection. Based on the potential for MEC, a
92 recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Carty
93 Reservoir Bomb Target. Additionally, because all analytical results from samples collected in
94 and around this MRS were either below background concentrations or screening values, Carty
95 Reservoir Bomb Target is recommended for NDAI relative to MC and no additional
96 investigations of any potential MC, chemical contamination, or perchlorate are recommended.

97 *Range Complex No. 1*

98 Based on historical evidence and results from the SI field activities, there is potential for MEC at
99 Range Complex No. 1. Analytical results indicate that all soil metals results are below
100 Boardman AFR background values and no explosives or perchlorate were detected, indicating no
101 observed adverse impacts from MC at Range Complex No. 1. Based on the potential for MEC, a
102 recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Range
103 Complex No. 1. Additionally, because all analytical results from samples collected in and
104 around this MRS were either below background concentrations or screening values, Range
105 Complex No. 1 is recommended for NDAI relative to MC and no additional investigations of any
106 potential MC, chemical contamination, or perchlorate are recommended.

107 ***Additional Recommendations***

108 Based on historical evidence and conditions observed in the SI, a removal action is not
109 recommended prior to additional investigation.

110 It is recommended that the two AOCs identified during the TPP process, the Demolition Area
111 No. 2 and the Impact Area, be designated as MRSs. If the Demolition Area No. 2 and the Impact
112 Area are identified as MRSs, it is recommended that additional investigations for MEC be
113 completed. Additional investigations for MC are not recommended, as concentrations of MC in
114 samples collected from these two AOCs did not exceed site background or screening values.

115 It is also recommended that areas where MEC has been reported, but are not included in the four
116 MRSs presented above or the two AOCs recommended for as additional MRSs, be further
117 investigated to determine whether additional MEC is present in the vicinity.

118 **MRSPP Scoring**

119 Draft MRSPP scoring was completed for the four identified MRSs. The priority scoring ranges
120 from 1 to 8 (highest to lowest). The draft priority scores for the four MRSs are:

MRS	MRSPP Priority Score
Target No. 1	6
Target No. 2	4
Carty Reservoir Bomb Target	3
Range Complex No. 1	4

121 With the exception of Target No. 1, none of the MRSs presented sufficient risk to human health
122 or the environment from MC to merit valuation under the Health Hazard Evaluation (HHE)
123 MRSPP module. Thus, in all but Target No. 1, the MRSs received the HHE rating of “No
124 Known or Suspected MC Hazard.” Target No. 1 was assigned value under the HHE module due
125 to the presence of iron concentrations above the background values in a groundwater sample
126 collected onsite. Overall, the MRSPP priority scores for the Boardman AFR MRSs reflect the
127 risk of explosive hazards, not chemical contamination at the sites. Note that these MRSPP
128 priority scores are draft and additional review by DoD will be completed.

129 **1.0 Introduction**

130 This Site Inspection (SI) Report presents the results of an SI conducted at the Boardman Air
131 Force Range (AFR) Formerly Used Defense Site (FUDS) located near Boardman, Oregon (OR).
132 Shaw Environmental, Inc. (Shaw) has prepared this report for the U.S. Army Corps of Engineers
133 (USACE) in accordance with Task Order 003, issued under USACE Contract No. W912DY-04-
134 D-0010. Shaw is responsible for conducting SIs at FUDS in the Northwest Region managed by
135 the Omaha District Military Munitions Design Center (NWO) as directed by the Performance
136 Work Statement (Appendix A).

137 The technical approach is based on the *Type I Work Plan, Site Inspections at Multiple Sites,*
138 *NWO Region* (Shaw, 2006a) and the *Formerly Used Defense Sites, Military Munitions Response*
139 *Program, Site Inspections, Program Management Plan* (USACE, 2005).

140 **1.1 Project Authorization**

141 The Department of Defense (DoD) has established the Military Munitions Response Program
142 (MMRP) to address DoD sites suspected of containing munitions and explosives of concern
143 (MEC) or munitions constituents (MC). Under the MMRP, the USACE is conducting
144 environmental response activities at FUDS for the Army, the DoD Executive Agent for the
145 FUDS program.

146 Pursuant to USACE Engineer Regulation (ER) 200-3-1 (USACE, 2004a) and the *Management*
147 *Guidance for the Defense Environmental Restoration Program* (DERP) (Office of the Deputy
148 Under Secretary of Defense [Installations and Environment], September 2001), USACE is
149 conducting FUDS response activities in accordance with the DERP statute (10 USC 2701 et
150 seq.), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980
151 (CERCLA) (42 USC 9601), Executive Orders 12580 and 13016, and the National Oil and
152 Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). As such, USACE
153 is conducting remedial SIs, as set forth in the NCP, to evaluate hazardous substance releases or
154 threatened releases from eligible FUDS.

155 While not all MEC/MC constitute CERCLA hazardous substances, pollutants, or contaminants,
156 the DERP statute provides DoD the authority to respond to releases of MEC and MC, and DoD
157 policy states that such responses shall be conducted in accordance with CERCLA and the NCP.

158 **1.2 Site Name and Location**

159 Boardman AFR, property number F10OR0160, is located approximately 5.5 miles southwest of
160 Boardman, OR, in Morrow County (Figure 1-1). The Boardman AFR is included in the MMRP
161 Inventory in the *Defense Environmental Programs Annual Report to Congress (ARC) Fiscal*
162 *Year 2006* (DoD, 2006), and in the *Archive Search Report (ASR) Supplement, Former*

163 Boardman Air Force Range, Boardman, Oregon (USACE, 2004b), with four identified ranges
 164 and three sub-ranges as follows:

Range Name	Range ID	Approximate Area (acres)	UTM Coordinates* (meters)
Target No. 1	F10OR016001R01	649	N 5063404; E 279733
Target No. 2	F10OR016001R02	649	N 5072555; E 280149
Carty Reservoir Bomb Target	F10OR016001R03	649	N 5061866; E 279539
Range Complex No. 1	F10OR016001R03	9,505	N 5072555; E 280149
INPR Site No. 1	F10OR016001R03-SR01	536	N 5072555; E 280149
Demolition Area	F10OR016001R03-SR02	157	N 5072555; E 280149
Turret Gunnery Training Range	F10OR016001R03-SR03	9,443	N 5072555; E 280149

165 *Coordinates for the ranges are in Universal Transverse Mercator (UTM) Zone 11N, NAD 1983.

166 Of the 649 total acres reported for the Carty Reservoir Bomb Target, the ASR Supplement
 167 indicates 325 acres were on land and 324 acres were water acres. In addition to the four ranges
 168 and three sub-ranges, two other areas that were not identified in the range inventory, are
 169 evaluated in this SI. The two areas including coordinates are as follows:

- 170 • Demolition Area No. 2 N 5065433; E 284894
- 171 • Impact Area N 5059240; E 282333

172 These two additional areas were added in the *Technical Project Planning (TPP) Memorandum,*
 173 *Boardman Air Force Base* (Shaw, 2006b) following discussions with stakeholders who indicated
 174 the presence of munitions debris (MD) at these locations.

175 **1.3 Purpose, Scope, and Objectives of the Site Inspection**

176 The primary objective of the MMRP SI is to determine whether a FUDS project warrants further
 177 response action related to risks posed by MEC or MC. The SI collects the minimum amount of
 178 information necessary to make this determination, as well as it (i) determines the potential need
 179 for a removal action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking
 180 System (HRS) scoring by Environmental Protection Agency (EPA); and (iii) collects data, as
 181 appropriate, to characterize the release for effective and rapid initiation of the Remedial
 182 Investigation and Feasibility Study (RI/FS). An additional objective of the MMRP SI is to

183 collect the additional data necessary to complete the Munitions Response Site Prioritization
184 Protocol (MRSPP).

185 The scope of the SI reported herein is restricted to evaluation of the presence of MEC or MC
186 related to historical use of the FUDS prior to transfer. Potential releases of hazardous, toxic, or
187 radioactive wastes (HTRW) are not addressed within the current scope. The intent of the SI is to
188 confirm the presence or absence of contamination from MEC and/or MC. The general approach
189 for each SI is to conduct records review and site reconnaissance to evaluate the presence or
190 absence of MEC, and to collect samples at locations where MC might be expected based on the
191 conceptual site model (CSM). The following decision rules are used to evaluate the results of
192 the SI:

193 **Is No DoD Action Indicated (NDAI)?** An NDAI recommendation may be made if:

- 194 • There is no indication of MEC;
195 and
- 196 • MC contamination does not exceed screening levels determined from TPP.

197 **Is an RI/FS warranted?** An RI/FS may be recommended if:

- 198 • There is evidence of MEC hazard. MEC hazard may be indicated by direct
199 observation of MEC during the SI, by indirect evidence (e.g., a crater potentially
200 caused by impact of unexploded ordnance [UXO]), or by a report of MEC being
201 found in the past without record that the area was subsequently cleared;
202 or
- 203 • MC contamination exceeds screening levels determined from TPP.

204 **Is a removal action warranted?** A removal action may be needed if:

- 205 • High MEC hazard is identified. Shaw will immediately report any MEC findings
206 so that USACE can determine the hazard in accordance with the MRSPP. An
207 example of a high hazard would be finding sensitive MEC at the surface in a
208 populated area with no barriers to restrict access;
209 or
- 210 • Elevated MC risk is identified. Identification of a complete exposure pathway
211 (e.g., confirming MC concentrations above health-based risk standards in a water
212 supply well) would trigger notification of affected stakeholders. Data would be
213 presented at a second TPP meeting regarding the possible need for a removal.

214 For purposes of applying these decision rules, USACE has provided guidance that evidence of
215 MEC will generally be a basis of recommending RI/FS. Evidence of MEC may include
216 confirmed presence of MEC from historical sources or SI field work, or presence of MD.

217 **1.4 Munitions Response Site Prioritization Protocol**

218 The MRSPP was published as a rule on October 5, 2005 (70 FR 58028). This rule implements
219 the requirement established in section 311(b) of the National Defense Authorization Act for

220 Fiscal Year 2002 for the DoD to assign a relative priority for munitions responses to each
221 location in the DoD inventory of defense sites known or suspected of containing UXO, discarded
222 military munitions, or MC (70 FR 58016).

223 The MRSPP uses three modules to evaluate the hazards on these sites. The modules include the:

- 224 1. Explosive Hazard Evaluation (EHE) module, that evaluates relative risks of explosive
225 hazards;
- 226 2. Chemical Warfare Material Hazard Evaluation (CHE) module, that evaluates hazards
227 related to the physiological effects of chemical warfare material; and
- 228 3. Health Hazard Evaluation (HHE) module, that evaluates relative risk to human health
229 and the environment from MC and any incidental non-munitions related contaminants.

230 A munitions response site (MRS) receives a separate numerical score and priority ranking under
231 each module. There are three alternative scoring outcomes for each module, including: 1)
232 “Evaluation Pending”; 2) “No Longer Required” (e.g. a response action was already taken); and
233 3) “No Known or Suspected Hazard.” Ultimately, the MRS is assigned one site-wide priority
234 derived from the module specific scores and priorities.

235 Draft MRSPP scoring sheets for the MRSs identified in this SI Report are included in Appendix
236 K. The MRSPP scoring will be updated on an annual basis to incorporate new information.

237 *2.0 Property Description and History*

238 The setting, history, and use of Boardman AFR are described in the following sections. Unless
239 otherwise referenced, this information is taken from the ASR (USACE, 1997).

240 *2.1 Historical Military Use*

241 Boardman AFR (Figure 2-1) was used primarily as a practice bombing and gunnery range.
242 According to the ASR, beginning in 1941 and continuing through 1943, the United States Army
243 Air Corps acquired 95,985.51 acres through purchase of private land and transfer of Department
244 of the Interior (DOI) land for a practice bombing and gunnery range. Throughout the World War
245 II years, it was used for bombing practice by the Walla Walla Army Air Base. After World War
246 II, the Army Air Corps categorized the bombing range as surplus land and by 1946 discussions
247 were held concerning authorizing livestock grazing on the inactive range. However, in 1948, the
248 lands were withdrawn from surplus and the Air Force used the range until to 1960. Renamed the
249 Boardman Precision Bombing Range, the range was configured with five targets and exclusion
250 areas.

251 The 57th Air Division, Fairchild Air Force Base, assumed responsibility, control, and utilization
252 of the former Boardman AFR between 1952 to 1957. Records indicate that a “moving 20-
253 millimeter (mm) target gunnery range, with three mounted B-36 turrets, was added in 1952. The
254 gunners fired at remote controlled aerial target drones (OC aircraft) under daylight and night
255 conditions. Practice bombing was also occurring during this time. Target No. 2 was the
256 principal bomb target during this time.”

257 The historical records do not indicate how the area was used between 1956 and 1958. However,
258 in December 1958, the Air Force granted the Department of the Navy permission to use the
259 bombing range site as a high altitude bombing range. Also, in 1960, the Umatilla Army
260 Ordnance Depot was granted a permit to use two small areas for the destruction of unusable
261 munitions and small arms ammunition tracer testing.

262 In 1960, once again the Air Force placed the former Boardman AFR in an excess category and
263 transferred 37,320.31 acres to the DOI, 58,372.9 acres to the Navy, and 290 acres to the USACE.

264 In 1963, following discussions between the Navy, the DOI, and the State of Oregon, an
265 agreement was reached where the Navy would consolidate its needs to the eastern half of the
266 original range and release the western half. This allowed for single contiguous land use by the
267 Navy and DOI. The Air Force then passed ownership on to the State of Oregon and other
268 entities.

269 **2.2 Munitions Information**

270 The types of munitions used at Boardman AFR would have included 100-pound (lb) practice
271 bombs, 2- and 4-lb incendiary bombs, 2.25-inch practice rockets, fragmentation bombs, and
272 conventional small arms (.50-caliber or less) and 20-mm ball ammunition. Table 2-1 contains a
273 list of the munitions and associated MC reportedly used at the Areas of Concern (AOCs). Metals
274 and explosives comprise the principle MC that could come from the types of munitions used at
275 Boardman AFR.

276 **2.3 Ownership History**

277 Originally the former Boardman AFR occupied approximately 95,985 acres. In 1960, the Air
278 Force declared the property surplus and portions of the bombing range were transferred to the
279 DOI, USACE, and Department of the Navy (Navy). The parcels transferred to the DOI and the
280 Navy were aligned in a checkerboard pattern. In 1963, the area was split into two parcels, with
281 the Navy controlling the eastern portion and the State of Oregon owning the western portion.
282 The USACE maintained ownership of a small parcel (approximately 290 acres) along the
283 Columbia River. After the property redistribution, the former Boardman AFR FUDS occupies
284 an area of approximately 48,976 acres.

285 Following closure of the Boardman AFR, the land was transferred from the Air Force to the
286 State of Oregon, Portland General Electric, and Morrow County. Currently the property within
287 the former Boardman AFR FUDS is owned by the City of Boardman, Morrow County,
288 Boardman Agri-Industrial Complex, Inc. (BAIC, Inc.), and Portland General Electric (PGE).
289 Presently BAIC, Inc. leases land to PGE, the Boeing Company, Inland Land Company, and The
290 Nature Conservancy. Figure 2-2 shows the area surrounding Boardman AFR from an aerial
291 photograph perspective. Parcel ownership within the identified range areas is shown on Figure
292 2-3. The property owners are identified by an index number rather than a name on the figures.
293 The property owner name is available on request from the USACE Seattle District office.

294 **2.4 Physical Setting**

295 **2.4.1 Topography and Vegetation**

296 The topography of the former Boardman AFR slopes gently up from the Columbia River
297 (approximately 310 feet [ft] elevation) near the northern boundary of the FUDS to the southern
298 boundary at about 1,000 ft elevation (Figure 2-4).

299 The native vegetation of the Boardman AFR is shrub-steppe, with wild grasses and small brush
300 including sage and grey rabbit bush.

301 **2.4.2 Land Use**

302 The FUDS is currently used for irrigated agricultural and grazing purposes; for farming of
303 potatoes, onions, and other vegetables; as a restricted antennae test range operated by the Boeing
304 Company; as a fossil fuel power generating plant owned by PGE; as a habitat management area

305 for the protection of the Washington Ground Squirrel managed by The Nature Conservancy; and
306 as an airstrip operated and maintained by the Morrow County Port Authority.

307 *2.4.3 Nearby Population*

308 The community nearest the former Boardman AFR is Boardman, OR, with an estimated
309 population of 2,855 (U.S. Census, 2000) (Figure 2-5). Morrow County has an estimated
310 population of 10,995 or 5.4 people per square mile (U.S. Census, 2000). Several hundred
311 residences and numerous farms are located within a two mile radius of the FUDS. Two schools
312 are located approximately 2 miles northeast of the FUDS (Figure 2-6). Based on the 2000 U.S.
313 Census, the estimated population within a 4-mile radius of the Boardman AFR FUDS property
314 boundary is 3,432 persons. The estimated numbers of housing units and households within a 4-
315 mile radius are 1,162 and 1,049, respectively.

316 The estimated population within a 2-mile radius for each of the four ranges listed in the 2006
317 ARC (DoD, 2006) are: Target No 1 – 0 persons, Target No. 2 – 0 persons, Carty Reservoir
318 Bomb Target – 0 persons, and Range Complex No. 1 – 63. There are no schools or other critical
319 assets located within a 2-mile radius of any of these four ranges.

320 *2.4.4 Climate*

321 The climate in the Boardman area is semi-arid. It is warm and dry in the summer and cool and
322 dry in the winter. The wettest month is generally December and with the driest month is July.
323 The highest monthly average maximum temperature is 89.7 degrees Fahrenheit (°F) in July and
324 the lowest monthly average maximum temperature is 27 °F in January. The average annual
325 precipitation is 8.41 inches per year.

326 *2.4.5 Area Water Supply*

327 Local drinking water is obtained from individual domestic water wells at residences. Well
328 depths range from 80 to 300 ft., and are typically completed in the basalt aquifer. The City of
329 Boardman obtains water from a well located adjacent to the Columbia River. Within the
330 Boardman AFR FUDS there is one water supply well for the PGE fossil fuel power generating
331 plant. This well serves both industrial and drinking water needs for the power plant. Irrigation
332 water is obtained either from groundwater wells or the Columbia River. Figure 2-7 shows
333 groundwater wells in the vicinity of Boardman AFR.

334 *2.4.6 Surface Water*

335 The former Boardman AFR is located within the Middle Columbia-Lake Wallula Watershed.
336 Figure 2-8 shows the regional surface water drainages. Carty Reservoir is located within the
337 former Boardman AFR and portions of the Target No. 1 and Carty Reservoir AOCs are
338 submerged under the reservoir. Carty Reservoir was created when PGE dammed a portion of
339 Sixmile Canyon Creek in 1977. The reservoir level is maintained using water pumped from the
340 Columbia River. There is no surface water outlet from the reservoir. Sixmile Canyon Creek

341 traverses across the western portion of the former Boardman AFR. The creek is not known to
342 support fisheries. Historically the creek was dry except during periods of heavy rain and snow
343 melt. With the creation of Carty Reservoir and the resulting groundwater mound, water now is
344 present in Sixmile Canyon Creek. The creek flows into the Columbia River, which is a major
345 river that supports both federally and state threatened and listed species.

346 **2.4.7 Geologic and Hydrogeologic Setting**

347 The former Boardman AFR lies within the Columbia Basin Subprovince of the Columbia
348 Intermontane Physiographic Province.

349 **2.4.7.1 Bedrock Geology**

350 The bedrock beneath the Boardman AFR consists of basalt flows of the Columbia River Basalt
351 Group. Individual basalt flows range in thickness from a few tens of feet to several hundred feet.
352 Interflow zones between individual flows may contain fine-grained sediments and are productive
353 water-bearing zones, frequently producing high volumes of water for irrigation purposes. A
354 layer of alluvium overlies the basalt flows and ranges in thickness from absent up to 70 feet.

355 **2.4.7.2 Overburden Soils**

356 The soils at the former Boardman AFR are composed of four different soil groups: the Quincy
357 loamy fine sand, the Koehler loamy fine sand, the Hezel loamy fine sand, and the Tauton fine
358 sandy loam.

359 **2.4.7.3 Hydrogeology**

360 Groundwater occurs within two distinct aquifers, the alluvial aquifer and the Columbia River
361 Basalt aquifer system. Based on documentation received from PGE and included in
362 *Hydrogeology, Groundwater Chemistry, and Land Use in the Lower Umatilla Basin*
363 *Groundwater Management Area* (ODEQ, 1995), prior to construction of Carty Reservoir by PGE
364 in 1977 only thin occurrences of groundwater within the alluvium were reported and Sixmile
365 Canyon Creek was dry. Leakage from Carty Reservoir has resulted in a perched groundwater
366 zone above the uppermost basalt flow. Water levels in the alluvium were observed to rise up to
367 30 ft (40 ft below ground surface [bgs]) in wells constructed near Carty Reservoir. The water
368 levels have now stabilized. There appears to be a groundwater mound beneath Carty Reservoir.
369 Groundwater flow direction for both the alluvial aquifer and the Columbia River Basalt aquifer
370 system is to the north toward the Columbia River.

371 There are no private irrigation wells, two industrial water source wells and several monitoring
372 wells located within the former Boardman AFR (mostly associated with the PGE fossil fuel
373 power plant).

374 **2.4.8 Sensitive Environments**

375 The ranges and other areas do qualify as Important Ecological Places (IEPs) or sensitive
376 environments as defined by USACE (2006) or EPA (1997) and shown in Table 2-2. An

377 exception to this is Target No. 2 which is used entirely for agricultural purposes and does not fit
378 the definition of an IEP. Portions of the ranges and other areas of interest at the Boardman AFR
379 addressed by this SI are used for agricultural and industrial purposes as well as a wildlife
380 management area for the protection of the Washington Ground Squirrel by The Nature
381 Conservancy under a multi-species candidate conservation agreement (Figure 2-6). The
382 Washington Ground squirrel is a state listed endangered species and a federal candidate species.
383 Portions of Boardman AFR are within the Threemile Canyon Farms Multi-Species Candidate
384 Conservation Agreement with Assurances area created by the U.S. Fish and Wildlife Service in
385 cooperation with the Oregon Department of Fish and Wildlife, The Nature Conservancy, and
386 PGE. The agreement contains a strategy for managing lands used by the Washington Ground
387 Squirrel and to preclude the need to federally list the species as threatened or endangered. These
388 lands are managed by The Nature Conservancy and are shown on Figure 2-6.

389 *2.5 Previous Investigations for MC and MEC*

390 During the ASR site visit, MD was reported within Target No. 2, Carty Reservoir Bomb Target,
391 and INPR Site No. 1. A range clearance was reportedly completed in the 1954-1955 timeframe
392 (USACE, 1997, Appendix I).

393 MEC has been reported recently as March 2006 at Target No. 2 AOC. These reports were made
394 following the discovery of six AN-M57 General Purpose (GP) practice bombs (capable of
395 detonating) at a local recycler. These six bombs and fifteen additional AN-M57 GP practice
396 bombs recovered from a pile accumulated from Target No. 2 were detonated by a Navy
397 explosive ordnance disposal (EOD) team at the nearby Navy Bombing Range. According to
398 reports from the Navy EOD the bombs were training bombs. The bombs had been gathered from
399 agricultural fields and placed in a pile by the agricultural workers.

400 MEC and MD were reported to the Oregon State Police in the June 2006 at Demolition Area No.
401 2. The MEC and MD consisted of an M83 Butterfly Bomb, M66 or M68 Base Detonating Fuze
402 for 75-mm or 90-mm projectiles, and a 100-lb GP Bomb base plate. The Oregon State Police
403 Bomb Squad destroyed these munitions.

404 *2.5.1 Archives Search Report*

405 The USACE completed an ASR in 1997, which compiled available information for the former
406 Boardman AFR with emphasis on types and areas of ordnance use and disposal (USACE, 1997).

407 *2.5.2 ASR Supplement*

408 The USACE completed an ASR Supplement in 2004 identified specific ranges (Target No. 1,
409 Target No. 2, Carty Reservoir Bomb Target, and Range Complex No. 1 [INPR Site No. 1,
410 Demolition Area, and Turret Gunnery Training Range]) (USACE, 2004b).

411 **2.5.3 Other Investigations**

412 The USACE prepared an Inventory Project Report (INPR) for the former Boardman AFR in
413 September 1992, in which a potential hazard from UXO at the FUDS was identified.

414 A Risk Assessment Code (RAC) scoring was conducted by the USACE in 2004 for the ranges
415 identified in the ASR Supplement. Possible scores range from 5 (low risk) to 1 (high risk). The
416 following table summarizes the RAC determinations for the ranges and indications of whether
417 MEC has been found at these AOCs since the end of training activities, as summarized in the
418 ASR Supplement:

AOC	RAC Score	MEC Found
Target No. 1	4	No
Target No. 2	4	Yes
Carty Reservoir Bomb Target	4	Yes
Range Complex No. 1	4	Yes

419 Weston Solutions, Inc. (Weston) conducted a Preliminary Assessment/Site Inspection (PA/SI)
420 for the EPA at the former the former Boardman AFR in 2004. The results of the investigation
421 are presented in *Boardman AFR FUDS Preliminary Assessment/Site Inspection Report* (Weston,
422 2004). The scope of the PA/SI largely paralleled the scope of this SI. However, a greater
423 emphasis was placed on determining the presence of perchlorate in soil and groundwater within
424 and around the Boardman AFR FUDS. To the extent possible, this MMRP SI used data
425 previously collected for the PA/SI. Additional reconnaissance and sampling activities were
426 planned only to address specific data needs identified during the TPP. The PA/SI collected
427 samples from soil, sediment, surface water, and groundwater. Table 2-3 lists the samples
428 collected and analyses completed. Samples were analyzed for Target Analyte List (TAL) metals,
429 explosives, and perchlorate. The PA/SI sample locations are shown on Figure 2-9. Note that
430 many of the groundwater samples were collected off FUDS property.

431 The collection and analysis of environmental samples for perchlorate during the PA/SI were
432 performed in accordance with an EPA Region 10 approved Sampling and Quality Assurance
433 Plan (SQAP) prepared by Weston. Environmental samples analyzed for perchlorate employed
434 EPA Method 314.0 (Ion Chromatography) (IC). Additionally, several surface water and
435 groundwater samples employed a combination of EPA Method 314.0 and SW-846 Method
436 8321A Modified (Liquid Chromatography/Mass Spectroscopy). Perchlorate analyses by EPA
437 Method 314.0 are susceptible to false positives because of the non-specificity of the conductivity
438 detector. Therefore, all perchlorate “hits” (detects) reported by EPA Method 314.0 may be

439 biased high because of positive matrix interference. In cases where the sample was analyzed by
 440 both EPA Method 314.0 and SW-846 Method 8321A Modified, Shaw reported the perchlorate
 441 result from the EPA SW-846 Method 8321A Modified analysis. This is because EPA SW-846
 442 Method 8321A Modified provides greater method sensitivity and minimizes the possibility of
 443 false positives. The table below summarizes perchlorate results reported by both EPA Method
 444 314.0 and SW-846 Method 8321A Modified, and Weston’s calculated relative percent difference
 445 (RPD) values. A low RPD value indicates good reproducibility or precision between perchlorate
 446 results analyzed by both EPA Method 314.0 and SW-846 Method 8321A Modified.

Sample ID	EPA Method 314.0 Result (µg/L)	EPA SW-846 Method 8321A Modified Result (µg/L)	Relative Percent Difference (RPD)
GW-DW002	< 1.0	0.46	NC
GW-MW007	3.84	4.2	9
GW-MW012	<1.0	1.1	NC
GW-MW017	20.7	18	14
GW-MW20	9.73	9.8	1
GW-MW022	5.85	5.9	1
GW-MW0023	2	2.5	22
SW-SC001	<1.0	0.32	NC

447 µg/L = micrograms per liter
 448 < = concentration less than indicated quantity
 449 EPA = U.S. Environmental Protection Agency
 450 NC = not calculated
 451  = shaded samples indicate samples from locations off-site of Boardman AFR FUDS

452 Although perchlorate results analyzed by EPA Method 314.0 may be biased high, the data were
 453 collected and reported in accordance with EPA guidance and are assumed to be of acceptable
 454 quality. The reported analyte “detections” may be used for the purpose of comparing analyte
 455 concentrations against screening levels. All perchlorate results reported above the laboratory’s
 456 EPA Method 314.0 detection limit for the PA/SI are below Shaw’s SI human health screening
 457 value of 24.0 micrograms per liter (µg/L) (DoD Perchlorate Screening Value) and ecological
 458 screening values of 35,000 µg/L (Los Alamos National Laboratory [LANL], 2005) and 9,300
 459 µg/L (Dean et al., 2004).

460 The PA/SI report concluded that no samples contained significant (three times the PA/SI
 461 background concentration) concentrations of metals and no explosive compounds were detected.
 462 Perchlorate was detected in all five surface water samples from Sixmile Canyon Creek, with
 463 concentrations ranging between 0.32 µg/L and 7.49 µg/L. Perchlorate was not detected in the
 464 surface water sample collected from Carty Reservoir. Perchlorate was detected in 18 of 25
 465 groundwater samples collected from within and surrounding Boardman AFR and ranged in
 466 concentration between 0.46 µg/L and 20.7 µg/L. Perchlorate was detected in two of the four

467 samples collected from wells located on the Boardman AFR at concentrations of 2.5 µg/L and
468 3.56 µg/L. None of the perchlorate concentrations detected in samples collected during the
469 PA/SI from within and surrounding Boardman AFR exceed the DoD action level for perchlorate
470 of 24 µg/L or the ecological screening values of 35,000 µg/L (LANL, 2005) and 9,300 µg/L
471 (Dean et al., 2004).

472 Additional groundwater and surface water sampling has been completed in the lower Umatilla
473 Basin by the EPA, ODEQ, and the Navy confirming the presence of perchlorate in groundwater
474 and surface water throughout the Lower Umatilla Basin, within which the former Boardman
475 AFR FUDS resides (ODEQ, 2005). Locations with perchlorate detections occur both cross (up
476 to tens of miles) and down gradient of the former Boardman AFR. The source or sources of the
477 perchlorate have not been identified and the ODEQ and EPA are continuing investigations of
478 perchlorate impacts in the Lower Umatilla Basin.

479 *2.6 Other Land Uses that May Have Contributed to Contamination*

480 Agricultural use of pesticides and herbicides could have also contributed to media contamination
481 in particular relative to perchlorate. Perchlorate containing compounds have been documented in
482 historical uses of fertilizers and herbicides. In addition, arid climate soils have been found to
483 contain naturally occurring perchlorate (ITRC, 2005)

484 *2.7 Past Regulatory Activities*

485 There have been no regulatory actions with respect to MEC or MC reported for the site.

486 *2.8 Previous MEC Finds*

487 MEC finds, cited in the 1997 Boardman ASR and other more recent finds, are listed on Table 2-4
488 and shown on Figure 2-10. Several of the MEC finds are not located within defined AOCs.
489 These finds may be the result of errant bomb releases or the MEC may have been moved to the
490 location from another within a known AOC.

491 3.0 *SI Tasks and Findings*

492 SI tasks conducted for this FUDS property involved compiling and reviewing historical reports
493 and information, using this information in the subsequent TPP and overall SI process. Following
494 the TPP meeting, the *Final Site-Specific Work Plan, Boardman Air Force Range (SSWP)* (Shaw,
495 2007) was prepared to define the SI field activities necessary to collect the information needed to
496 address the data gaps and data quality objectives (DQOs). Field work was conducted at the
497 Boardman AFR between February 26 and 28, 2007.

498 3.1 *Technical Project Planning*

499 TPP involved compiling and reviewing historical reports and information to identify data gaps
500 and develop a path forward. The TPP meeting for the former Boardman AFR was held at the
501 Port of Morrow Riverfront Center in Boardman, Oregon on July 20, 2006. Representatives from
502 the USACE – Omaha Design Center and Seattle District, ODEQ, Oregon State Police, PGE,
503 BAIC Inc., Threemile Canyon Farms, Inland Land Company, The Nature Conservancy, the
504 Boeing Company, and Shaw were in attendance. EPA Region 10 was invited to attend but did
505 not respond.

506 Shaw reviewed the Boardman AFR information and presented a summary of the FUDS and the
507 proposed approach for the SI, addressing MEC and MC sampling. All parties were in general
508 agreement with the approach, but reserved judgment until the draft TPP Memorandum was
509 issued. The property owners and lessees agreed to act on the requests for rights of entry (ROE)
510 after they received the draft TPP Memorandum.

511 Based on the TPP meeting and subsequent evaluation of data obtained at the meeting, six AOCs
512 are identified and addressed in the TPP Memorandum (Shaw, 2006b) and this report. The six
513 AOCs are Target No. 1, Target No. 2, Carty Reservoir Bomb Target, Range Complex No. 1
514 (includes INPR Site No. 1, Demolition Area, and Turret Gunnery Training Range), Demolition
515 Area No. 2, and the Impact Area. Note that the Impact Area was identified after the TPP
516 meeting, following evaluation of aerial photos.

517 TPP meeting results were documented in the TPP Memorandum (Shaw, 2006b), which was
518 issued final on November 27, 2006 after incorporating comments from the stakeholders. The
519 proposed technical approach was defined in the SSWP (Shaw, 2007), which was issued final on
520 February 8, 2007 after incorporating comments from the stakeholders. A more complete
521 discussion of the TPP meeting is contained in TPP Memorandum provided as Appendix B.

522 Specific discussions during the meeting included:

523 **AOCs:** There was agreement on the AOCs presented: Target No. 1, Target No. 2, Carty
524 Reservoir Bomb Target, Range Complex No. 1 (INPR Site No.1, Demolition Area, and Turret
525 Gunnery Training Range). Demolition Area No. 2 was identified during the meeting. The SI
526 AOCs are shown on Figure 3-1. Note that the boundary for Demolition Area No. 2 is dashed
527 because the extent of the AOC has not been verified. The dashed boundary does include the
528 known extent of demolition craters observed on aerial photography.

529 Potential AOC(s) were discussed based on information provided by The Nature Conservancy
530 where MEC or MD have been located in areas within the FUDS boundary south of Demolition
531 Area No. 2. Additional air photo review of this area is warranted along with evaluation of
532 materials (topographic maps with MEC and MD locations) provided by The Nature Conservancy
533 on lands they manage. Following review of data obtained at the TPP Meeting from The Nature
534 Conservancy, an additional AOC, the Impact Area, was added. The extent of the Impact Area is
535 not known and therefore no boundary is placed on Figure 3-1 or other figures presented in this
536 report.

537 A firing target for the Turret Gunnery Training Range, which is part of Range Complex No. 1,
538 was noted by a representative of The Nature Conservancy as being within the FUDS boundary.
539 He stated that the target was an old car, making it a potential sampling location for projectiles.
540 The car is no longer present at the site.

541 **Property Ownership:** Ownership was clarified in the meeting. Much of the property is owned
542 by BAIC, Inc., which leases the area for farming, grazing, resource management, and scientific
543 research. Lessees include Inland Land Company, Threemile Canyon Farms, the Boeing
544 Company, The Nature Conservancy, and PGE.

545 **Air Photo Imagery:** ODEQ has 2006 imagery available, which they provided following the
546 meeting.

547 **Sampling:** ODEQ would like to have one of the samples collected from Target No. 1 and Carty
548 Reservoir Bomb Target also analyzed for explosives. The rationale is to demonstrate that no
549 explosives, other than black powder, were used at either of these targets.

550 **Background Sampling:** ODEQ agreed to provide available soil data from area (that may be
551 used as background soil data). ODEQ provided background data, and these data were reviewed
552 for applicability and completeness. The data were mostly based on x-ray fluorescence analytical
553 methods and reported as oxide percentages. X-ray fluorescence analytical methods do not
554 produce data that are directly comparable to methods used in this SI and were not used to
555 develop background concentrations.

556 As discussed during the TPP meeting and documented in the TPP Memorandum (Shaw, 2006b),
557 the following project objectives and DQOs were developed.

558 **Objective 1: Determine if the site requires additional investigation or can be recommended**
559 **for NDAI based on the presence or absence of MEC.**

560 DQO #1 – Utilizing trained UXO personnel and handheld all-metal detectors, a visual
561 reconnaissance survey of Target No. 1 and the Impact Area, consisting of four transects each,
562 will be conducted to identify physical evidence to indicate the presence of MEC (e.g., MEC on
563 the surface and MD). The visual search will consist of a meandering path within the primary
564 target area. The following decision rules will apply:

- 565 • If no evidence of MEC (non-small arms, MD, or magnetic anomalies was found during
566 prior investigations and none is observed during SI visual reconnaissance, the site will be
567 considered a potential candidate for NDAI with respect to MEC hazard.
- 568 • If MEC is not found, but isolated MD or magnetic anomalies were identified during prior
569 investigations or are identified during SI visual reconnaissance, the site will be
570 considered a potential candidate for NDAI with respect to MEC hazard.
- 571 • If MEC was found and/or if abundant or concentrated areas of MD or magnetic
572 anomalies were observed during prior investigations or during SI visual reconnaissance,
573 the site will be considered a potential candidate for further investigation with respect to
574 MEC hazard.
- 575 • If any evidence is identified that is inconsistent with the CSM for the site (e.g., if MD
576 indicating the potential use of high explosive [HE] munitions at a site for which the CSM
577 was based on practice munitions), the above decision rules will be revised appropriately.
- 578 • If there is indication of an imminent MEC hazard, the site may be recommended for a
579 removal action.

580 DQO #2 – Decision for recommending proceeding to RI with respect to MEC can be made for
581 Target No. 2, Carty Reservoir Bomb Target, Range Complex No. 1, and Demolition Area No. 2.

582 **Objective 2: Determine if the site requires additional investigation or can be recommended**
583 **for NDAI based on the presence or absence of MC above screening values.**

584 DQO #3 – Soil samples will be collected and analyzed as proposed in the SSWP (Shaw, 2007) at
585 Target No. 1, Target No. 2, Carty Reservoir Bomb Target, the Range Complex No. 1,
586 Demolition Area, Demolition Area No. 2, and the Impact Area. Analytical results will be
587 compared to screening values for human health and ecological risk assessment and to
588 background and ambient samples collected during the PA/SI and ODEQ supplied soil
589 background data set for naturally occurring substances (note that additional samples were
590 identified for the Turret Gunnery Training Range following a reviewer comment). The
591 following decision rules will apply:

- 592 • If sample results are less than background, or greater than background and less than
593 human health and ecological screening values, the site will be recommended for NDAI
594 relative to MC.

- 595 • If sample results exceed both human health screening values and background values, the
596 site will be recommended for additional investigation.
- 597 • If sample results do not exceed human health screening values but do exceed both
598 ecological screening values and background values, additional evaluation of the data will
599 be conducted in conjunction with the stakeholders to determine if additional investigation
600 is warranted.

601 **Objective 3: Obtain data required for HRS scoring.**

602 Data required for HRS scoring are identified in the HRS Data Gaps worksheet.

603 **Objective 4: Obtain data required for MRSPP ranking.**

604 Data required for MRSPP ranking are identified in the MRSPP worksheet.

605 **3.2 Additional Records Research**

606 **3.2.1 Coordination with State Historic Preservation Office**

607 The Oregon State Historic Preservation Office (SHPO) was contacted to determine if there are
608 any areas of cultural or archaeological significance on FUDS property that could be impacted by
609 field activities or future activities. The SHPO responded that while known archeological sites
610 are located within the project boundaries, none of the sites is within an area proposed for
611 sampling. Two general areas were identified to be within two of the sections contained in Target
612 No. 1 and Carty Reservoir Bomb Target AOCs. In addition, a 7-mile stretch of the Oregon Trail
613 crosses the extreme southern portion of the former Boardman AFR and is considered a high
614 potential segment for archeological resources (Oregon Parks and Recreation Department [OPRD],
615 2006; Appendix C).

616 The USACE Seattle District contacted the Confederated Tribes of the Umatilla Indian
617 Reservation (CTUIR) concerning SI field activities. It was agreed that if any items of cultural
618 significance were identified during field activities, the CTUIR Cultural Resources organization
619 would be notified promptly.

620 **3.2.2 Coordination with Natural Resources Offices**

621 The Oregon Department of Fish and Wildlife (ODFW) was contacted to determine if there are
622 threatened or endangered species that could be impacted by field activities or future activities at
623 the former Boardman AFR. The ODFW indicated that only the Washington Ground Squirrel
624 would be potentially impacted. They recommended that the field team work closely with The
625 Nature Conservancy, who manages the wildlife recovery area on the FUDS, to avoid impacts
626 (ODFW, 2007; Appendix C).

627 **3.2.3 Historical Aerial Photographs**

628 Historical aerial photographs from 1958 and 1965 were reviewed prior to preparation of this SI.
629 The review confirmed the locations of AOCs addressed in this SI. Copies of historical aerial
630 photographs are provided in Appendix L.

631 The most recent aerial photography is from 2006. Based on a review of the most recent aerial
632 photography coverage, the estimated numbers of buildings within a 2-mile radius of the ranges
633 listed in the 2006 ARC are: Target No. 1 – 54 buildings, Target No. 2 – 11 buildings, Carty
634 Reservoir Bomb Target – 54 buildings, and Range Complex No. 1 – 79 buildings (DoD, 2006).

635 **3.2.4 Environmental Database Search**

636 A search of available environmental records was conducted by Environmental Data Resources,
637 Inc. (EDR) (2006). The government records search met the requirements of ASTM Standard
638 Practice for Environmental Site Assessments (ASTM, 2006). Search results indicated the
639 Boardman AFR was included in several databases including:

- 640 • Formerly Used Defense Sites
- 641 • Oregon Environmental Cleanup Site information System
- 642 • Facility Index System/Facility Registry System

643 The AOCs did not appear on mapped sites in known federal, state, or local ASTM or ASTM
644 Supplemental databases (Appendix L). There are 12 Resource Conservation and Recovery Act-
645 Small Quantity Generators in the vicinity of the AOCs (not within the AOC acreages).

646 Additional information on the databases searched and the results for surrounding properties is
647 included in the EDR report found in Appendix L.

648 **3.2.5 Rights of Entry**

649 Prior to mobilizing to the site, the Project Manager for the USACE Seattle District office
650 obtained the ROE for the property where the SI field activities were performed.

651 **3.3 Field Work**

652 SI field activities, conducted the week of February 26, 2007, included visual reconnaissance,
653 collection of surface soil and sediment samples. The following conditions were recorded in the
654 field log book (Appendix D) and/or by digital photographs (Appendix E):

- 655 • Presence or absence of evidence of MEC,
- 656 • Changes, if any, in sample location because of field constraints,
- 657 • Vegetative cover, and
- 658 • Presence or absence of water for sediment samples, and other conditions encountered that
659 impacted sample collection.

660 **3.4 Sampling and Analysis**

661 Samples were collected and analyzed in accordance with the SSWP (Shaw, 2007) using the
662 standard operating procedures (SOPs) from the *Type I Work Plan* (Shaw, 2006a). Table 3-1
663 summarizes the soil and sediment sampling completed at Boardman AFR. Laboratory analysis
664 was performed by GPL Laboratories of Frederick, Maryland using methods defined in the

665 SSWP. Analytical results are provided in Appendix F. Samples were analyzed for metals using
666 EPA SW-846 Method 6020A and explosives using EPA SW-846 Method 8330A.

667 **3.5 Laboratory Analysis and Data Quality Review**

668 Laboratory analysis was performed by GPL Laboratories of Frederick, Maryland, using methods
669 defined in the SSWP. Analytical results are provided in Appendix F.

670 The data review process presented in this report compares sample results to pre-established
671 criteria referenced in the Sampling and Analysis Plan (Shaw, 2006a, Appendix E) to confirm that
672 the data are of acceptable technical quality. GPL Laboratories, LLLP (GPL) provided Shaw with
673 a Level 4 data package including “CLP-Like” summary forms, Staged Electronic Data
674 Deliverables (SEDD) Stage 2b (version Draft 5.0), and Automated Data Review (ADR)
675 compatible A1, A2, & A3 files for all sample delivery groups (SDGs).

676 Shaw conducted a data assessment on all samples collected in support of this SI. One-hundred
677 percent of the analytical data have been reviewed and validation qualifiers assigned based on
678 EPA *Contract Laboratory Program (CLP) National Functional Guidelines for Organic Data*
679 *Review, October 1999* and EPA *CLP National Functional Guidelines for Inorganic Data Review,*
680 *October 2004*. ADR software Version 8.1 was used to assist in the data validation process for all
681 areas with the exception of initial calibration blanks (ICB) / continuing calibration blanks (CCB),
682 interference check standards, internal standards, serial dilutions, and second-column
683 confirmation which were assessed manually. Data were evaluated against specific criteria to
684 verify the achievement of all precision, accuracy, representativeness, completeness,
685 comparability, and sensitivity goals established to meet the project DQOs.

686 The overall quality of the data collected is discussed in the Analytical Data QA/QC Report
687 (Appendix G). Results of the analyses as discussed in the Analytical Data QA/QC Report are
688 indicative of the media analyzed with the exception of some molybdenum and mercury analyses.
689 A number of the soil and sediment samples were qualified as “U” not detected due to continuing
690 calibration blank contamination and a number of the mercury analyses in the soil background
691 samples were qualified as “U” not detected due to method blank contamination. No data were
692 qualified “R” as unusable. Overall, the data reflect expected conditions and they are fully usable
693 for their intended purpose.

694 **3.6 Screening Values**

695 The following subsections describe development of background and screening values for this SI.

696 **3.6.1 Background Data**

697 Ten background soil samples were collected from the Boardman AFR area during the SI and
698 analyzed for metals. Background sample locations are shown on Figure 3-2. The selection of
699 the soil background locations was aided by Visual Sampling Plan (VSP) (PNNL, 2005). VSP is

700 a computer software program that allows for an independent sampling location selection across a
701 designated area. The area provided to the VSP software was all areas within the FUDS boundary
702 not included in a known AOC. After VSP identified potential sampling locations, the locations
703 were adjusted by hand to place the background sample location on a property for which the
704 USACE had a signed ROE. Background sediment sampling locations were collected from a
705 location upstream of the Boardman AFR AOCs.

706 The background soil sample analytical results were used to calculate background metal soil
707 concentrations using published EPA Guidance (1989, 1992, 1994, 1995, and 2006). The
708 background concentrations are either a 95th upper tolerance limit (UTL) for normally and
709 lognormally distributed analytes or the 95th percentile for nonparametric distributed analytes.
710 The background soil sample analytical results are provided in Appendix G. Table 3-2 lists the
711 soil, sediment and groundwater metals background concentrations used in this report. Table 3-2
712 also includes the background concentration for perchlorate in groundwater that was obtained
713 during the PA/SI (Weston, 2004). A summary of the soil background calculations is presented in
714 Appendix L.

715 One sediment background sample (NWO-030-5011) was collected in the vicinity of Boardman
716 AFR (Figure 3-2) during the SI and analyzed for metals. The analytical results are presented in
717 Appendix G.

718 Groundwater background concentrations were from samples collected from PGE well “120”
719 located upgradient of the Target No. 1 and Carty Reservoir AOCs. The well location is shown
720 on Figure 3-2. Metal background concentrations were obtained from the PGE Boardman Plant
721 2005 Water Quality Monitoring Report. A copy of the report is provided in Appendix L. PGE
722 monitors for all metal analytes of concern except mercury and perchlorate. The perchlorate
723 background concentration was obtained from the PA/SI report (Weston, 2004). Note that the
724 PA/SI identified the sample location as GW-MW025, which is the same well as PGE well “120.”
725 The groundwater background concentrations are listed on Table 3-2.

726 The method for comparing sediment and groundwater results to background was not defined in
727 the TPP process. For purposes of comparison in this SI, the background concentrations for
728 sediments and groundwater are taken to be the background sample value. The approach for
729 determining if a release has occurred is consistent with the EPA’s HRS (40 CFR Part 300:
730 Appendix A): “The minimum standard to establish an observed release by chemical analysis is
731 analytical evidence of a hazardous substance in the media significantly above the background
732 level.” Table 2-3, “Observed Release Criteria for Chemical Analysis” in the above referenced
733 regulation has the following criteria:

- 734 1. If the sample measurement is less than or equal to the sample quantitation limit, no
735 observed release is established.
- 736 2. If the sample measurement is greater than or equal to the sample quantitation limit,
737 then an observed release is established as follows:
- 738 • If the background concentration is not detected (or is less than the detection limit),
739 an observed release is established when the sample measurement equals or exceeds
740 the sample quantitation limit.
 - 741 • If the background concentration equals or exceeds the detection limit, an observed
742 release is established when the sample measurement is three times or more above
743 the background concentration.

744 In the discussions that follow in Sections 4 through 9, these criteria are used to determine
745 whether a release of MC has occurred in sediment and groundwater regardless of whether the
746 analyte is considered a hazardous substance. However, these criteria are not applied for soils
747 because a statistically based determination of background has been established, and an
748 exceedance of the 95th UTL or 95th percentile, depending on the individual analyte, is used to
749 establish a release of MC.

750 **3.6.2 Human Health Screening**

751 Human health screening values for soil and sediment analytical results were established using the
752 EPA Region 9 Preliminary Remediation Goals for Residential Soil. Note that in recent meetings
753 with ODEQ for other FUDS, they indicated that EPA Region 6 Preliminary Remediation Goals
754 should be used for all new sites in Oregon. Table 3-3 lists the human health screening values
755 that were agreed to during the TPP process. Selection of screening levels is shown in the TPP
756 Memorandum included as Appendix B in this SI Report.

757 **3.6.3 Ecological Screening**

758 According to the *Screening-Level Ecological Risk Assessment (SLERA) Guidance for FUDS*
759 *MMRP Site Inspections* (USACE, 2006), only sites that are considered to be IEP or are to be
760 managed for ecological purposes, require a SLERA. As shown in Table 2-2, the Boardman AFR
761 does meet some of the 33 criteria for designation as an IEP. Table 3-4 lists the ecological
762 screening values that were agreed to during the TPP process. Shaw developed a SLERA
763 (Appendix L) using ecological screening values obtained from ODEQ (2001) and other
764 appropriate sources as described in the TPP Memorandum included as Appendix B in this SI
765 Report.

766 **3.7 Variances from the SSWP**

767 There were no variances to the SSWP.

768 **3.8 Second TPP Meeting**

769 A second TPP meeting was held via conference call on September 5, 2007. The meeting was
770 held with stakeholders to present and discuss the SI findings and to reach consensus regarding

771 conclusions and recommendations. All stakeholders participating in the meeting concurred with
772 the SI conclusions and recommendations. However, ODEQ does not concur with the
773 recommendation of NDAI relative to MC at Range Complex No. 1. ODEQ indicated that there
774 are several potential non-DoD related activity sources for perchlorate in groundwater in the
775 Lower Umatilla Basin and until the other source(s) for perchlorate are determined they cannot
776 agree to a determination of NDAI relative to MC at Range Complex No. 1. ODEQ did agree
777 with the findings in the SI Report for a NDAI recommendation with respect to MC for Target
778 No. 1, Target No. 2, and Carty Reservoir Bomb Target. The meeting agenda and minutes are
779 provided in Appendix B.

780 4.0 Target No. 1

781 4.1 History and Land Use

782 The Target No. 1 AOC consists of a single target configured with concentric circles with radii of
783 100, 200, and 300 ft, which was standard range layout for the time of use. The target name is
784 consistent with the ASR Supplement. The southern one-third of the AOC overlaps with Carty
785 Reservoir Target AOC. The location of the AOC is shown on Figures 3-1 and 4-1.

786 The Target No. 1 AOC is located on BAIC, Inc. and PGE property adjacent to Carty Reservoir.
787 Approximately 40 percent of the target drop area safety zone is flooded by Carty Reservoir. The
788 safety zone is an area surrounding a target where the potential for bomb impacts exists.

789 The terrain is flat with a gradual slope toward the shoreline of Carty Reservoir. The area
790 northeast of the safety zone has been extensively reworked during power plant construction and
791 the building of an earthen dam for Carty Reservoir. The property to the north and west of the
792 target is now used for irrigated farming. Portions of land near Carty Reservoir are uncultivated
793 and near the reservoir shore, brush and trees have grown.

794 One groundwater monitoring well installed by the PGE Power Generating Station is located
795 within the AOC. An industrial water supply well is located approximately 650 ft northeast of the
796 outer boundary of the AOC. Carty Reservoir is the nearest surface water body to the AOC.
797 Sixmile Canyon Creek flows through the northeast corner of the target. The source of water for
798 Carty Reservoir is via pump from the Columbia River. The reservoir water is used for cooling at
799 the PGE Power Generating Station. Future land use is expected to remain the same.

800 The target was used between 1948 and 1960 and is thought to be a replacement target for the
801 Carty Reservoir Target, which was used between 1942 and 1945. It is unclear of the extent of
802 use of this target. During the ASR field visit, no MEC or MD were identified within the target
803 footprint or safety zone. The contractor that conducted the INPR for the USACE identified
804 several small items and according to the ASR, “the description matched that of a 31-lb practice
805 bomb.” This MD is thought to be from a MK-76 25-lb practice bomb. During the SI field
806 activities MD was identified within the footprint of Target No. 1.

807 4.2 Previous Investigations

808 Other than the ASR and INPR, no previous investigations have been completed at Target No. 1.
809 The PA/SI completed by Weston for the EPA in 2004 did not investigate this AOC. However,
810 the PA/SI collected a surface water sample from Carty Reservoir. The analytical results from
811 this sample are discussed in Section 4.4.2.

812 **4.3 MEC Evaluation**

813 The ASR Supplement identified the likely range munitions used at this AOC as being AN-Mk 5,
814 AN-Mk 23, and AN-Mk 43 practice bombs. These practice bombs contained a black powder
815 spotting charges which are relatively insensitive explosive components.

816 No MEC or MD were identified during the ASR site visit in 1997. However, the contractor that
817 conducted the INPR for the USACE identified several small items and according to the ASR,
818 “the description matched that of a 31-lb practice bomb.” This MD is thought to be from a
819 MK-76 25-lb practice bomb.

820 **4.3.1 Field Observations and Historical Evidence of MEC**

821 A visual reconnaissance of Target No. 1 was conducted prior to collection of samples to identify
822 evidence of former range activities (e.g., surface debris, or stressed vegetation). The visual
823 reconnaissance was supplemented with a Fisher all-metal detector in order to identify any
824 metallic items that may be present. The Fisher all-metal detector was used due to the high iron
825 content in the bedrock. The path walked during the visual reconnaissance was recorded using a
826 hand-held Global Positioning System (GPS) unit (Figure 4-1). During the reconnaissance, MD
827 likely from a M38A2 practice bomb was identified. No other evidence of military activity was
828 observed.

829 **4.3.2 MEC Risk Assessment**

830 The following section presents a qualitative assessment of the risk associated with potential
831 MEC at the Target No. 1 AOC. This assessment is based on historical documentation, prior
832 investigation, and visual inspection conducted during this SI. A MEC assessment is provided to
833 convey relative risk on a scale from low to high and is not intended to be a thorough risk
834 assessment as would be conducted for an RI/FS.

835 Shaw completed an all-metal detector assisted visual reconnaissance of the Target No. 1 AOC
836 the week of February 26, 2007. During the reconnaissance MD likely from a M38A2 practice
837 bomb was identified. No other MD was identified. Figure 4-1 shows the reconnaissance
838 pathways for this AOC.

839 Access to portions of Target No. 1 is restricted by locked gates and fences. Access is allowed
840 only with an escort from PGE management. Other portions of the AOC are used for irrigated
841 agriculture and access is not controlled.

842 MEC has not been reported historically at Target No. 1. MD was reported in the INPR and
843 observed during the SI field reconnaissance. The ASR nor the PA/SI (Weston, 2004) did not
844 identify any MEC or MD from this AOC. The MEC risk for this area is considered to be low
845 based on the following:

- 846
- Only MD has been reported for this AOC;

- 847 • The reported munitions used at this AOC are practice munitions only;
- 848 • The munitions used at this target used relatively insensitive explosive components;
- 849 • The area is used for farming, undergoing yearly tillage to depths of approximately 18
- 850 inches without MEC discovery;
- 851 • The unfenced area is not frequented by the public and only farm workers or PGE workers
- 852 have access to the area; and
- 853 • No MEC has ever been reported or found.

854 **4.4 Munitions Constituents Evaluation**

855 Potential MC include metals associated with steel, sheet metal, paint, and other components of
856 munitions (chromium, copper, iron, lead, molybdenum, and nickel), and black powder
857 (potassium nitrate, sulfur, and charcoal). Perchlorate was not identified as a potential MC at
858 Target No. 1. Nonetheless, discussion of perchlorate analytical results from surface water and
859 groundwater samples collected from Target No. 1 during the PA/SI is included in the following
860 evaluation for completeness.

861 **4.4.1 Terrestrial Pathway**

862 Terrestrial receptors may be exposed to MC because soil may have been directly affected by the
863 corrosion of metals from the bomb bodies or explosives used. One surface soil sample (NWO-
864 030-0001) was proposed and collected at Target No. 1. The location was near the center of the
865 former target. The sample location is shown in Figure 4-2. The samples were analyzed for
866 select metals (chromium, copper, iron, lead, molybdenum, and nickel) by EPA Method 6020. In
867 addition, samples were analyzed for aluminum and manganese for potential use in evaluating
868 naturally occurring concentrations of metals in soil using the method of Myers and Thorbjornsen
869 (2004). The sample was also analyzed for explosives including nitroglycerin by EPA Method
870 8330A. The explosives were added at the request of the ODEQ to confirm than no explosives
871 were present.

872 Detected soil analytical results and comparison to soil background and human health and
873 ecological screening values are shown in Table 4-1. The results of the comparison to soil
874 background and human health and ecological screening values are shown pictorially on Figures
875 4-2 (metals) and 4-3 (explosives).

876 **4.4.1.1 Comparison to Background Data**

877 The analytical results were compared to the Boardman AFR site specific background values.
878 There were no background exceedances for metals and no detections of explosives.

879 **4.4.1.2 Comparison to Human Health Screening Values**

880 Soil analytical results are only compared to human health screening values if background
881 concentrations are exceeded. Because there were no exceedances of background concentrations,
882 no comparison has been completed for this SI.

883 **4.4.1.3 Comparison to Ecological Screening Values**

884 Soil analytical results are only compared to ecological screening values if background
885 concentrations are exceeded. Because there were no exceedances of background concentrations,
886 no comparison has been completed for this SI.

887 **4.4.2 Surface Water Pathway**

888 The surface water pathway at Boardman AFR is evaluated through surface water and sediments.
889 The potential receptors for surface water and sediments are agricultural and PGE workers and
890 wildlife. One surface water sample (SW-CR001) was collected from Carty Reservoir during the
891 PA/SI (Weston, 2004) and analyzed for perchlorate using EPA method *CLP Statement of Work*
892 *(SOW) for Inorganics Analysis* 314.0 (EPA, 2000). Perchlorate was not detected in the PA/SI
893 surface water sample. The detection limit was 1 µg/L. A sediment sample was proposed and
894 collected for the SI as part of the adjacent Carty Reservoir Bombing Target evaluation (see
895 Section 6.4.2)

896 **4.4.3 Groundwater Pathway**

897 The groundwater pathway at Boardman AFR was considered during the TPP discussions.
898 Groundwater was sampled during the PA/SI and analyzed for explosives and perchlorate.
899 Analysis for metals in groundwater was not included in the PA/SI. Metals analyses are available
900 for some of the nearby monitoring wells by used by PGE.

901 Two groundwater monitoring wells owned by PGE (“008” and “120”) in the vicinity of Target
902 No. 1 were sampled and analyzed for perchlorate and explosives in the PA/SI. These same two
903 wells are also sampled annually for metals by PGE. Both wells are completed in the upper most
904 water bearing zone at the top of the Columbia River Basalt. The depth to water in well “008 is
905 approximately 23 ft bgs and in well “120” approximately 46 ft bgs. Note that the PA/SI
906 identifies well “008” as GW-MW024 and well “120” as GW-MW025. Well “008” is located
907 within the Target No. 1 AOC (Figure 4-4), north of the Carty Reservoir earthen dam. The
908 second well “120” is located southeast and upgradient of well “008” and Target No. 1 (see
909 Figure 3-2). The most recent metals data are from 2005. Data are only available for chromium,
910 copper, iron, mercury, and lead. Molybdenum and nickel are not included in the annual PGE
911 groundwater monitoring analytical suite. Table 4-2 compares downgradient well “008” to well
912 “120” (background) and to groundwater human health screening criteria.

913 **4.4.3.1 Comparison to Background**

914 Comparison of metals analytical results from well “008” to the local background (well “120”)
915 from 2005, indicates that the iron concentration from well “008” of 50 µg/L exceeded the three
916 times background criteria of less than 10 µg/L. This indicates that a significant exceedance of
917 background has occurred. Note that PGE does not monitor for molybdenum and nickel and no
918 evaluation of these two analytes of concern can be completed.

919 During the PA/SI, groundwater samples were collected in the vicinity of Target No. 1 (wells 008
920 and 120) and analyzed for explosives and perchlorate. No explosive compounds were detected.
921 Perchlorate was detected in the local upgradient well “120” at a concentration of 3.56 µg/L. This
922 concentration is far lower than the DoD action level of 24 µg/L. Perchlorate was not detected in
923 the downgradient well “008”.

924 **4.4.3.2 Comparison to Human Health Screening Values**

925 Comparison to human health screening levels is only completed for those analytes that
926 significantly exceed the background concentration. Iron was the only metal to be significantly
927 detected (greater than three times background) above background at a concentration of 50 µg/L.
928 This concentration is below the human health screening value of 11,000 µg/L.

929 **4.4.4 Air Pathway**

930 Air is considered to be a potential pathway due to inhalation of MC in from blowing dust. The
931 potential inhalation of soil particles is included in the development of health-based screening
932 values for soil.

933 5.0 Target No. 2

934 5.1 History and Land Use

935 The Target No. 2 AOC consists of a single target configured with concentric circles in 200- and
936 400-yard radii. In addition, there were three scoring towers 120 degrees apart near the target.
937 This range was previously assessed during the PA/SI (Weston, 2004). The target name is
938 consistent with the ASR Supplement. Figure 3-1 shows the general location of the Target No. 2
939 and Figure 5-1 shows the location with respect to the current land use in the vicinity of the target.
940 Figure 5-2 is a historical aerial photograph showing the concentric circles of the target center.
941 Note that the AOC boundary, obtained from the ASR Supplement (USACE, 2004b and the 2006
942 ARC (DoD, 2006) is not centered on the target center.

943 The Target No. 2 AOC is located on agricultural property owned by Threemile Canyon Farms.
944 The area is currently used for irrigated farming. No groundwater wells are located within the
945 boundary of Target No 2 AOC. The nearest surface water is Sixmile Canyon Creek located
946 approximately 1,800 ft west of the southwest boundary of the AOC. The future land use is not
947 expected to change from the present use. The target was used between 1942 and 1960 for
948 practice bombing. As discussed in Section 2.4.8, Target No. 2 is used entirely for agricultural
949 purposes and does not contain any sensitive environments and does not fit the definition of an
950 IEP.

951 5.2 Previous Investigations

952 The ASR evaluated Target Area No. 2. The team encountered MD up to 325 yards from the
953 target center. Items observed by the ASR team included M38A2 practice bombs, AN-M52 and
954 AN-M50A2 incendiary bombs, and Mk 6 2.25-inch practice rockets.

955 The PA/SI collected two surface soil samples (0 to 0.5 ft bgs) and two subsurface soil samples
956 (0.5 to 2.0 ft bgs) from a location north of the target area (Figure 5-2). Samples were analyzed
957 for metals and perchlorate. As previously indicated, the PA/SI also sampled surface and
958 groundwater in and around the Boardman AFR for perchlorate.

959 5.3 MEC Evaluation

960 Likely range munitions used at this AOC are listed as AN-M50 incendiary bombs, M38A2
961 practice bombs and Mk 6 2.25-inch practice rockets. Recent MEC finds at Target No. 2 included
962 AN-M57 GP practice bomb. MD from AN-47, and Mk-15 Mod 3 100 lb practice bombs has
963 also been reported (Weston, 2004). The AN-M50 and AN-M52 incendiary bombs were cased in
964 a magnesium shell and contained a fuze and thermite. Thermite consists of a mixture of
965 powdered aluminum metal and ferric oxide. The M38A2 practice bombs were a sand-filled,
966 sheet metal cased, 100-lb practice bomb and contained a black powder spotting charge. The

967 Mk 6 2.25-inch practice rockets were constructed from sheet metal. The propellant used in the
968 rocket was ballistite, which consists of nitrocellulose and nitroglycerin. There were no spotting
969 charges in the Mk 6 rockets. The use of the Mk 6 practice rocket is thought to be limited at this
970 target as evidenced by the scarcity of spent rocket motors. The reported AN-M57 GP practice
971 bombs contained a spotting charge only. The AN-47 practice bombs were reported in the PA/SI
972 (Weston, 2004) and may have been sand filled or were smoke or incendiary munitions. All of
973 the above munitions contained relatively insensitive explosive components, except the AN-M47
974 which may have contained a sensitive fuze.

975 *5.3.1 Field Observations and Historical Evidence of MEC*

976 The types of munitions used at the Target No. 2 AOC are listed above. Debris from these
977 munitions was observed during the ASR site visit in 1997, during the 2004 PA/SI investigation,
978 and in 2006 during a Navy EOD recovery. The ASR indicated that four 75-mm HEAT M66
979 projectiles were reported to have been destroyed in the target area by Army EOD in 1987. The
980 ASR indicated that the 75-mm projectiles were likely brought to the AOC for disposal and not
981 used at the site. MEC was reported from this AOC as recently as March 2006.

982 No field reconnaissance was conducted at this AOC during the SI because MEC and MD were
983 reported as recently as March 2006. However, prior to collecting soil samples, the path from the
984 vehicle to the sampling point was visually surveyed and the path recorded using a GPS unit by a
985 UXO technician with the aid of an all-metal detector. No MEC or MD was noted during
986 sampling activities. The path is shown on Figure 5-1.

987 *5.3.2 MEC Risk Assessment*

988 The following section presents a qualitative assessment of the risk associated with potential
989 MEC, as based on historical documentation, prior investigation, and visual inspection conducted
990 during this SI. A MEC assessment is provided to convey relative risk on a scale from low to
991 high and is not intended to be a thorough risk assessment as would be conducted for an RI/FS.

992 Access to Target No. 2 is unrestricted. The area is used for irrigated agriculture and physical
993 barriers are not present.

994 MEC has been reported historically at Target No. 2 as recently as March 2006. The MEC risk
995 for this area is considered to be moderate based on the following:

- 996 • MEC has been reported as recently as March 2006, recent finds were AN-M57 GP
997 practice bombs;
- 998 • All munitions contained relatively insensitive explosive components except for the
999 AN-M47, which may have had a sensitive fuze;
- 1000 • The area is used for farming, undergoing yearly tillage to depths of approximately 18
1001 inches and MEC and MD is periodically unearthed;

- 1002 • The unfenced area is frequented by farm workers; the general public does not have
1003 routine access to the AOC.

1004 **5.4 Munitions Constituents Evaluation**

1005 Potential MC include metals associated with steel, sheet metal, paint, and other components of
1006 munitions (chromium, copper, iron, lead, molybdenum, and nickel), black powder (potassium
1007 nitrate, sulfur, and charcoal), thermite (powdered aluminum and ferric oxide), ballistite
1008 (nitrocellulose and nitroglycerine), and Amatol (ammonium nitrate and 2,4,6-trinitrotoluene
1009 [TNT]), and tetryl. Perchlorate was not identified as a potential MC at Target No. 2.
1010 Nonetheless, discussion of perchlorate analytical results from surface water samples collected
1011 from Target No. 2 during the PA/SI is included in the following evaluation for completeness.

1012 **5.4.1 Terrestrial Pathway**

1013 Terrestrial receptors may be exposed to MC because soil may have been directly affected by the
1014 corrosion of metals from the bomb bodies or explosives used. Two surface soil samples (NWO-
1015 030-0002 and NWO-030-0003) were proposed and collected at Target No. 2. The sample
1016 locations are shown on Figures 5-2 and 5-3. The samples were analyzed for select metals
1017 (aluminum, chromium, copper, iron, lead, molybdenum, and nickel) by EPA Method 6020A. In
1018 addition, samples were analyzed for aluminum and manganese for potential use in evaluating
1019 naturally occurring concentrations of metals in soil using the method of Myers and Thorbjornsen
1020 (2004). The samples were also analyzed for explosives including nitroglycerin by EPA Method
1021 8330A.

1022 Two surface soil samples (0 to 0.5 ft bgs) (SS-PS003 and SS-PS005) and two subsurface soil
1023 samples (0.5 to 2.0 ft bgs) (SB-PS003 and SB-PS005) were collected during the PA/SI (Weston,
1024 2004). Samples were analyzed for TAL metals using CLP SOW ILM05.3 (EPA, 2004) and
1025 perchlorate using EPA Method 314.0 (EPA, 2000) (Table 2-3). The PA/SI sample locations
1026 were located north of the Target No. 2 AOC boundary, but are included in this evaluation for
1027 completeness.

1028 **5.4.1.1 Comparison to Background Data**

1029 The detected metals concentrations in soil for both the SI samples and the PA/SI samples are
1030 listed on Table 5-1. There were no exceedances of the SI background soil concentrations in any
1031 sample. There were no explosive or perchlorate detections in either the SI or PA/SI samples.

1032 **5.4.1.2 Comparison to Human Health Screening Values**

1033 Soil analytical results are only compared to human health screening values if background
1034 concentrations are exceeded. Because there were no exceedances of background concentrations,
1035 no comparison has been completed for this SI.

1036 *5.4.1.3 Comparison to Ecological Screening Values*
1037 Soil analytical results are only compared to ecological screening values if background
1038 concentrations are exceeded. Because there were no exceedances of background concentrations,
1039 no comparison has been completed for this SI.

1040 *5.4.2 Surface Water Pathway*

1041 As agreed to during the TPP process, no surface water or sediment samples were identified to be
1042 collected in the vicinity of the Target No. 2. Five surface water samples and one sediment
1043 sample were collected from the Sixmile Canyon Creek drainage during the PA/SI at locations
1044 greater than one mile from the center of the AOC. The locations of the surface water samples
1045 are shown on Figure 5-4. The surface water samples were analyzed for perchlorate using EPA
1046 Method 314.0 (EPA, 2000) and one sample was also analyzed for perchlorate using EPA SW-
1047 846 Method 8321-modified (STL, 2003). The sediment sample was analyzed for TAL metals
1048 using EPA method CLP SOW ILM05.3 (EPA, 2004). The potential receptors for MC in surface
1049 water and sediments are agricultural and PGE workers and wildlife.

1050 Detected sediment analytical results and comparison to background and human health and
1051 ecological screening values are provided on Table 5-2. The surface water perchlorate analytical
1052 results are shown on Figure 5-4.

1053 *5.4.2.1 Comparison to Background Data*

1054 A background surface water sample was not collected for the PA/SI. Perchlorate was detected in
1055 all five surface water samples at concentrations ranging from 0.32 µg/L to 7.49 µg/L. The
1056 highest surface water concentration was detected in the sample (SW-SC006) collected the
1057 farthest upstream near the western boundary of the FUDS. This location (SW-SC006) is
1058 approximately 1.5 miles northwest of Target No. 1 and well away from any bombing activity at
1059 Boardman AFR (Figure 2-9). The lowest concentration was detected in the sample (SW-SC001)
1060 collected the farthest downstream (Figure 5-4).

1061 The concentrations of metals detected in the PA/SI sediment are listed on Table 5-2. There were
1062 no significant exceedances (greater than three times the background concentration) of the SI
1063 background sediment soil concentration in the sample.

1064 *5.4.2.2 Comparison to Human Health Screening Values*

1065 The maximum detected concentration of perchlorate was 7.49 µg/L which is below the DoD
1066 action level of 24 µg/L.

1067 The sediment sample analytical results are only compared to human health screening values if
1068 background concentrations are significantly exceeded. Because there were no significant
1069 exceedances of background concentrations, no comparison has been completed for this SI.

1070 *5.4.2.3 Comparison to Ecological Screening Values*

1071 Perchlorate ecological screening values of 35,000 µg/L (LANL, 2005) and 9,300 µg/L (Dean et
1072 al., 2004) were not exceeded by the detected surface water concentration. Sediment analytical
1073 results are only compared to ecological screening values if background concentrations are
1074 significantly exceeded. Because there were no significant exceedances of background
1075 concentrations, no comparison has been completed for this SI.

1076 *5.4.3 Groundwater Pathway*

1077 As agreed to in the TPP Memorandum, no groundwater samples were collected from Target No.
1078 2 as part of the SI field activities (Shaw, 2006b). Groundwater samples were collected from
1079 within the Boardman AFR FUDS and surrounding property during the PA/SI (see Section 2.5.3).

1080 *5.5 Air Pathway*

1081 Air is considered to be a potential pathway due to inhalation of MC in blowing dust. The
1082 potential inhalation of soil particles is included in the development of health-based screening
1083 values for soil.

1084 **6.0 Carty Reservoir Bomb Target**

1085 **6.1 History and Land Use**

1086 The Carty Reservoir Bomb Target AOC consists of a single target configured with concentric
1087 circles (spacing not identified). This target is located on the western side of Carty Reservoir
1088 (Figure 4-1). Prior to the ASR, this target was not identified in any historical documents. It is
1089 thought that this target was the original target at the range. The ASR team believed that the
1090 original Target No. 1 was located in this area and then was relocated approximately 1 mile north
1091 in approximately 1946. The target is thought to have been used between 1942 and 1945 for
1092 practice bombing; however, the actual date of use is not known.

1093 The Carty Reservoir Bomb Target was located in a depression which made scoring difficult. The
1094 new Target No. 1 location (discussed in Section 4.0) is much flatter and at a higher elevation.
1095 The target name is consistent with the ASR Supplement. Figure 3-1 shows the general location
1096 of Carty Reservoir Bomb Target AOC. Figure 4-1 shows a more detailed view of the AOC.
1097 Figure 4-2 is a photograph from 1965 and the concentric target circles can be observed. This
1098 AOC overlaps Target No. 1 AOC.

1099 The Carty Reservoir Bomb Target AOC is located on PGE and BAIC, Inc. (leased by Threemile
1100 Canyon Farms) property. The western half of the AOC is currently used for irrigated farming
1101 and the southern and eastern portion is native vegetation consisting of grasses and small trees are
1102 present along the shoreline of Carty Reservoir. There is evidence of historical livestock grazing
1103 in the area. The terrain slopes toward Carty Reservoir. No groundwater wells are located within
1104 the boundary of this AOC. Carty Reservoir covers approximately 30 percent of the area.

1105 **6.2 Previous Investigations**

1106 The ASR team visited the Carty Reservoir Bomb Target and identified live practice bombs near
1107 the target center. The Army EOD was notified by PGE and disposed of five suspected live
1108 practice bombs (USACE, 1997, Appendix M2). MEC and MD identified by the ASR team
1109 included Mk-23, M38A2 practice bombs, and M75 and M84 target marker bombs.

1110 One surface water sample was collected from Carty Reservoir during the PA/SI and analyzed for
1111 perchlorate. Note that the water for Carty Reservoir is pumped from the Columbia River.

1112 **6.3 MEC Evaluation**

1113 Likely range munitions used at this AOC was the Mk 23, and M38A2 practice bombs and the
1114 M75 and M84 target marker bomb. The Mk 23 practice bombs were constructed from cast iron
1115 and contained black powder and a red phosphorus pyrotechnic signal charge. The M38A2
1116 practice bombs were a sand-filled sheet metal cased 100-lb practice bomb and contained a black
1117 powder spotting charge. The M75 and M84 target marker bombs were cased in sheet metal and

1118 contained a burster and fuze and a charge of red iron ore (hematite) that was used as a marker.
1119 The M75/M84 target marker bombs contained sensitive fuzing.
1120 Large amounts of debris from these munitions were observed during the ASR site visit in 1997.
1121 This AOC was the only area where the ASR team observed relatively intact, fuzed, and
1122 suspected live munitions (M75/M84 practice bomb) during the 1997 site visit.

1123 ***6.3.1 Field Observations and Historical Evidence of MEC***

1124 As agreed to at the TPP meeting, no visual reconnaissance was completed at the Carty Reservoir
1125 Bomb Target, because sufficient historical evidence of MEC and munitions debris present at this
1126 AOC. A visual reconnaissance was completed at Target No. 1 located immediately north. The
1127 northern portion of the Carty Reservoir Bomb Target safety circle overlaps the reconnaissance
1128 route completed on Target No. 1, on a portion of property. The route is shown on Figure 4-1.

1129 ***6.3.2 MEC Risk Assessment***

1130 The following section presents a qualitative assessment of the risk associated with potential
1131 MEC, as based on historical documentation, prior investigation, and visual inspection conducted
1132 during this SI. A MEC assessment is provided to convey relative risk on a scale from low to
1133 high and is not intended to be a thorough risk assessment as would be conducted for an RI/FS.

1134 Access to portions of Carty Reservoir Bomb Target is restricted by locked gates and fences.
1135 Access is available only by escort by PGE management or The Nature Conservancy. Other
1136 portions of the AOC are used for irrigated agriculture and access is not controlled.

1137 Munitions used at Carty Reservoir Bomb Target were primarily practice rounds including AN-
1138 Mk23 and M38A2 practice bombs. The M75/M84 target identification bombs may have
1139 contained sensitive fuzing. The potential for MEC at the Carty Reservoir Bomb Target is
1140 moderate. This is based on the following:

- 1141 • MEC was reported during the 1995 visual site inspection conducted as part of the ASR;
- 1142 • The M75/M84 target marker bombs may have contained sensitive fuzing;
- 1143 • The unfenced area is used for farming, undergoing yearly tillage to depths of
1144 approximately 18 inches.

1145 The area is frequented by farm workers; the general public does not have routine access to the
1146 AOC.

1147 ***6.4 Munitions Constituents Evaluation***

1148 Based on historical information and reports of MEC and MD in the ASR, munitions used at
1149 Carty Reservoir Bomb Target were practice munitions. Potential MC include metals associated
1150 with sheet metal, cast iron, paint, and other components of munitions (iron and lead).
1151 Chromium, copper, molybdenum, and nickel were included as potential metal MC during the
1152 TPP planning, although no identified source is known at the Carty Reservoir AOC. The only

1153 explosive documented as being used was black powder. Perchlorate was not identified as a
1154 potential MC at Carty Reservoir Bomb Target. Nonetheless, discussion of perchlorate analytical
1155 results from a surface water sample collected from Carty Reservoir Bomb Target during the
1156 PA/SI is included in the following evaluation for completeness.

1157 *6.4.1 Terrestrial Pathway*

1158 Terrestrial receptors may be exposed to MC because soil may have been directly affected by the
1159 corrosion of metals from the bomb bodies or explosives used. Two surface soil samples (NWO-
1160 030-0004 and NWO-030-0005) were proposed and collected at Carty Reservoir Bomb Target.
1161 The samples were analyzed for select metals (chromium, copper, iron, lead, molybdenum, and
1162 nickel) by EPA Method 6020A. Chromium, copper, molybdenum, and nickel were included in
1163 the analytical suite for this AOC to be consistent with other AOCs at Boardman AFR. In
1164 addition, samples were analyzed for aluminum and manganese for potential use in evaluating
1165 naturally occurring concentrations of metals in soil using the method of Myers and Thorbjornsen
1166 (2004). One sample NWO-030-0005 was also analyzed for explosives including nitroglycerin
1167 by EPA Method 8330A. The explosives were added at the request of the ODEQ to confirm that
1168 no explosives were present. The sample locations and results are shown in Figures 4-2 and 4-3.
1169 No soil samples were collected from this AOC during the PA/SI.

1170 *6.4.1.1 Comparison to Background Data*

1171 The detected metals concentrations in soil are listed on Table 6-1. There were no exceedances of
1172 the SI background soil concentrations in any sample. There were no explosives detected in the
1173 one sample analyzed for explosives.

1174 *6.4.1.2 Comparison to Human Health Screening Values*

1175 Soil analytical results are only compared to human health screening values if background
1176 concentrations are exceeded. Because there were no exceedances of background concentrations,
1177 no comparison has been completed for this SI.

1178 *6.4.1.3 Comparison to Ecological Screening Values*

1179 Soil analytical results are only compared to ecological screening values if background
1180 concentrations are exceeded. Because there were no exceedances of background concentrations,
1181 no comparison has been completed for this SI.

1182 *6.4.2 Surface Water Pathway*

1183 Primary exposure to surface water is through direct contact of PGE workers and wildlife. One
1184 surface water sample was collected from Carty Reservoir during the PA/SI (SW-CR001) and
1185 analyzed for perchlorate using EPA method CLP-SOW 314.0 (EPA, 2000). One sediment
1186 sample (NWO-030-1001) and field duplicate (NWO-030-1003) were collected from the shore of
1187 Carty Reservoir (Figure 4-2). The samples were analyzed for select metals using EPA SW-846
1188 Method 6020A, and explosives including nitroglycerin using EPA SW-846 Method 8330A.

1189 **6.4.2.1 Comparison to Background Data**

1190 The detected metals concentrations in sediment are listed on Table 6-2. There were no
1191 significant exceedances of the SI background sediment concentrations in any sample. There
1192 were no explosive detections in the sediment samples. Perchlorate was not detected in the PA/SI
1193 surface water sample (detection limit 1 µg/L).

1194 **6.4.2.2 Comparison to Human Health Screening Values**

1195 Sediment and surface water analytical results are only compared to human health screening
1196 values if background concentrations are exceeded. Because there were no exceedances of
1197 background concentrations, no comparison has been completed for this SI.

1198 **6.4.2.3 Comparison to Ecological Screening Values**

1199 Sediment and surface water analytical results are only compared to ecological screening values if
1200 background concentrations are exceeded. Because there were no exceedances of background
1201 concentrations, no comparison has been completed for this SI.

1202 **6.4.3 Groundwater Pathway**

1203 As agreed to in the TPP Memorandum (Shaw, 2006b), no groundwater samples were collected
1204 from Carty Reservoir Bomb Target as part of the SI field activities. Groundwater samples were
1205 collected from within the Boardman AFR FUDS and surrounding property (see Section 2.5.3)
1206 during the PA/SI. None of the PA/SI groundwater samples were collected from Carty Reservoir
1207 Bomb Target. The perchlorate concentrations detected in the PA/SI groundwater samples do not
1208 exceed the DoD action level of 24 µg/L for perchlorate.

1209 **6.4.4 Air Pathway**

1210 Air is considered to be a potential pathway due to inhalation of MC in from blowing dust. The
1211 potential inhalation of soil particles is included in the development of health-based screening
1212 values for soil.

1213 *7.0 Range Complex No. 1*

1214 *7.1 History and Land Use*

1215 The Range Complex No. 1 AOC consists of three areas: INPR Site No. 1, the Demolition Area,
1216 and the Turret Gunnery Training Range. Figure 3-1 shows the general location of the Range No.
1217 1 Complex AOC. Figure 7-1 shows a general overview of the AOC.

1218 The INPR Site No. 1 is a bomb target that was in use between 1946 and 1960. The ASR
1219 Supplement indicated that the target was configured with concentric circles of 100, 200, and 300
1220 ft. However, analysis of historical aerial photos (1965) shows faint concentric circles at 75, 500,
1221 and 1000 ft (Figures 7-2 and 7-3). A portion of the safety zone for INPR Site No. 1 lies within
1222 the non-FUDS property currently used by the Navy Bombing Range. Soil samples were
1223 collected from INPR Site No.1 during the PA/SI.

1224 The Demolition Area was used for the demolition of munitions between 1952 and 1960 and may
1225 be the area used by the Umatilla Ordnance Depot for demolition of unserviceable munitions.
1226 The area consists of two rows, approximately 200 ft apart (Figures 7-4, 7-5 and 7-6). Each row
1227 has approximately 20 pits (craters) spaced approximately 50 ft apart. MD was reported as
1228 embedded in the crater walls and scattered in a wide radius from the craters (USACE, 1997), and
1229 MD was found during the 2007 field activities.

1230 The Turret Gunnery Training Range was used to train B-36 Bomber gunners to fire at target
1231 drones that flew across their front. The turret gun firing points were located on current Navy
1232 Bombing Range Property and are not FUDS property. Only the downrange portion of the range
1233 is within the Boardman AFR FUDS. A portion of the safety zone is outside of the FUDS
1234 boundary on the active Navy bombing range. The range name is consistent with the ASR
1235 Supplement.

1236 Much of the northern and eastern portions of Range Complex No.1 are currently being used for
1237 irrigated crops (Figure 7-1). The southern portion of the range is used for the Boeing Antennae
1238 Test Range, and wildlife conservation area managed by The Nature Conservancy. No
1239 groundwater wells are located within the boundary of this AOC. Future land use is expected to
1240 remain the same as current land use.

1241 *7.2 Previous Investigations*

1242 The ASR visited the Range Complex No. 1 area. The area of INPR Site No. 1 was reported to be
1243 “littered with bomb bodies in sizes ranging from the 3-lb Mk 23 up to the 2,000 lb BDU-10.” In
1244 addition, the ASR reported finding “pieces of heavy metal fragments from high explosive
1245 ordnance” (USACE, 1997).

1246 The Demolition Area was also visited by the ASR team, which reported finding two rows of
1247 demolition craters, each row consisting of approximately twenty craters. The craters were used
1248 for demolition of munitions. MD was reported within and surrounding the craters. The ASR
1249 team performed a random inspection of the Turret Gunnery Training Range safety fan and did
1250 not find any MD.

1251 The PA/SI collected two surface soil samples (0 to 0.5 ft bgs) and two subsurface soil samples
1252 (0.5 to 2.0 ft) from within INPR Site No. 1 and shown on Figures 7-2 and 7-3. Samples were
1253 analyzed for metals, explosives and perchlorate.

1254 **7.3 MEC Evaluation**

1255 The likely range munitions used were:

- 1256 • INPR Site No. 1 – Mk 23, Mk 76, Mk 84, Mk 89, Mk 106, M38A2, BDU 10, and BDU
1257 33 practice bombs. In addition Weston (2004) reported finding a Mark-12 practice
1258 nuclear bomb (inert training bomb filled with concrete) and a Fuel-Air-Explosive BLU-
1259 95 bomb. The Mark-12 and BLU-95 were likely bombs that drifted over from the
1260 adjacent Navy Bomb Range. The Mark-12 has a parachute that is deployed during
1261 decent from the aircraft. The Shaw UXO safety expert reviewed the photograph of the
1262 reported BLU-95 and identified the bomb as a BLU-73. The BLU-73 contains extremely
1263 sensitive explosive components. All others contain relatively insensitive explosive
1264 components.
- 1265 • Demolition Area – C-4 Blocks, M60 igniter, detonation cord and time blasting fuze,
1266 blasting caps both electric and non-electric, all other munitions types used on the
1267 Boardman AFR. The detonation cord has a moderate explosive sensitivity risk.
- 1268 • Turret Gunnery Training Range – 20-mm Ball practice ammunition. The projectile is
1269 machined from bar steel. The ammunition has a relatively insensitive explosive risk.

1270 The types of munitions used at the Range Complex No. 1 AOC are listed above. Debris from
1271 these munitions was observed during the ASR site visit in 1997. The ASR noted that other than
1272 the Mk 23 practice bomb, the remaining bombs on INPR Site No. 1 are post Korean War
1273 vintage, particularly the BDU-10 practice nuclear bomb.

1274 **7.3.1 Field Observations and Historical Evidence of MEC**

1275 The Demolition Area and Turret Gunnery Training Range were visited during the SI field
1276 investigation. No visual reconnaissance was completed in either area as the presence of MEC
1277 and munitions debris has been previously observed. However, prior to collecting soil samples at
1278 both areas, the path from the vehicle to the sampling point was visually surveyed by a UXO
1279 technician with the aid of an all-metal detector. The paths are shown on Figures 7-1 and 7-6.
1280 MD was observed in the Demolition Area (Figure 7-6), but no debris was observed at the
1281 sampling locations for the Turret Gunnery Training Range.

1282 The ASR identified MD in both INPR Site No. 1 and the Demolition Area. None was observed
1283 in the Turret Gunnery Training Range. The PA/SI reported observing at the INPR Site No. 1
1284 Mk-76, Mk-89, Mk-84, and Mark 12 practice bombs and a BLU-95 (BLU-75) fuel air explosive
1285 bomb.

1286 *7.3.2 MEC Risk Assessment*

1287 The following section presents a qualitative assessment of the risk associated with potential
1288 MEC, as based on historical documentation and SI field observations. A MEC assessment is
1289 provided to convey relative risk on a scale from low to high and is not intended to be a thorough
1290 risk assessment as would be conducted for an RI/FS.

1291 Access to portions of Range Complex No. 1 is restricted by the Boeing Company through locked
1292 gates and fences and access is only through security personnel. Areas with restricted access
1293 include all of the Demolition Area and portions INPR Site No. 1 and the Turret Gunnery Range.
1294 Access to the remainder of INPR Site No. 1 is through locked gates. Access to those areas used
1295 for irrigated agriculture is not restricted.

1296 The overall MEC risk for Range Complex No. 1 is moderate, with the risk concentrated at INPR
1297 Site No. 1 and the Demolition Area. This assessment is based on the following:

- 1298 • Munitions debris has been reported at INPR Site No. 1 and the Demolition area;
- 1299 • The BLU-73 that was located at INPR Site No. 1 contains extremely sensitive explosive
1300 components. The munitions likely drifted over from the adjacent Navy Range;
- 1301 • Detonation cord used at the Demolition area contains sensitive explosive components;
- 1302 • A portion of the area is used for farming, undergoing yearly tillage to depths of
1303 approximately 18 inches.
- 1304 • Access to portions of INPR Site No. 1 and all of the Demolition area are controlled by
1305 security personnel. The remainder of the area of INPR Site No. 1 is controlled by locked
1306 gates. All irrigated agricultural areas are frequented by farm workers: the general public
1307 does not have routine access to the AOC.

1308 *7.4 Munitions Constituents Evaluation*

1309 Potential MC include metals associated with steel, sheet metal, paint, and other components of
1310 munitions (chromium, copper, iron, lead, mercury, molybdenum, and nickel), and explosives
1311 including nitroglycerin and pentaerythritol tetranitrate (PETN).

1312 *7.4.1 Terrestrial Pathway*

1313 Terrestrial receptors may be exposed to MC because soil may have been directly affected by the
1314 corrosion of metals from the bomb bodies or explosives used. As discussed in Section 7.2
1315 above, two surface soil samples (0 to 0.5 ft bgs) and two subsurface soil samples (0.5 to 2.0 ft
1316 bgs) were collected during the PA/SI (Figures 7-2 and 7-3). The samples were analyzed for TAL

1317 metals using EPA method CLP SOW ILM05.3 (EPA, 2004), explosives using EPA SW-846
1318 Method 8330, and perchlorate using EPA Method 314.0 (EPA, 2000) (Table 2-3).

1319 Two surface soil samples (NWO-030-0006 and NWO-030-0007) and one field duplicate (NWO-
1320 030-0013) were proposed and collected from the Demolition Area (Figures 7-4, 7-5, and 7-6).
1321 One sample location was from within a detonation crater and the second was from outside and
1322 both near locations of MD. Two soil samples (NWO-030-0008 and NWO-030-0009) were
1323 proposed and collected from the Turret Gunnery Training Range (Figure 7-7). Locations were
1324 from within the fan of the gunnery range.

1325 The four samples were analyzed for select metals (chromium, copper, iron, lead, mercury,
1326 molybdenum, and nickel) by EPA Method 6020A. In addition, samples were analyzed for
1327 aluminum and manganese for potential use in evaluating naturally occurring concentrations of
1328 metals in soil using the method of Myers and Thorbjornsen (2004). The two samples from the
1329 Demolition Area were also analyzed for explosives including nitroglycerin and PETN by EPA
1330 SW-846 Method 8330A (Table 3-1). Samples from the Turret Gunnery Training Range were not
1331 analyzed for explosives because only 20-mm ball practice rounds from ground-to-air gunnery
1332 practice were used.

1333 *7.4.1.1 Comparison to Background Data*

1334 The detected metals concentrations in soil from both SI and PA/SI sampling are listed on Tables
1335 7-1, 7-2, and 7-3. There were no metals exceedances of the background soil concentrations in
1336 any samples (Figures 7-2, 7-4, and 7-7). There were no explosives detected in the two SI
1337 samples from the Demolition Area (Figure 7-5). There were no explosives detected and no
1338 perchlorate detected in the PA/SI samples (Figure 7-3).

1339 *7.4.1.2 Comparison to Human Health Screening Values*

1340 Soil analytical results are only compared to human health screening values if background
1341 concentrations are exceeded. Because there were no exceedances of background concentrations,
1342 no comparison has been completed for this SI.

1343 *7.4.1.3 Comparison to Ecological Screening Values*

1344 Soil analytical results are only compared to ecological screening values if background
1345 concentrations are exceeded. Because there were no exceedances of background concentrations,
1346 no comparison has been completed for this SI.

1347 *7.4.2 Surface Water Pathway*

1348 The nearest surface water is Carty Reservoir located approximately 6 miles southwest of the
1349 center of the range complex. Because of the distance, there is no complete surface water
1350 pathway and no surface water or sediment samples were planned or collected.

1351 **7.4.3 Groundwater Pathway**

1352 The TPP Memorandum indicated that groundwater was a potentially affected media, with
1353 potential receptors located downgradient of the FUDS boundary (Shaw 2006b). No groundwater
1354 drinking water wells are located within the AOC, but drinking water wells are located
1355 downgradient of the AOC. As discussed in the TPP Memorandum, the PA/SI addressed the
1356 groundwater pathway for the Boardman AFR; therefore, sufficient data exists to assess
1357 groundwater. Section 2.5.3 of this SI report presents the results of the PA/SI sampling.

1358 Groundwater samples were collected within, downgradient, and cross gradient of the Boardman
1359 AFR. A total of 25 groundwater samples were collected from the area within and surrounding
1360 the Boardman AFR. Four of the samples were located on the Boardman AFR FUDS. Samples
1361 were analyzed for explosive compounds and perchlorate (see Section 2.5.3). Metals were not
1362 included in the PA/SI analytical suite; however, the metals associated with the munitions used at
1363 this AOC have a low mobility. If impacts from metals in soil were present, movement to the
1364 groundwater would not be expected. As agreed to in the TPP Memorandum, no groundwater
1365 samples were planned or collected during the SI (Shaw, 2006b).

1366 **7.4.3.1 Comparison to Background**

1367 As agreed in the TPP Memorandum, no groundwater samples were collected from within the
1368 Range Complex No. 1 AOC during the SI, and no groundwater samples were collected from the
1369 AOC during the PA/SI (Shaw, 2006b). However, as discussed in Section 2.5.3, samples were
1370 collected down and cross gradient of the AOC and FUDS. The sampling results indicated that
1371 no explosives were detected in any groundwater sample and perchlorate was detected in 18 of 25
1372 wells sampled in the PA/SI. In the 18 samples with perchlorate detections, concentrations
1373 ranged between 0.46 µg/L and 20.7 µg/L. No background value for perchlorate was established
1374 in the PA/SI. However, based on studies completed by the ODEQ and EPA (ODEQ, 2005),
1375 perchlorate is found throughout the lower Umatilla Basin in wells located up, cross and
1376 downgradient of the Boardman AFR. This indicates that the perchlorate detected in groundwater
1377 samples is not originating from sources within this AOC or the Boardman AFR FUDS.

1378 **7.4.3.2 Comparison to Human Health Screening Values**

1379 The DoD action level for perchlorate is 24 µg/L. All detected concentrations of perchlorate in
1380 the vicinity of Boardman AFR FUDS are below the DoD action level.

1381 **7.4.4 Air Pathway**

1382 Air is considered to be a potential pathway due to inhalation of MC in from blowing dust. The
1383 potential inhalation of soil particles is included in the development of health-based screening
1384 values for soil.

1385 **8.0 Demolition Area No. 2**

1386 **8.1 History and Land Use**

1387 Demolition Area No. 2 was identified during the TPP meeting. The identification was made
1388 through interviews with a property leaseholder (The Nature Conservancy) and the Oregon State
1389 Police. The AOC consists of a number of detonation craters with MD (Figure 8-1). Munitions,
1390 fuzes, and MD were recently destroyed by the Oregon State Police at this AOC.

1391 Little is known of the Demolition Area No. 2 AOC and who used it. The area appears to have
1392 been used as an ordnance disposal/demolition area. Note that the boundary for Demolition Area
1393 No. 2 is dashed because the extent of the AOC has not been verified (Figure 8-1). The dashed
1394 boundary does include extent of demolition craters observed on aerial photography. No
1395 groundwater wells are located within the boundary of this AOC. The land is currently used as a
1396 wildlife conservation area. Future land is expected to remain the same as current land use.

1397 **8.2 Previous Investigations**

1398 No previous investigations have been completed at this AOC.

1399 **8.3 MEC Evaluation**

1400 Munitions identified as having been present at the Demolition Area No. 2 include: M83 Butterfly
1401 bombs, M66 base detonator fuzes, 100-lb GP bomb base plate, C-4 blocks, detonation cord and
1402 time blasting fuze, and blasting caps (both electric and non-electric). Other munitions may have
1403 been destroyed at this site. All of the above munitions have sensitive explosive components
1404 except for the C-4 blocks.

1405 **8.3.1 Field Observations and Historical Evidence of MEC**

1406 A visual reconnaissance with the aid of an all metal detector for safety was completed as part of
1407 the SI field activities. The path of the visual reconnaissance is shown on Figure 8-1. The UXO
1408 technician reported that large accumulations of MD were observed, including heavy wall
1409 fragments. No MEC was identified.

1410 Debris from munitions was privately located by employees of The Nature Conservancy who
1411 manage a portion of land for critical wildlife habitat and Oregon State Police EOD unit. In June
1412 2006 ordnance disposal of an M83 Butterfly bomb was completed by the Oregon State Police.

1413 **8.3.2 MEC Risk Assessment**

1414 The following section presents a qualitative assessment of the risk associated with potential
1415 MEC, as based on historical documentation and SI field work. A MEC assessment is provided to
1416 convey relative risk on a scale from low to high and is not intended to be a thorough risk
1417 assessment as would be conducted for an RI/FS.

1418 Access to Demolition Area No. 2 is restricted by locked gates and fences. Access is available
1419 through The Nature Conservancy.

1420 The MEC risk for Demolition Area No. 2 is moderate. This assessment is based on:

- 1421 • Recent find and demolition of a M83 butterfly bomb by Oregon State Police EOD Unit;
- 1422 • Observed accumulations of MD;
- 1423 • Sensitive fuzes contained in reported MEC and MD;
- 1424 • Access through locked but unpatrolled gates.

1425 ***8.4 Munitions Constituents Evaluation***

1426 Potential MC include metals associated with steel, sheet metal, paint, and other components of
1427 munitions (chromium, copper, iron, lead, mercury, molybdenum, and nickel) and explosives
1428 (TNT, tetryl, hexahydro-1,3,5-trinitro-1,3,5-triazine [RDX], and PETN). Perchlorate was not
1429 identified as a potential MC at Demolition Area No. 2. Nonetheless, discussion of perchlorate
1430 analytical results from groundwater samples collected during the PA/SI is included in the
1431 following evaluation for completeness.

1432 ***8.4.1 Terrestrial Pathway***

1433 Terrestrial receptors may be exposed to MC because soil may have been directly affected by the
1434 corrosion of metals from the bomb bodies or explosives used. Two surface soil samples (NWO-
1435 030-0010 and NWO-030-0011) were proposed and collected from the Demolition Area No. 2.
1436 The sample locations are shown on Figures 8-2 and 8-3. The samples were analyzed for select
1437 metals (chromium, copper, iron, lead, mercury, molybdenum, and nickel) by EPA Method
1438 6020A. In addition, samples were analyzed for aluminum and manganese for potential use in
1439 evaluating naturally occurring concentrations of metals in soil using the method of Myers and
1440 Thorbjornsen (2004). The soil sample was also analyzed for explosives including nitroglycerin
1441 and PETN by EPA SW-846 Method 8330A (Table 3-1).

1442 ***8.4.1.1 Comparison to Background Data***

1443 Detected metals were compared to background soil concentrations (Table 8-1). There were no
1444 exceedances of background soil concentrations. There were no detections of explosives in either
1445 sample.

1446 ***8.4.1.2 Comparison to Human Health Screening Values***

1447 Soil analytical results are only compared to human health screening values if background
1448 concentrations are exceeded. Because there were no exceedances of background concentrations,
1449 no comparison has been completed for this SI.

1450 **8.4.1.3 Comparison to Ecological Screening Values**

1451 Soil analytical results are only compared to ecological screening values if background
1452 concentrations are exceeded. Because there were no exceedances of background concentrations,
1453 no comparison has been completed for this SI.

1454 **8.4.2 Surface Water Pathway**

1455 The nearest surface water is Carty Reservoir, located approximately 4 miles to the southwest.
1456 Because of this distance, there is no complete surface water pathway. No surface water or
1457 sediment samples were planned or collected from the Demolition Area No. 2.

1458 **8.4.3 Groundwater Pathway**

1459 The TPP Memorandum indicated that groundwater was a potentially affected media, with
1460 potential receptors located downgradient of the FUDS boundary (Shaw, 2006b). No
1461 groundwater drinking water wells are located within the AOC, but drinking water wells are
1462 located downgradient of the Demolition Area No. 2 AOC. As discussed in the TPP
1463 Memorandum, the PA/SI addressed the groundwater pathway for the Boardman AFR, and
1464 sufficient data exist to assess groundwater. Section 2.5.3 of this SI report presents the results of
1465 the PA/SI sampling.

1466 Groundwater samples were collected within, downgradient, and cross gradient of the Boardman
1467 AFR. A total of 25 groundwater samples were collected from the area within and surrounding
1468 the Boardman AFR. Four of the samples were located on the Boardman AFR FUDS. Samples
1469 were analyzed for explosive compounds and perchlorate (see Section 2.5.3). Metals were not
1470 included in the PA/SI analytical suite. However, the metals associated with the munitions used
1471 at this AOC have a low mobility, and if impacts from metals in soil were present, movement to
1472 the groundwater would not be expected. As agreed to in the TPP Memorandum, no groundwater
1473 samples were planned or collected during the SI (Shaw, 2006b).

1474 **8.4.3.1 Comparison to Background**

1475 As agreed in the TPP Memorandum, no groundwater samples were collected from within the
1476 Demolition Area No. 2 AOC during the SI, and no groundwater samples were collected from the
1477 AOC during the PA/SI (Shaw, 2006b). However, as discussed in Section 2.5.3, samples were
1478 collected down and cross gradient of the AOC and FUDS. The sampling results indicated that
1479 no explosives were detected in any groundwater sample and perchlorate was detected in 18 of 25
1480 wells sampled in the PA/SI. In the 18 samples with perchlorate detections concentrations ranged
1481 between 0.46 µg/L and 20.7 µg/L. No background value for perchlorate was established in the
1482 PA/SI. However, based on studies completed by the ODEQ and EPA (ODEQ, 2005),
1483 perchlorate is found throughout the lower Umatilla Basin in wells located up, cross and
1484 downgradient of the Boardman AFR. This indicates that the perchlorate detected in groundwater
1485 samples is not originating from sources within this AOC or the Boardman AFR FUDS.

1486 *8.4.3.2 Comparison to Human Health Screening Values*

1487 The DoD action level for perchlorate is 24 µg/L. All detected concentrations of perchlorate in
1488 the vicinity of Boardman AFR FUDS are below the DoD action level.

1489 *8.4.4 Air Pathway*

1490 Air is considered to be a potential pathway due to inhalation of MC in from blowing dust. The
1491 potential inhalation of soil particles is included in the development of health-based screening
1492 values for soil.

1493 **9.0 Impact Area**

1494 **9.1 History and Land Use**

1495 The Impact Area was identified following the TPP meeting. The identification was made
1496 through interviews with a property leaseholder (The Nature Conservancy) and located on aerial
1497 photography. According to The Nature Conservancy, the AOC consists of a number of impact
1498 craters with a small amount of MD. The AOC is locally known as the “Ship in the Desert”.
1499 Apparent impact craters are also visible on aerial photographs (Figure 9-1).

1500 Little is known of the Impact Area and who used it. The extent of the Impact Area is not known
1501 and therefore no boundary is placed on figures presented in this report. One groundwater well is
1502 located approximately 1 mile south (upgradient) of the AOC. The land is currently used as a
1503 wildlife conservation area. Future land use is expected to remain the same as current land use.

1504 The area appears to have been used as an unofficial practice bomb target. Review of historical
1505 and recent aerial photographs does not indicate any established targets. The period of use is
1506 unknown.

1507 **9.2 Previous Investigations**

1508 No previous investigations have been completed at the Impact Area.

1509 **9.3 MEC Evaluation**

1510 The potential munitions used at this AOC are AN-Mk 5, AN-Mk 23, and AN-Mk 43 practice
1511 bombs, which were the standard practice bombs used at Boardman AFR during World War II.
1512 These practice bombs contained black powder and a red or white phosphorus pyrotechnic
1513 spotting charge but contain no sensitive explosive components. The use of other practice bombs
1514 is possible.

1515 **9.3.1 Field Observations and Historical Evidence of MEC**

1516 A limited visual field reconnaissance aided by an all-metal detector for safety was completed at
1517 the Impact Area AOC. The path is shown on Figure 9-1. No MEC or MD was identified and no
1518 impact craters were observed. An employee of the Nature Conservancy stated that MD has been
1519 observed during The Nature Conservancy work in the area.

1520 **9.3.2 MEC Risk Assessment**

1521 The following section presents a qualitative assessment of the risk associated with potential
1522 MEC, as based on historical documentation and limited visual reconnaissance. A MEC
1523 assessment is provided to convey relative risk on a scale from low to high and is not intended to
1524 be a thorough risk assessment as would be conducted for an RI/FS.

1525 Access to the Impact Area is restricted by locked gates and fences. Access is controlled by The
1526 Nature Conservancy.

1527 The MEC risk for the Impact Area AOC is low. This assessment is based on:

- 1528 • No MEC has been reported at this AOC;
- 1529 • No observed accumulations of MD during the SI. However, an employee of The Nature
1530 Conservancy stated that he has observed MD at the AOC;
- 1531 • Munitions assumed to have been used at the Impact Area contain no sensitive explosive
1532 components;
- 1533 • Access to area is only through locked gates.

1534 **9.4 Munitions Constituents Evaluation**

1535 Potential MC at the Impact Area includes metals associated with steel, sheet metal, paint, and
1536 other components of munitions metals (chromium, copper, iron, lead, molybdenum, and nickel)
1537 from bomb bodies. Black powder was the explosive most likely used; however, other explosives
1538 were possibly used. Perchlorate was not identified as a potential MC at the Impact Area.
1539 Nonetheless, discussion of perchlorate analytical results from groundwater samples collected
1540 during the PA/SI is included in the following evaluation for completeness.

1541 **9.4.1 Terrestrial Pathway**

1542 Terrestrial receptors may be exposed to MC because soil may have been directly affected by the
1543 corrosion of metals from the bomb bodies or explosives used. One surface soil sample (NWO-
1544 030-0012) was proposed and collected from the Impact Area. The samples were analyzed for
1545 select metals (chromium, copper, iron, lead, mercury, molybdenum, and nickel) by EPA Method
1546 6020A. In addition, samples were analyzed for aluminum and manganese for potential use in
1547 evaluating naturally occurring concentrations of metals in soil using the method of Myers and
1548 Thorbjornsen (2004). The two samples from the Demolition Area were also analyzed for
1549 explosives including nitroglycerin by EPA SW-846 Method 8330A (Table 3-1). The sample
1550 location and results are shown on Figures 9-2 and 9-3).

1551 **9.4.1.1 Comparison to Background Data**

1552 Detected metals were compared to background soil concentrations (Table 9-1). There were no
1553 exceedances of background soil concentrations.

1554 **9.4.1.2 Comparison to Human Health Screening Values**

1555 Soil analytical results are only compared to human health screening values if background
1556 concentrations are exceeded. Because there were no exceedances of background concentrations,
1557 no comparison has been completed for this SI.

1558 **9.4.1.3 Comparison to Ecological Screening Values**

1559 Soil analytical results are only compared to ecological screening values if background

1560 concentrations are exceeded. Because there were no exceedances of background concentrations,
1561 no comparison has been completed for this SI.

1562 *9.4.2 Surface Water Pathway*

1563 The surface water pathway at Boardman AFR is evaluated through sediments. The potential
1564 receptors for sediments are conservation area workers and wildlife. One sediment sample
1565 (NWO-030-1002) was proposed from this AOC (Figures 9-2 and 9-3). The sediment sample
1566 was analyzed for select metals (chromium, copper, iron, lead, mercury, molybdenum, and nickel)
1567 by EPA Method 6020A. In addition, aluminum and manganese were analyzed as they may be
1568 useful in evaluating naturally occurring concentrations of metals in soil using the method of
1569 Myers and Thorbjornsen (2004). The sediment sample was also analyzed for explosives
1570 including nitroglycerin by EPA SW-846 Method 8330A (Table 3-1).

1571 *9.4.2.1 Comparison to Background Data*

1572 The detected metals concentrations in sediment are listed on Table 9-2. There were no
1573 significant exceedances (greater than three times maximum background concentration) of the SI
1574 background sediment concentrations. No explosive compounds were detected.

1575 *9.4.2.2 Comparison to Human Health Screening Values*

1576 Sediment analytical results are only compared to human health screening values if background
1577 concentrations are significantly exceeded. Because there were no significant exceedances of
1578 background concentrations, no comparison has been completed for this SI.

1579 *9.4.2.3 Comparison to Ecological Screening Values*

1580 Sediment analytical results are only compared to ecological screening values if background
1581 concentrations are significantly exceeded. Because there were no significant exceedances of
1582 background concentrations, no comparison has been completed for this SI.

1583 *9.4.3 Groundwater Pathway*

1584 The TPP Memorandum indicated that groundwater was a potentially affected media, with
1585 potential receptors located downgradient of the FUDS boundary (Shaw 2006b). No groundwater
1586 drinking water wells are within the AOC, but drinking water wells are located downgradient of
1587 the Impact Area AOC. As discussed in the TPP Memorandum, the PA/SI addressed the
1588 groundwater pathway for the Boardman AFR; therefore, sufficient data exists to assess
1589 groundwater. Section 2.5.3 of this SI report presents the results of the PA/SI sampling.

1590 Groundwater samples were collected within, downgradient, and cross gradient of the Boardman
1591 AFR. A total of 25 groundwater samples were collected from the area within and surrounding
1592 the Boardman AFR. Four of the samples were located on the Boardman AFR FUDS. Samples
1593 were analyzed for explosive compounds and perchlorate (see Section 2.5.3). Metals were not
1594 included in the PA/SI analytical suite. However, the metals associated with the munitions used
1595 at this AOC have a low mobility, and if impacts from metals in soil were present movement to

1596 the groundwater would not be expected. As agreed to in the TPP Memorandum, no groundwater
1597 samples were planned or collected during the SI (Shaw, 2006b).

1598 *9.4.3.1 Comparison to Background*

1599 As agreed in the TPP Memorandum, no groundwater samples were collected from within the
1600 Impact Range AOC during the SI and no groundwater samples were collected from the AOC
1601 during the PA/SI (Shaw, 2006b). However, as discussed in Section 2.5.3, samples were
1602 collected down and cross gradient of the AOC and FUDS. The sampling results indicated that
1603 no explosives were detected in any groundwater sample and perchlorate was detected in 18 of 25
1604 wells sampled in the PA/SI. In the 18 samples with perchlorate detections concentrations ranged
1605 between 0.46 µg/L and 20.7 µg/L. No background value for perchlorate was established in the
1606 PA/SI. However, based on studies completed by the ODEQ and EPA (ODEQ, 2005),
1607 perchlorate is found throughout the lower Umatilla Basin in wells located up, cross and
1608 downgradient of the Boardman AFR. This indicates that the perchlorate detected in groundwater
1609 samples is not originating from sources within this AOC or the Boardman AFR FUDS.

1610 *9.4.3.2 Comparison to Human Health Screening Values*

1611 The DoD action level for perchlorate is 24 µg/L. All detected concentrations of perchlorate in
1612 the vicinity of Boardman AFR FUDS are below the DoD action level.

1613 *9.4.4 Air Pathway*

1614 Air is considered to be a potential pathway due to inhalation of MC in from blowing dust. The
1615 potential inhalation of soil particles is included in the development of health-based screening
1616 values for soil.

1617 **10.0 Summary and Conclusions**

1618 The conclusions of the SI are presented in this section. Recommendations are presented in
 1619 Section 11.0. Updated CSMs are presented in Appendix J.

1620 The six AOCs at Boardman AFR include Target No. 1, Target No. 2, Carty Reservoir Bomb
 1621 Target, Range Complex No. 1, Demolition Area No. 2, and the Impact Area. The former
 1622 Boardman AFR is included on the MMRP Inventory in the 2006 ARC (DoD, 2006), and in the
 1623 ASR Supplement (USACE, 2004b), with four identified ranges and three sub-ranges as follows:

Range Name	Range ID	Approximate Area (acres)	UTM Coordinates* (meters)
Target No. 1	F10OR016001R01	649	N 5063404; E 279733
Target No. 2	F10OR016001R02	649	N 5072555; E 280149
Carty Reservoir Bomb Target	F10OR016001R03	649	N 5061866; E 279539
Range Complex No. 1	F10OR016001R03	9,505	N 5072555; E 280149
INPR Site No. 1	F10OR016001R03-SR01	536	N 5072555; E 280149
Demolition Area	F10OR016001R03-SR02	157	N 5072555; E 280149
Turret Gunnery Training Range	F10OR016001R03-SR03	9,443	N 5072555; E 280149

1624 *Coordinates for the ranges are in UTM Zone 11N, NAD 1983.

1625 Of the 649 total acres reported for the Carty Reservoir Bomb Target, the ASR Supplement
 1626 indicates 325 acres were on land and 324 acres were water acres. In addition to the four ranges
 1627 and three sub-ranges, two other areas which were not identified in the range inventory, were
 1628 evaluated in this SI. The two areas including coordinates are as follows:

- 1629 • Demolition Area No. 2 N 5065433; E 284894
- 1630 • Impact Area N 5059240; E 282333

1631 **10.1 Target No. 1**

1632 A visual reconnaissance of Target No. 1 was conducted prior to collecting a soil sample. MD,
 1633 likely from a M38A2 practice bomb was identified. Previously MD was identified during the
 1634 INPR site visit. No MEC has been identified at this AOC. The risk for potential MEC at Target
 1635 No. 1 is considered to be low based on the following:

- 1636 • No MEC has ever been reported or found;
- 1637 • MD has been reported for this AOC;
- 1638 • The reported munitions used at this AOC are practice munitions only;
- 1639 • The munitions used at this target used relatively insensitive explosive components;
- 1640 • The area is used for farming, undergoing yearly tillage to depths of approximately 18
- 1641 inches without MEC discovery; and
- 1642 • The unfenced area is not frequented by the public and only farm workers of PGE workers
- 1643 have access to the area.

1644 One surface soil sample was collected from Target No. 1 and analyzed for select metals and
1645 explosives. Detected results were compared to background concentrations and there were no
1646 exceedances of background and there were no detections of explosive compounds. Because
1647 there were no exceedances of background concentrations, no comparison to human health or
1648 ecological screening values was completed. No surface water or sediment samples were
1649 collected from this AOC. Surface water and sediments were addressed under the adjacent Carty
1650 Reservoir Bomb Target (Section 10.3)

1651 During the 2004 Weston PA/SI groundwater samples were collected from two wells located in
1652 the vicinity of the Target No. 1. One well was located upgradient of Target No.1 and one well
1653 was located within the Target No. 1 AOC boundary. Samples were analyzed for perchlorate. In
1654 addition, both of these wells are sampled annually by PGE for metals. Analytical results indicate
1655 that metals in the groundwater from the well located within Target No. 1 were below the
1656 background well concentrations. An exception to this was for iron, which significantly exceeded
1657 (three times the background concentration) the background concentration. However, the
1658 concentration was well below the human health screening value. In addition, iron was not
1659 detected in soil at concentrations that are above soil background concentrations. Molybdenum
1660 and nickel were not included in the groundwater analytical suite completed by PGE and no
1661 evaluation was completed for these analytes of concern. Perchlorate was detected in the
1662 upgradient well but not the downgradient well. The detection in the upgradient well was below
1663 the DoD action level.

1664 *10.2 Target No. 2*

1665 No MEC or MD was identified during the SI field activities. MEC has been identified as
1666 recently as Spring 2006 and destroyed by a Navy EOD unit. MD was observed during the ASR
1667 field visit. The risk for potential MEC at Target No. 2 is considered to be moderate based on the
1668 following:

- 1669 • MEC has been reported as recently as March 2006, recent finds were AN-M57 GP
- 1670 practice bombs;

- 1671 • All munitions contained relatively insensitive explosive components except for the AN-
1672 M57 which may have had a sensitive fuze;
- 1673 • The area is used for farming, undergoing yearly tillage to depths of approximately 18
1674 inches and MEC is periodically unearthed;
- 1675 • The unfenced area is frequented by farm workers; the general public does not have
1676 routine access to the AOC.

1677 Two surface soil samples were collected during the SI field activities and analyzed for select
1678 metals and explosives. In addition, two surface soil samples and two subsurface soil samples
1679 were collected from this AOC during the PA/SI (Weston, 2004). The PA/SI samples were
1680 analyzed for metals and perchlorate. Analytical results for metals for all soil samples were
1681 below Boardman AFR background values. There were no explosive or perchlorate detections.

1682 No surface water or sediment samples were collected during the SI field activities at Target No.
1683 2. Five surface water samples and one sediment sample were collected during the PA/SI from
1684 locations located west of the Target No. 2. The surface water samples were analyzed for
1685 perchlorate and the sediment sample was analyzed for metals. Perchlorate was detected in all
1686 surface water samples. All concentrations were below the DoD action level and below available
1687 ecological screening values. The highest perchlorate concentration was in the most upstream
1688 sample and the lowest was in the most downstream sample. The most upstream sample location
1689 is upstream of all FUDS AOCs. These results indicate that the source of perchlorate in Sixmile
1690 Canyon Creek is not from FUDS related activity. The metals analytical results from the
1691 sediment sample were below background concentration.

1692 *10.3 Carty Reservoir Bomb Target*

1693 No MEC or MD was observed during the SI field activities. During the ASR field visit, large
1694 amounts of MD were observed as well as relatively intact, fuzed and suspected live munitions.
1695 The risk for potential MEC at Carty Reservoir Bomb Target is considered to be moderate based
1696 on the following:

- 1697 • MEC was reported during the ASR in 1995;
- 1698 • The M75/M84 target marker bombs may have contained sensitive fuzing;
- 1699 • The area is used for farming, undergoing yearly tillage to depths of approximately 18
1700 inches;
- 1701 • The unfenced area is frequented by farm workers; the general public does not have
1702 routine access to the AOC.

1703 Two surface soil samples were collected during the SI field activities and analyzed for select
1704 metals. One of the two samples was also analyzed for explosives. Metal analytical results were
1705 all below Boardman AFR background values. There were no explosives detections. One
1706 sediment sample was collected during the SI field activities and analyzed for select metals and

1707 explosives. Metals analytical results were all below background concentrations. There were no
1708 explosive detections. A surface water sample was collected from Carty Reservoir during the
1709 PA/SI (Weston, 2004). The sample was analyzed for perchlorate. There was no perchlorate
1710 detected.

1711 *10.4 Range Complex No. 1*

1712 Range Complex Consists of three sub-ranges: INPR Site No. 1, the Demolition Area, and the
1713 Turret Gunnery Training Range. Historically, MD has been reported at both INPR Site No. 1 (a
1714 former bombing target) and the Demolition Area. During the SI Field work MD was observed at
1715 the Demolition Area. No MEC has been reported at Range Complex No. 1. No MD was
1716 observed or has been reported within the Turret Gunnery Training Range. The risk for potential
1717 MEC at Range Complex No. 1 is considered to be moderate based on the following:

- 1718 • Munitions debris has been reported at INPR Site No. 1 and the Demolition area;
- 1719 • The BLU-73 that was located at INPR Site No. 1 contains extremely sensitive explosive
1720 components. The munitions likely drifted over from the adjacent Navy Range activities;
- 1721 • Detonation cord used at the Demolition area contains sensitive explosive components;
- 1722 • A portion of the area is used for farming, undergoing yearly tillage to depths of
1723 approximately 18 inches.
- 1724 • Access to portions of INPR Site No. 1 and all of the Demolition Area are controlled by
1725 security personnel. The remainder of the area of INPR Site No. 1 is controlled by locked
1726 gates. All irrigated agricultural areas are frequented by farm workers: the general public
1727 does not have routine access to the AOC.

1728 Two soil samples each were collected from the Demolition Area and the Turret Gunnery
1729 Training Range during the SI field activities. The two samples from the Demolition Area were
1730 analyzed for select metals and explosives and the two samples from the Turret Gunnery Training
1731 Range were analyzed for select metals only. Two samples were also collected during the PA/SI
1732 (Weston, 2004) at INPR Site No. 1 and analyzed for metals, explosives, and perchlorate. Metals
1733 analytical results for all samples were below Boardman AFR background concentrations. There
1734 were no detections of explosives or perchlorate.

1735 No groundwater samples were collected from Range Complex No. 1. However the PA/SI
1736 (Weston, 2004) collected groundwater samples from wells located cross and down gradient of
1737 the FUDS. Samples were analyzed for explosives and perchlorate. There were no explosive
1738 detections. Perchlorate was detected in 18 of 25 wells sampled. All results were below the DoD
1739 action level. The ODEQ has identified perchlorate in groundwater throughout the lower
1740 Umatilla Basin in wells located within 10 miles from the Boardman AFR (ODEQ, 2005). Based
1741 on studies completed by the ODEQ and EPA (ODEQ, 2005), perchlorate is found throughout the
1742 lower Umatilla Basin in wells located up, cross and downgradient of the Boardman AFR. This

1743 indicates that the perchlorate detected in groundwater samples is not originating from sources
1744 within this AOC or the Boardman AFR FUDS.

1745 **10.5 Demolition Area No. 2**

1746 MEC has been identified within the Demolition Area No. 2 vicinity as recently as June 2006. A
1747 visual reconnaissance of the area was completed during the SI field activities and large quantities
1748 of MD were observed in the area of the disposal pits. Based on the reported presence of MEC
1749 and MD, the risk for potential MEC is considered moderate based on the following:

- 1750 • Recent find and demolition of a M83 butterfly bomb by Oregon State Police EOD Unit;
- 1751 • Observed accumulations of MD;
- 1752 • Sensitive fuzes contain in reported MEC and MD;
- 1753 • Access through locked gates but unpatrolled.

1754 Two soil samples were collected from Demolition Area No. 2 and analyzed for select metals and
1755 explosives. All metals detections were below Boardman AFR background concentrations.
1756 There were no explosive detections.

1757 No groundwater samples were collected from Demolition Area No. 2. However the PA/SI
1758 collected groundwater sample from wells located cross and down gradient of the FUDS (Weston,
1759 2004). Samples were analyzed for explosives and perchlorate. There were no explosive
1760 detections. Perchlorate was detected in 18 of 25 wells sampled. All results were below the DoD
1761 action level. The ODEQ has identified perchlorate in groundwater throughout the lower
1762 Umatilla Basin in wells located within 10 miles from the Boardman AFR (ODEQ, 2005). Based
1763 on studies completed by the ODEQ and EPA (ODEQ, 2005), perchlorate is found throughout the
1764 lower Umatilla Basin in wells located up, cross, and downgradient of the Boardman AFR. This
1765 indicates that the perchlorate detected in groundwater samples is not originating from sources
1766 within this AOC or the Boardman AFR FUDS.

1767 **10.6 Impact Area**

1768 MD has been reported by workers in the vicinity of the Impact Area. No MEC has been
1769 reported. No MEC or MD was identified during the SI field visual reconnaissance. The risk for
1770 potential MEC at the Impact Area is considered to be low based on the following:

- 1771 • No MEC has been reported at this AOC;
- 1772 • No observed accumulations of MD during the SI. However, an employee of The Nature
1773 Conservancy stated that he has observed MD at the AOC;
- 1774 • Munitions assumed to have been used at the Impact Area contain no sensitive explosive
1775 components;
- 1776 • Access to area is only through locked gates.

1777 One soil sample and one sediment sample were collected from the Impact Area. Samples were
1778 analyzed for select metals and explosives. All metals results were below Boardman AFR
1779 background concentrations and no explosives were detected.

1780 No groundwater samples were collected from the Impact Area. However the PA/SI (Weston,
1781 2004) collected groundwater sample from wells located cross and down gradient of the FUDS.
1782 Samples were analyzed for explosives and perchlorate. There were no explosive detections.
1783 Perchlorate was detected in 18 of 25 wells sampled. All results were below the DoD action
1784 level. The ODEQ has identified perchlorate in groundwater throughout the lower Umatilla Basin
1785 in wells located within 10 miles from the Boardman AFR (ODEQ, 2005). Based on studies
1786 completed by the ODEQ and EPA (ODEQ, 2005), perchlorate is found throughout the lower
1787 Umatilla Basin in wells located up, cross and downgradient of the Boardman AFR. This
1788 indicates that the perchlorate detected in groundwater samples is not originating from sources
1789 within this AOC or the Boardman AFR FUDS.

1790 ***11.0 Recommendations***

1791 Results of the SI provide the basis for conclusions and/or recommendations for further actions at
1792 each of the AOCs.

1793 ***11.1 Target No. 1***

1794 Based on historical evidence and results from the SI field activities, there is potential for MEC at
1795 Target No. 1. Analytical results indicate that all soil metals results are below Boardman AFR
1796 background values and no explosives were detected. Groundwater analytical results indicate that
1797 metals concentrations are similar to background, with the exception of iron, which was above the
1798 background value but below the human health screening value. In addition, iron is not a
1799 CERCLA hazardous substance, and therefore a recommendation based on iron alone cannot be
1800 used to recommend RI/FS. Perchlorate was not detected in the groundwater sample from within
1801 the AOC. Based on the potential for MEC, a recommendation for a RI/FS limited to further
1802 evaluation of the MEC hazard is made for Target No. 1. Additionally, because all analytical
1803 results from samples collected in and around this MRS were either below background
1804 concentrations or screening values, Target No. 1 is recommended for NDAI relative to MC and
1805 no additional investigations of any potential MC, chemical contamination, or perchlorate are
1806 recommended.

1807 ***11.2 Target No. 2***

1808 Based on historical evidence and recent MEC finds, there is potential for MEC at Target No. 2.
1809 Analytical results indicate that all soil metals results are below Boardman AFR background
1810 values and no explosives were detected. While PA/SI (Weston, 2004) surface water analytical
1811 results indicate that perchlorate is present, the upstream sampling locations with the highest
1812 perchlorate concentrations indicate that the perchlorate is not from Target No. 2 or any other
1813 known FUDS AOC. Based on the potential for MEC, a recommendation for a RI/FS limited to
1814 further evaluation of the MEC hazard is made for Target No. 2. Additionally, because all
1815 analytical results from samples collected in and around this MRS were either below background
1816 concentrations or screening values, Target No. 2 is recommended for NDAI relative to MC and
1817 no additional investigations of any potential MC, chemical contamination, or perchlorate are
1818 recommended.

1819 ***11.3 Carty Reservoir Bomb Target***

1820 Based on historical evidence, there is potential for MEC at Carty Reservoir Bombing Target.
1821 Analytical results indicate that all soil metals results are below Boardman AFR background
1822 values and no explosives were detected. Surface water and sediment sample analytical results
1823 indicate that there are no observed adverse impacts. Based on the potential for MEC, a
1824 recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Carty

1825 Reservoir Bomb Target. Additionally, because all analytical results from samples collected in
1826 and around this MRS were either below background concentrations or screening values, Carty
1827 Reservoir Bomb Target is recommended for NDAI relative to MC and no additional
1828 investigations of any potential MC, chemical contamination, or perchlorate are recommended.

1829 **11.4 Range Complex No. 1**

1830 Based on historical evidence and results from the SI field activities, there is potential for MEC at
1831 Range Complex No.1. Analytical results indicate that all soil metals results are below Boardman
1832 AFR background values and no explosives or perchlorate were detected, indicating no observed
1833 adverse impacts from MC at Range Complex No. 1. Based on the potential for MEC, a
1834 recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Range
1835 Complex No. 1. Additionally, because all analytical results from samples collected in and
1836 around this MRS were either below background concentrations or screening values, Range
1837 Complex No. 1 is recommended for NDAI relative to MC and no additional investigations of any
1838 potential MC, chemical contamination, or perchlorate are recommended.

1839 **11.5 Removal Actions**

1840 Section 1.3 identified as one of the decision rules, evaluation of whether a removal action is
1841 warranted. A removal action would be warranted if a high MEC hazard or elevated MC risk was
1842 identified. There is no indication that a high MEC risk is present at Boardman AFR. No MEC
1843 was found or identified during the SI. MEC has been identified on remote and restricted access
1844 lands as recently as spring 2006. The exposure risk for MEC was evaluated to be moderate.
1845 Therefore, a removal action is not recommended for the Boardman AFR.

1846 **11.6 Munitions Response Areas**

1847 Results of the SI field activities provide the basis for identifying MRSs and, as appropriate,
1848 munitions response areas (MRAs), and for scoring each MRS using the MRSPP. A MRA is any
1849 area on a defense site that is known or suspected to contain MEC or MC, and may contain one or
1850 more MRS.

1851 Based on the use and physical distribution of the AOCs at Boardman AFR, four MRSs are
1852 identified (Figure 11-1):

- 1853 1. MRS #1 – Target No. 1.
- 1854 2. MRS #2 – Target No. 2.
- 1855 3. MRS #3 – Carty Reservoir Bomb Target.
- 1856 4. MRS #4 – Range Complex No. 1.

1857 MRSPP scoring is provided in Appendix K.

1858 For the purposes of scoring, the Range Inventory list is used, as per USACE direction. MRS No.
1859 1 - Target No. 1 consists of the area shown in the Range Inventory. MRS No. 2 is Target No. 2,

1860 MRS No. 3 is the Carty Reservoir Bomb Target, and MRS No. 4 is the Range Complex No. 1
1861 which includes INPR Site No. 1, the Demolition Area, and the Turret Gunnery Range.

1862 Based on USACE guidance, only those ranges identified in the ARC (DoD, 2006) are assigned
1863 to an MRA/MRS and scored using the MRSPP protocols until DoD can determine the eligibility
1864 of the other AOCs. Recommendations for identification for those remaining AOC are provided
1865 below:

- 1866 • Demolition Area No. 2 – Recommended to be identified as an MRS. The area has
1867 been used as a munitions demolition area as evidenced by several rows of detonation
1868 craters and a high density of MD. MEC was located and destroyed in June 2006.
1869 The MEC risk is considered to be moderate. Access to this area is restricted by the
1870 property leaseholder The Nature Conservancy.
- 1871 • Impact Area – Recommended to be identified as an MRS. The area may have been
1872 used for unregulated practice bombing. The Nature Conservancy workers have stated
1873 that MD from practice bombs has been found in the area. The SI field team did not
1874 identify any craters or MD.
- 1875 • If Demolition Area No. 2 and the Impact Area are identified as MRSs, it is
1876 recommended that additional investigations for MEC be completed. Additional
1877 investigations for MC are not recommended, as concentrations of MC in samples
1878 collected from these two AOCs did not exceed site background or screening values.

1879 It is recommended that areas where MEC has been reported but are not included in the four
1880 MRSs presented above or the two additional AOCs recommended for identification as an MRS,
1881 be further investigated to determine whether additional MEC is present in the vicinity.

1882 **11.7 MRSPP Scoring**

1883 Draft MRSPP scoring was completed for the four identified MRSs. The priority scoring ranges
1884 from 1 to 8 (highest to lowest). The draft priority scores for the four MRSs are:

MRS	MRSPP Priority Score
Target No. 1	6
Target No. 2	4
Carty Reservoir Bomb Target	3
Range Complex No. 1	4

1885

1886 With the exception of Target No. 1, none of the MRSs presented sufficient risk to human health
1887 or the environment from MC to merit valuation under the HHE MRSPP module. Thus, in all but
1888 Target No. 1, the MRSs received the HHE rating of “No Known or Suspected MC Hazard.”
1889 Target No. 1 was assigned value under the HHE module due to the presence of iron
1890 concentrations above the background values in a groundwater sample collected onsite. Overall,
1891 the MRSPP priority scores for the Boardman AFR MRSs reflect the risk of explosive hazards,

1892 not chemical contamination at the sites. Note that these MRSPP priority scores are draft and
1893 additional review by DoD will be completed.

1894 **12.0 References**

- 1895 10 USC 101. *Definitions*. U.S. Government Printing Office. January 20, 2004. Website:
1896 http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=browse_usc&docid=Cite:+10USC101
- 1897 10 USC 2701 et seq. *Environmental Restoration*. U.S. Government Printing Office. January 20,
1898 2004. Website: [http://frwebgate.access.gpo.gov/cgi-](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=browse_usc&docid=Cite:+10USC2701)
1899 [bin/getdoc.cgi?dbname=browse_usc&docid=Cite:+10USC2701](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=browse_usc&docid=Cite:+10USC2701)
- 1900 32 CFR 179.3. 2006. Munitions Response Site Prioritization Protocol (MRSP) – Definitions. July
1901 1, 2006. http://www.access.gpo.gov/nara/cfr/waisidx_06/32cfr179_06.html.
- 1902 40 CFR 300. National Oil and Hazardous Substances Pollution Contingency Plan. 59 Federal
1903 Register 47416, September 15, 1994.
- 1904 42 USC 9601. *Hazardous Substances Releases, Liability, and Compensation*. U.S. Government
1905 Printing Office. January 7, 2003. Website: [http://frwebgate5.access.gpo.gov/cgi-](http://frwebgate5.access.gpo.gov/cgi-bin/waisgate.cgi?WAISdocID=209840153119+0+0+0&WAISaction=retrieve)
1906 [bin/waisgate.cgi?WAISdocID=209840153119+0+0+0&WAISaction=retrieve](http://frwebgate5.access.gpo.gov/cgi-bin/waisgate.cgi?WAISdocID=209840153119+0+0+0&WAISaction=retrieve)
- 1907 70 FR 58016. 2005. Federal Register, Vol. 70, No. 192. *Rules and Regulations – Munitions*
1908 *Response Site Prioritization Protocol*, Preamble. Codified 32 CFR Part 179. October 5, 2005.
- 1909 70 FR 58028. Federal Register, Vol. 70, No. 192. *Munitions Response Site Prioritization Protocol*,
1910 *Final Rule*. Codified 32 CFR Part 179. October 5, 2005.
- 1911 Anderson, Steve. 2006. Email from S. Anderson (USACE) to D. Landon (Shaw). Boardman Air
1912 Force Bombing Range FUDS MMRP-SI TPP and Public Meetings. July 31, 2006.
- 1913 ASTM International (ASTM). 2006. ASTM E 1527-05, *Standard Practice for Environmental Site*
1914 *Assessments: Phase I Environmental Site Assessment Process*.
- 1915 Department of Army. 2005. *Munitions Response Terminology*. Memorandum, Raymond J. Fatz.
1916 April 21, 2005.
- 1917 Department of Defense (DoD). 2001. *Management Guidance for the Defense Environmental*
1918 *Restoration Program*. September 2001.
- 1919 Department of Defense (DoD). 2006. *Defense Environmental Programs Annual Report to Congress*
1920 *Fiscal Year 2006*. Website: <http://deparc.egovservices.net/deparc/do/home>.
- 1921 Dean et al. 2004. “Development of Freshwater Water Quality Criteria for Perchlorate,”
1922 *Environmental Toxicology and Chemistry* 23 (6): 1441-1451.
- 1923 Environmental Data Resources, Inc. (EDR). 2006. *The EDR Radius Map with GeoCheck®*,
1924 *Boardman AFR*. June 8, 2006.
- 1925 Executive Order 12580. 1987. *Superfund Implementation*. 52 FR 2923. January 23, 1987.
1926 Website: <http://www.archives.gov/federal-register/codification/executive-order/12580.html>.
- 1927 Executive Order 13016. 1996. *Amendment to Executive Order No. 12580*. 61 FR 45871. August,
1928 28, 1996. Website: <http://www.archives.gov/federal-register/executive-orders/1996.html>.
- 1929 Interstate Technology & Regulatory Council (ITRC). 2005. *Perchlorate: Overview of Issues, Status,*
1930 *and Remedial Options*. PERCHLORATE-1. Washington, D.C.: Interstate Technology & Regulatory
1931 Council, Perchlorate Team. Website: <http://www.itrcweb.org>.

- 1932 Los Alamos National Laboratory (LANL), 2005, *Environmental Restoration (ER) Project*
 1933 *Ecorisk Database (Release 2.2)*, September. Copies of the LANL data base can be obtained by
 1934 contacting Patricia G. Newell, Toxicologist/ Database Manager, Environmental Health
 1935 Associates, Inc. pgnewell@cybermesa.com; Rich Miranda, LANL rmiranda@lanl.gov; or Alison
 1936 Dorries, LANL, adorries@lanl.gov.
- 1937 Myers, Jonathan and Karen Thorbjornsen. 2004. "Identifying Metal Contamination in Soil: A
 1938 Geochemical Approach", in *Soil and Sediment Contamination*. Vol. 12, pp 1-16.
- 1939 Nelson, Leslie. 2006. Email from M. Nelson (USACE) to D. Landon (Shaw). *Boardman*
 1940 *Demolition Shape File*. July 21, 2006.
- 1941 Oregon Department of Environmental Quality (ODEQ). 1995. *Hydrogeology, Groundwater*
 1942 *Chemistry, and Land Use in the Lower Umatilla Basin Groundwater Management Area*. Final
 1943 Review Draft. 1995.
- 1944 Oregon Department of Environmental Quality (ODEQ). 2001. *Screening Level Values*. December
 1945 2001.
- 1946 Oregon Department of Environmental Quality (ODEQ). 2005. *Perchlorate in the Lower Umatilla*
 1947 *Basin Groundwater Management Area – Issues and Answers*. June 2005.
- 1948 Oregon Parks and Recreation Department (OPRD). 2006. Letter from Dennis Griffin (OPRD
 1949 Heritage Conservation Division) to Lisa Stahl (Shaw). Re: SHPO Case No. 06-2401, Military
 1950 Munitions Response Program Projects, Boardman AFR and Central Oregon Gunnery Range.
 1951 October 13, 2006.
- 1952 Oregon Department of Fish and Wildlife (ODFW). 2007. Telephone call from Dale Landon (Shaw)
 1953 to Russ Morgan (ODFW). Re: T & E Species at Boardman AFR. January 7, 2007.
- 1954 Pacific Northwest National Laboratory (PNNL). 2005. *Visual Sampling Plan*.
 1955 <http://dgo.pnl.gov/vsp/>. Prepared for the U.S. Department of Energy. July 2005.
- 1956 Severn Trent Laboratories (STL). 2003. *Standard Operating Procedure – SW-846 Method 8321-*
 1957 *modified, Determination of Perchlorate by Liquid Chromatography/Mass Spectrometry*.
- 1958 Shaw Environmental, Inc. (Shaw). 2006a. *Final Type I Work Plan, Site Inspections at Multiple*
 1959 *Sites, NWO Region, Formerly Used Defense Sites, Military Munitions Response Program*. Prepared
 1960 for U.S. Army Corps of Engineers. February 2006.
- 1961 Shaw Environmental, Inc. (Shaw). 2006b. *Final Technical Project Planning Memorandum,*
 1962 *Boardman Air Force Range, FUDS ID F10OR0160*. Prepared for U.S. Army Corps of Engineers.
 1963 November 27, 2006.
- 1964 Shaw Environmental, Inc. (Shaw). 2007. *Final Site-Specific Work Plan, Boardman Air Force*
 1965 *Range, FUDS ID F10OR0160*. Prepared for U.S. Army Corps of Engineers. February 8, 2007.
- 1966 U.S. Army Corps of Engineers (USACE). 1992. *Boardman Air Force Range Inventory Project*
 1967 *Report*. September 1992.
- 1968 U.S. Army Corps of Engineers (USACE). 1997. *Archives Search Report, Findings, Former*
 1969 *Boardman Air Force Range, Boardman, Oregon*. August 1997.
- 1970 U.S. Army Corps of Engineers (USACE). 2003. *Explosives Safety Submission, Engineer Pamphlet*
 1971 *385-1-95b*.

- 1972 U.S. Army Corps of Engineers (USACE). 2004a. *Defense Environmental Restoration Program (DERP) Formerly Used Defense Sites (FUDS) Program Policy*. Engineer Regulation (ER) 200-3-1.
1973
1974 May 10, 2004.
- 1975 U.S. Army Corps of Engineers (USACE). 2004b. *Archives Search Report Supplement, Former Boardman Air Force Range, Boardman, Oregon*. 26 November 2004.
1976
- 1977 U.S. Army Corps of Engineers (USACE). 2005. *Formerly Used Defense Sites (FUDS) Military Munitions Response Program (MMRP) Site Inspections. Program Management Plan*. February
1978
1979 2005.
- 1980 U.S. Army Corps of Engineers (USACE). 2006. *Screening-Level Ecological Risk Assessments for FUDS MMRP Site Inspections*. Prepared by USACE HTRW CX. August 11, 2006.
1981
- 1982 U.S. Census. 2000. Website: <http://www.census.gov/main/www/cen2000.html>.
- 1983 U.S. Environmental Protection Agency (EPA). 1989. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance*. Office of Solid Waste, Waste
1984
1985 Management Division. EPA/530/SW-89/026. July 1989.
- 1986 U.S. Environmental Protection Agency (EPA). 1992. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance*. Environmental
1987
1988 Statistics and Information Division, Office of Policy, Planning, and Evaluation. EPA/530/R-93/003.
1989 July 1992.
- 1990 U.S. Environmental Protection Agency (EPA). 1994. *Statistical Methods for Evaluating The Attainment Of Cleanup Standards*. Environmental Statistics and Information Division, Office of
1991
1992 Policy, Planning, and Evaluation. EPA/230/R-94/004. June 1994.
- 1993 U.S. Environmental Protection Agency (EPA). 1995. *Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites*. Office of Research and
1994
1995 Development. EPA/540/S-96/500. December 1995.
- 1996 U.S. Environmental Protection Agency (EPA). 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecologic I Risk Assessments (ERAGS)*. EPA
1997
1998 540-R-97-006, OSWER Directive # 9285.7-25. June 1997.
- 1999 U.S. Environmental Protection Agency (EPA). 1999. *Contract Laboratory Program (CLP): National Functional Guidelines for Organic Data Review*. EPA 540-R-99-008, OSWER Directive #
2000
2001 9240.1-05A-P. October 1999.
- 2002 U.S. Environmental Protection Agency (EPA). 2000. *Methods for the Determination of Organic and Inorganic Compounds in Drinking Water, Volume 1: Method 314.0 Determination of Perchlorate in Drinking Water by Ion Chromatography*. EPA815R-00-014, Office of Groundwater
2003
2004 and Drinking Water. August 2000.
2005
- 2006 U.S. Environmental Protection Agency (EPA). 2004. *Contract Laboratory Program (CLP): National Functional Guidelines for Inorganic Data Review*. EPA 540-R-04-004, OSWER Directive
2007
2008 # 9240.1-45. October 2004.
- 2009 U.S. Environmental Protection Agency (EPA). 2006. *Data Quality Assessment: Statistical Methods for Practitioners*. EPA/240/B-06/003. Office of Environmental Information. February 2006.
2010
- 2011 Weston Solutions, Inc. (Weston). 2004. *Boardman Air Force Range FUDS Preliminary Assessment/Site Inspection Report*. TDD:01-08-0006. Seattle, WA. September 2004.
2012

Tables

**Table 2-1
Munitions Information
Boardman Air Force Range**

AOC	Range Munitions	Munitions Constituents
Target No. 1	Practice Bombs: AN-Mk 5, AN-Mk 23, AN-Mk 43, Mk 4 (signal charge)	Steel (chromium, copper, iron, molybdenum, nickel), cast iron (iron), or lead, lead-based paints, black powder (potassium nitrate, sulfur, charcoal), red phosphorus
	M38A2 Practice Bomb, 100-lb	Sheet metal (iron), lead-based paints, inert sand filled, 3 lb black powder (potassium nitrate, sulfur, charcoal)
Target No. 2	AN-M50A2 Incendiary Bomb, 4-lb	Magnesium alloy casing, 0.63 lb thermite (powdered aluminum metal and ferric oxide), lead-based paints
	AN-M52 Incendiary Bomb, 2-lb	Magnesium alloy, 0.4 lb thermite (powdered aluminum metal and ferric oxide), lead-based paints
	M38A2 Practice Bomb, 100-lb	Sheet metal (iron), lead-based paints, inert sand filled, 3 lb black powder (potassium nitrate, sulfur, charcoal)
	AN M-47	Sheet metal (iron), inert
	MK-15, Mod 3	Sheet metal(iron) , spotting charge consisting of 1 lb. black powder (potassium nitrate, sulfur, charcoal)
	2.25-inch Practice Rocket MK6	Sheet metal (iron), ballistite (nitrocellulose and nitroglycerin)
	AN-M57 GP Practice Bomb	Sheet metal (iron), lead-based paints, spotting charge
	75-mm HEAT M66 projectiles (disposed in area)	Steel (chromium, copper, iron, molybdenum, nickel), lead azide, potassium chlorate, antimony sulfide, carborundum 150, tetryl, lead styphnate, tetracene, barium nitrate, lead sulfphocyanate, TNT
Carty Reservoir	AN-Mk 23	Cast iron (iron), black powder (potassium nitrate, sulfur, charcoal), red phosphorus
	M38A2	Sheet metal (iron), inert sand filled, 3 lb black powder (potassium nitrate, sulfur, charcoal)
	M75/M84 Target ID Bomb	Sheet metal (iron), lead-based paints, red iron oxide, tetryl
Range Complex No. 1	Small Arms – 50 caliber, M2 Ball, M1 Tracer, M10 Tracer	Soft steel (chromium, copper, iron, lead, molybdenum, nickel), lead, single (nitrocellulose) or double base powder (nitrocellulose and nitroglycerin), tracer (calcium resinate, strontium peroxide, magnesium powder, strontium nitrate), perchlorate
	BDU-33, MK 76	Cast iron (iron), steel (chromium, copper, iron, molybdenum, nickel), sheet metal (iron), lead-based paints, 10 gauge shotgun shell
	Mk-84	Inert, steel (chromium, copper, iron, molybdenum, nickel), sheet metal (iron)

**Table 2-1 (Cont.)
Munitions Information
Boardman Air Force Range**

AOC	Range Munitions	Munitions Constituents
Range Complex No. 1	Small Arms – 50 caliber, M2 Ball, M1 Tracer, M10 Tracer	Soft steel (chromium, copper, iron, lead, molybdenum, nickel), lead, single (nitrocellulose) or double base powder (nitrocellulose and nitroglycerin), tracer (calcium resinate, strontium peroxide, magnesium powder, strontium nitrate), perchlorate
	BDU-33, MK 76	Cast iron (iron), steel (chromium, copper, iron, molybdenum, nickel), sheet metal (iron), lead-based paints, 10 gauge shotgun shell
	Mk-84	Inert, steel (chromium, copper, iron, molybdenum, nickel), sheet metal (iron)
	BLU-95 (likely drift over from adjacent Navy range)	Ethylene oxide
	Mark-12 Practice Nuclear Bomb	Sheet metal (iron), lead-based paints, Inert, concrete filled, steel sheet metal
	Mk 106 5-lb	Sheet metal (iron), lead-based paints, single- (nitrocellulose) or double-base (nitrocellulose and nitroglycerin) powder
	Mk 89, 56-lb	Soft steel (chromium, copper, iron, lead, molybdenum, nickel), lead-based paints, 10 gauge shotgun shell, red phosphorus
	Medium caliber practice – 20-mm Ball Mk 1	Soft steel (chromium, copper, iron, lead, molybdenum, nickel), single (nitrocellulose) or double base (nitrocellulose and nitroglycerin) powder
	Explosives C-4 blocks	RDX
	Explosives Detonating Cord, M60 Igniter	PETN
Demolition Area No. 2	M83 Fragmentation Bombs (Butterfly Bomblets)	Steel, (chromium copper, iron, molybdenum, nickel), sheet metal (iron), TNT
	M66, M68 Detonating Fuzes	Mercury fulminate, lead azide, tetryl,
	100-lb GP Bomb	Cast iron (iron), lead-based paints, TNT, Amatol (ammonium nitrate, TNT), Tritonal (TNT aluminum powder), lead styphnate, lead azide, tetryl, mercury fulminate
	Explosives C-4 Blocks	RDX
	Explosives Detonating Cord	PETN
	M60 Igniter	Lead azide
Impact Area (note munitions listed are only suspected)	Practice Bombs: AN-Mk 5, AN-Mk 23, AN-Mk 43, Mk 4 (signal charge)	Steel (chromium, copper, iron, molybdenum, nickel), cast iron (iron), or lead, lead-based paints, black powder (potassium nitrate, sulfur, charcoal), red phosphorus
Suspected Use - No AOC Specified	Practice Bomb BDU-10 series, 2,025-lb	Steel (chromium, copper, iron, molybdenum, nickel), lead-based paints, Inert (hot gas generator in folding fins configuration)
	M66 and M68 Base Detonating Fuze for 75-mm and 90-mm projectiles	TNT or 50/50 pentolite (TNT and PETN), mercury fulminate, tetryl

AOC = area of concern;

lb = pound

PETN = pentaerythritol tetranitrate

RDX= Hexahydro-1,3,5-trinitro-1,3,5-triazine

TNT = 2,4,6-Trinitrotoluene

Table 2-2
Army Checklist for Important Ecological Places ^a
Boardman Air Force Range

No.	Criteria	Yes / No	Comments
1	Locally important ecological place identified by the Integrated Natural Resource Management Plan, BRAC Cleanup Plan or Redevelopment Plan, or other official land management plans	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Portions of the Site are within the Threemile Canyon Farms Multi-Species Candidate Conservation Agreement with Assurances (MSCCAA) area created by the U.S. Fish and Wildlife Service (USFWS), in cooperation with the Oregon Department of Fish and Wildlife (ODFW), The Nature Conservancy, and Portland General Electric. MSCCAAs contain a strategy for covered lands and activities that demonstrate an applicant's contribution to preclude or remove the need to list a covered species as threatened or endangered under the Act.
2	Critical habitat for Federal designated endangered or threatened species	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
3	Marine Sanctuary	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
4	National Park	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
5	Designated Federal Wilderness Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
6	Areas identified under the Coastal Zone Management Act	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
7	Sensitive Areas identified under the National Estuary Program or Near Coastal Waters Program	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
8	Critical areas identified under the Clean Lakes Program	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
9	National Monument	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
10	National Seashore Recreational Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
11	National Lakeshore Recreational Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
12	Habitat known to be used by Federal designated or proposed endangered or threatened species	<input checked="" type="checkbox"/> / <input type="checkbox"/>	ODFW and USFWS state that 2 bird, 2 mammal, 3 fish, 2 butterfly, and 8 plant threatened or endangered species may be present in the site area.
13	National preserve	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
14	National or State Wildlife Refuge	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
15	Unit of Coastal Barrier Resources System	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
16	Coastal Barrier (undeveloped)	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
17	Federal land designated for protection of natural ecosystems	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
18	Administratively Proposed Federal Wilderness Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	

**Table 2-2 (Cont.)
Army Checklist for Important Ecological Places ^a
Boardman Air Force Range**

No.	Criteria	Yes / No	Comments
19	Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
20	Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which fish spend extended periods of time	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
21	Terrestrial areas utilized for breeding by large or dense aggregations of animals	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
22	National river reach designated as Recreational	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
23	Habitat known to be used by state designated endangered or threatened species	<input checked="" type="checkbox"/> / <input type="checkbox"/>	ODFW and USFWS state that 2 bird, 2 mammal, 3 fish, 2 butterfly, and 8 plant threatened or endangered species may be present in the site area.
24	Habitat known to be used by species under review as to its Federal endangered or threatened status	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Washington Ground Squirrel is a candidate species
25	Coastal Barrier (partially developed)	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
26	Federally designated Scenic or Wild River	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
27	State land designated for wildlife or game management	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
28	State-designated Scenic or Wild River	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
29	State-designated Natural Areas	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
30	Particular areas, relatively small in size, important to maintenance of unique biotic communities	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
31	State-designated areas for protection or maintenance of aquatic life	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
32	Wetlands	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Wetlands likely around Carty Reservoir and/or along Six-Mile Canyon Creek.
33	Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes	<input type="checkbox"/> / <input checked="" type="checkbox"/>	

a – Based on EPA, 1990, 55 FR 51624, Table 4-23 – Sensitive Environments Rating Values, Dec. 14, 1990; EPA, 1997, E RAGS, Exhibit 1-1 List of Sensitive Environments.

Table 2-3
Summary of Weston 2004 PA/SI Sampling^a
Boardman Air Force Range

PA/SI Sample ID	UTM Northing	UTM Easting	Matrix	Sample Date	Sample Interval (ft)	TAL Metals (ILM05.3)	Explosives by SW-846-8330	Perchlorate by 314.0	Perchlorate by SW-846-8321-A Modified
Domestic Well Groundwater									
BAFR-GW-DW001-0000	5077207.937	283861.5424	GW	6/21/04	UNK		X	X	
BAFR-GW-DW002-0000	5077549.415	288459.2144	GW	6/22/2004	UNK		X	X	X
BAFR-GW-DW003-0000	5076690.238	284808.6526	GW	6/21/2004	UNK		X	X	
Drinking water Supply Well Groundwater									
BAFR-GW-DS001-0000	5077331.803	282422.9545	GW	6/22/2004	UNK		X	X	
BAFR-GW-DS002-0000	5077245.199	281591.3009	GW	6/22/2004	UNK		X	X	
BAFR-GW-DS003-0000	5064320.848	280974.6486	GW	6/23/2004				X	
Monitoring Well Groundwater									
BAFR-GW-MW001-0000	5077529.962	293028.744	GW	6/22/2004	UNK		X	X	
BAFR-GW-MW002-0000	5077518.146	294535.1342	GW	6/22/2004	UNK		X	X	
BAFR-GW-MW003-0000	5077214.44	291647.1872	GW	6/22/2004	UNK		X	X	
BAFR-GW-MW005-0000	1749288.801	218899.8815	GW	6/22/2004	UNK		X	X	
BAFR-GW-MW006-0000	5075900.245	296111.4942	GW	6/22/2004	UNK		X	X	
BAFR-GW-MW007-0000	5075962.364	293998.9057	GW	6/22/2004	UNK		X	X	X
BAFR-GW-MW009-0000	5076015.673	292219.8429	GW	6/22/2004	UNK		X	X	
BAFR-GW-MW011-0000	5080552.875	292498.0653	GW	6/21/2004	UNK		X	X	
BAFR-GW-MW012-0000	5080588.542	292430.3931	GW	6/21/2004	UNK		X	X	X
BAFR-GW-MW013-0000	5080595.711	292391.3932	GW	6/21/2004	UNK		X	X	
BAFR-GW-MW014-0000	5080599.793	292485.6687	GW	6/21/2004	UNK		X	X	
BAFR-GW-MW015-0000	5080705.283	292290.2968	GW	6/21/2004	UNK		X	X	
BAFR-GW-MW016-0000	5074075.184	276359.5285	GW	6/23/2004	UNK		X	X	
BAFR-GW-MW017-0000	5069561.232	275938.3925	GW	6/23/2004	UNK		X	X	X
BAFR-GW-MW020-0000	5068061.885	275382.3642	GW	6/23/2004	UNK		X	X	X
BAFR-GW-MW022-0000	5065211.717	276483.3325	GW	6/24/2004	UNK		X	X	X
BAFR-GW-MW023-0000	5066786.328	279481.7059	GW	6/24/2004	UNK		X	X	X
BAFR-GW-MW024-0000	5063978.762	280063.3955	GW	6/24/2004	93 - 103		X	X	
BAFR-GW-MW025-0000	5061794.241	283074.9631	GW	6/24/2004	58 - 68		X	X	
Carty Reservoir Surface Water									
BAFR-SW-CR001-0000	5063641.789	281293.0393	SW	6/24/2004	NA			X	
Sixmile Canyon Creek Surface Water									
BAFR-SW-SC001-0000	5075362.798	277170.4606	SW	6/24/2004	NA			X	X
BAFR-SW-SC002-0000	5072281.374	278226.7296	SW	6/24/2004	NA			X	
BAFR-SW-SC004-0000	5067498.182	277544.9651	SW	6/24/2004	NA			X	
BAFR-SW-SC005-0000	5065682.547	276753.6786	SW	6/24/2004	NA			X	
BAFR-SW-SC006-0000	5064320.848	280974.6486	SW	6/24/2004	NA			X	

**Table 2-3 (Cont.)
Summary of Weston 2004 PA/SI Sampling^a
Boardman Air Force Range**

PA/SI Sample ID	UTM Northing	UTM Easting	Matrix	Sample Date	Sample Interval (ft)	TAL Metals (ILM05.3)	Explosives by SW-846-8330	Perchlorate by 314.0	Perchlorate by SW-846-8321-A Modified
Target No. 2 (Area C) Surface Soil									
BAFR-SS-PS003-0000	5074081.967	280669.1067	SS	6/23/2004	0 - 0.5	X		X	
BAFR-SS-PS005-0000	5074057.031	280645.0757	SS	6/23/2004	0 - 0.5	X		X	
Target No. 2 (Area C) Subsurface Soil									
BAFR-SB-PS003-0015	5074081.967	280669.1067	SB	6/23/2004	0.5 - 2.0	X		X	
BAFR-SB-PS005-0015	5074057.031	280645.0757	SB	6/23/2004	0.5 - 2.0	X		X	
INPR Target No. 1 (Area E) Surface Soil									
BAFR-SS-PS001-0000	5068952.218	285664.2264	SS	6/23/2004	0 - 0.5	X		X	
BAFR-SS-PS002-0000	5068881.604	285474.6113	SS	6/23/2004	0 - 0.5	X	X	X	
INPR Target No. 1 (Area E) Subsurface Soil									
BAFR-SB-PS001-0015	5068952.218	285664.2264	SB	6/23/2004	0.5 - 2.0	X		X	
BAFR-SB-PS002-0015	5068881.604	285474.6113	SB	6/23/2004	0.5 - 2.0	X	X	X	
Sixmile Canyon Creek Sediment									
BAFR-SD-SC002-0000	5072044.851	278490.0705	SD	6/24/2004	0 - 0.5	X			

Notes

^a Boardman Air Force Range FUDS Preliminary Assessment/Site Inspection Report, TDD: 01-08-0006, Weston Solutions for U.S. EPA Region X, September, 2004.

X = indicates sample analyzed for parameter

Shaded areas indicate samples from locations off-site of Boardman Air Force Range FUDS

Abbreviations and Acronyms

ft = feet

GW = groundwater

PA/SI = Preliminary Assessment/Site Inspection

SB = subsurface soil

SD = sediment

SS = surface soil

SW = surface water

TAL = target analyte list metals

UNK = screen interval is unknown, information not provided in PA/SI report.

UTM = Universal Transverse Mercator, Zone 11

Analytical Methods

314.0 = EPA Method 314.0 determination of Perchlorate in Drinking Water by Ion Chromatography (EPA, 2000a).

8321-A = EPA SW-846 Method 8321-modified Determination of Perchlorate by Liquid Chromatography/Mass Spectrometry (STL, 2003).

8330 = EPA SW-836 Method 8330 Determination of Nitroaromatics and Nitramines by High Performance Liquid Chromatography.

ILM05.3 = EPA Contract Laboratory Program Statement of Work for Inorganics Analysis (CLP-SOW)

Table 2-4
Locations of Confirmed MEC Finds^a
Boardman Air Force Range

AOC	Ordnance Found ^b
Target No. 1	Mk-76 practice bomb M38A2 100-lb practice bomb
Target No. 2	56-lb practice bombs 75-mm projectiles 100-lb practice bombs 2.25-inch rockets 2-lb to 4-lb incendiary bomblets AN-M57 GP practice bombs AN-47 AN-M50 incendiary bomb M38A2 practice bombs Mk 6 2.25-inch practice rocket
Carty Reservoir Bomb Target	100-lb practice bombs
Range Complex No. 1	
INPR Site No. 1	56-lb practice bombs BDU-10 practice bombs
Demolition Range	Fragments
Demolition Range No. 2	M-83 butterfly bomb

^a Locations are shown on Figure 2-10 of this SI Report.

^b Sources: ASR, 1997; L. Nelson, The Nature Conservancy 2006; PA/SI (Weston, 2004); S. Anderson, PGE 2006.

**Table 3-1
Summary of Samples Collected for Site Inspection
Boardman Air Force Range**

Location ID	Sample Number	UTM Northing	UTM Easting	Sample Purpose	Sample Type	Date Collected	Sample Depth (ft)	Laboratory SDG Number	Select Metals* by EPA SW-846 6020A	Mercury by EPA SW-846 7471A	Explosives by EPA SW-846 8330A	Nitroglycerine by EPA SW-846 8330A (Modified)	PETN by EPA SW-846 8330A (Modified)
Target No. 1													
030A001	NWO-030-0001	5063362	279813	REG	SS	27-Feb-07	0 - 0.5	703016-001	X	X	X	X	
Target No. 2													
030A002	NWO-030-0002	5072790	279899	REG	SS	27-Feb-07	0 - 0.5	703016-002	X	X	X	X	
030A003	NWO-030-0003	5072287	280581	REG	SS	28-Feb-07	0 - 0.5	703016-003	X	X	X	X	
Carty Reservoir Bomb Target													
030A004	NWO-030-0004	5062058	279533	REG	SS	27-Feb-07	0 - 0.5	703016-004	X	X			
030A005	NWO-030-0005	5061497	280459	REG	SS	26-Feb-07	0 - 0.5	703016-005	X	X	X	X	
030A006	NWO-030-1001	5062016	279650	REG	SD	27-Feb-07	0 - 0.5	703016-006	X	X	X	X	
	NWO-030-1003	5062016	279650	FD	SD	27-Feb-07	0 - 0.5	703016-007	X	X	X	X	
Range Complex No. 1, Demolition Area													
030A007	NWO-030-0006	5070044	284769	REG	SS	28-Feb-07	0 - 0.5	703016-008	X	X	X	X	X
030A008	NWO-030-0007	5070005	284553	REG	SS	28-Feb-07	0 - 0.5	703016-009	X	X	X	X	X
	NWO-030-0013	5070005	284553	FD	SS	28-Feb-07	0 - 0.5	703016-010	X	X	X	X	X
Range Complex No. 1, Turret Gunnery Range													
030A009	NWO-030-0008	5074466	284904	REG	SS	26-Feb-07	0 - 0.5	703016-011	X	X			
030A010	NWO-030-0009	5074034	283679	REG	SS	27-Feb-07	0 - 0.5	703016-012	X	X			
Demolition Area No. 2													
030A011	NWO-030-0010	5065570	284677	REG	SS	27-Feb-07	0 - 0.5	703016-013	X	X	X	X	X
	NWO-030-0010-MS	5065570	284677	MS	SS	27-Feb-07	0 - 0.5	703016-013-MS	X	X	X	X	X
	NWO-030-0010-MSD	5065570	284677	MSD	SS	27-Feb-07	0 - 0.5	703016-013-MSD	X	X	X	X	X
030A012	NWO-030-0011	5065590	284950	REG	SS	27-Feb-07	0 - 0.5	703016-014	X	X	X	X	X
Impact Area													
030A013	NWO-030-0012	5059290	282402	REG	SS	27-Feb-07	0 - 0.5	703016-015	X	X	X	X	
030A014	NWO-030-1002	5059237	281565	REG	SD	27-Feb-07	0 - 0.5	703016-016	X	X	X	X	
Background													
030A015	NWO-030-5001	5059936	282313	REG	SS	27-Feb-07	0 - 0.5	703017-001	X	X			
	NWO-030-5012	5059936	282313	FD	SS	27-Feb-07	0 - 0.5	703017-012	X	X			
030A016	NWO-030-5002	5059677	279861	REG	SS	26-Feb-07	0 - 0.5	703017-002	X	X			
030A017	NWO-030-5003	5059531	278687	REG	SS	26-Feb-07	0 - 0.5	703017-003	X	X			
030A018	NWO-030-5004	5059404	277541	REG	SS	26-Feb-07	0 - 0.5	703017-004	X	X			
030A019	NWO-030-5005	5058129	276422	REG	SS	26-Feb-07	0 - 0.5	703017-005	X	X			
	NWO-030-5005-MS	5058129	276422	MS	SS	26-Feb-07	0 - 0.5	703017-005-MS	X	X			
	NWO-030-5005-MSD	5058129	276422	MSD	SS	26-Feb-07	0 - 0.5	703017-005-MSD	X	X			
030A020	NWO-030-5006	5063545	284883	REG	SS	27-Feb-07	0 - 0.5	703017-006	X	X			
030A021	NWO-030-5007	5067017	280686	REG	SS	26-Feb-07	0 - 0.5	703017-007	X	X			
030A022	NWO-030-5008	5061321	284035	REG	SS	27-Feb-07	0 - 0.5	703017-008	X	X			
030A023	NWO-030-5009	5057948	284517	REG	SS	27-Feb-07	0 - 0.5	703017-009	X	X			
030A024	NWO-030-5010	5065870	282431	REG	SS	26-Feb-07	0 - 0.5	703017-010	X	X			
030A025	NWO-030-5011	5057525	281183	REG	SD	26-Feb-07	0 - 0.5	703017-011	X	X			

Notes:

X - Indicates a sample was collected and analyzed for the given parameter

* Select metals are aluminum, chromium, copper, iron, lead, manganese, molybdenum, and nickel.

FD - field duplicate

MS - matrix spike

MSD - matrix spike duplicate

REG - regular field sample

SD - sediment

SDG - sample delivery group

SS - surface soil (< 0.5ft bgs)

UTM - Universal Transverse Mercator, Zone 11

**Table 3-2
Background Screening Values for Soil, Sediment and Groundwater
Boardman Air Force Range**

Element	Soil Background Value 95th UTL/95th Percentile ^a (based on 10 samples^b) (mg/kg)	Sediment Background Value (based on 1 sample^b) (mg/kg)	Groundwater Background Value (based on 1 sample^c) (µg/L)
Aluminum	21,900	10,500	<100
Chromium	26.1	13.2	<1
Copper	33.0	13.6	<1
Iron	36,900	22,400	<10
Lead	17.7	7.1	<1
Mercury	<0.036	<0.014	<0.2
Molybdenum	0.44	0.31	NVA
Nickel	20.3	10.9	NVA
Perchlorate	NVA	NVA	3.86 ^d

Notes

^a The 95th UTLs are provided for analytes with normal or lognormal distributions. The 95th percentiles are provided for analytes with distributions that are neither normal nor lognormal, or that have greater than 15 percent nondetects (per EPA, 1989); supporting calculations for soil background values are provided in appendix L

^b Analytical results provided in Appendix G

^c Groundwater background concentrations from PGE Boardman Plant 2005 Water Quality Monitoring Report provided in Appendix L.

^d Groundwater background concentration for perchlorate from Boardman Air Force Range FUDS Preliminary Assessment/Site Inspection Report, Weston, 2004.

Abbreviations and Acronyms

mg/kg = milligrams per kilogram.

UTL = upper tolerance limit.

NVA = No value available.

< = less than

µg/L = micrograms per liter

Table 3-3
Human Health Screening Values for Soil/Sediment and Groundwater^a
Boardman Air Force Range

Analyte	Abbreviation	Soil/Sediment Human Health Screening Values (mg/kg)	Groundwater Human Health Screening Values (µg/L)
Explosives			
1,3,5-Trinitrobenzene	1,3,5-TNB	1,800	1,100
1,3-Dinitrobenzene	1,3-DNB	6.1	3.6
2,4,6-Trinitrotoluene	2,4,6-TNT	16	2.2
2,4-Dinitrotoluene	2,4-DNT	0.72	0.099
2,6-Dinitrotoluene	2,6-DNT	0.72	0.099
2-Amino-4,6-dinitrotoluene	2-Am-DNT	12	7.3
2-Nitrotoluene	2-NT	0.88	0.049
3-Nitrotoluene	3-NT	730	120
4-Amino-2,6-dinitrotoluene	4-Am-DNT	12	7.3
4-Nitrotoluene	4-NT	12	0.66
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	4.4	0.61
Methyl-2,4,6-trinitrophenylnitramine	tetryl	610	360
Nitrobenzene	NB	20	3.4
Nitroglycerin	NG	35	NVA
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	3,100	1,800
Metals/Inorganics			
Aluminum	Al	76,000	36,000
Chromium ^b	Cr	210	100
Copper	Cu	3,100	1,300
Iron	Fe	23,000	11,000
Lead	Pb	400	15
Mercury	Hg	23	NVA
Molybdenum	Mo	390	180
Nickel	Ni	1,600	730
Perchlorate		NVA	24

Notes

^a Selection of Human Health Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

^b Total chromium values used.

Abbreviations and Acronyms

NVA = no value available

mg/kg = milligrams per kilogram

µg/L = micrograms per liter

**Table 3-4
Ecological Screening Values for Soil and Sediment^a
Boardman Air Force Range^a**

Analyte	Abbreviation	Soil Ecological Screening Value (mg/kg)	Sediment Ecological Screening Value (mg/kg)
Explosives			
1,3,5-Trinitrobenzene	1,3,5-TNB	0.376	0.024
1,3-Dinitrobenzene	1,3-DNB	0.655	0.067
2,4,6-Trinitrotoluene	2,4,6-TNT	6.4	0.92
2,4-Dinitrotoluene	2,4-DNT	1.28	0.29
2,6-Dinitrotoluene	2,6-DNT	0.0328	1.9
2-Amino-4,6-Dinitrotoluene	2-Am-4,6-DNT	2.1	7
2-Nitrotoluene	2-NT	2	5.6
3-Nitrotoluene	3-NT	2.4	4.9
4-Amino-2,6-Dinitrotoluene	4-Am-2,6-DNT	0.73	1.9
4-Nitrotoluene	4-NT	4.4	10
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	7.5	0.13
Methyl-2,4,6-trinitrophenylnitramine	tetryl	0.99	100
Nitrobenzene	NB	8	32
Nitroglycerin	NG	71	1,700
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	27	0.047
Pentaerythritol tetranitrate	PETN	8600	120,000
Metals			
Aluminum	Al	50	280
Chromium ^b	Cr	0.4	37
Copper	Cu	50	10
Iron	Fe	10	20
Lead	Pb	16	35
Mercury	Hg	0.1	0.2
Molybdenum	Mo	2	NVA
Nickel	Ni	30	18

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

^b Total chromium values used.

Abbreviations and Acronyms

NVA = no value available

mg/kg = milligrams per kilogram

µg/L = micrograms per liter

Table 4-1
Comparison of Target No. 1 Soil Analytical Detections to
Background, Human Health and Ecological Screening Values^a
Boardman Air Force Range

Location						030A001	
Sample Date						27-Feb-07	
Sample Number						NWO-030-0001	
Sample Depth (ft bgs)						0 to 0.5	
Sample Purpose						REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Levels^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	Validation Qualifier
Metals	Chromium	mg/kg	26.1	0.4	210	<i>13.5</i>	
Metals	Copper	mg/kg	33	50	3100	14.1	
Metals	Iron	mg/kg	36900	10	23000	<i>20800</i>	
Metals	Lead	mg/kg	17.7	16	400	5.6	
Metals	Mercury	mg/kg	0.036	0.1	23	0.0048	J
Metals	Nickel	mg/kg	20.3	30	1600	12.4	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

UTL = upper tolerance limit

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to use a particular result in the event of a reanalysis.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

**Table 4-2
Comparison of Target No. 1 Groundwater Analytical Detections to
Background and Human Health Screening Values
Boardman Air Force Range**

Location						PGE Well 008 ^a		PA/SI Sample ^b	
Sample Date						2005		24-Jun-04	
Sample Number						Unknown		GW-MW024-0000	
Sample Depth (ft bgs)						93 - 103		93 - 103	
Sample Purpose						REG		REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample ^c	"3x" Maximum Concentration from Media Background Sample	Human Health Screening Values ^d	Result	Validation Qualifier	Result	Validation Qualifier
Metals	Chromium	ug/L	<1	<1	100	<1		NA	
Metals	Copper	ug/L	<1	<1	1,300	<2		NA	
Metals	Iron	ug/L	<10	<10	11,000	50		NA	
Metals	Lead	ug/L	<1	<1	15	<1		NA	
Metals	Mercury	ug/L	<0.2	<0.2	NVA	<0.2		NA	
Perchlorate	Perchlorate	ug/L	3.56	10.68	24	NA		<1.0	

Notes

^a Sample results from *PGE Boardman Plant 2005 Water Quality Monitoring Report*

^b PA/SI - *Boardman AFR Preliminary Assessment/Site Inspection Report TDD:01-08-0006*, (Weston Solutions, 2004)

^c Groundwater background sample concentrations are from: metals - well 120, PGE Boardman Plant 2005 Water Quality Monitoring Report; perchlorate - sample GW-MW025, Boardman AFR Preliminary Assessment/Site Inspection Report TDD:01-08-0006, (Weston Solutions, 2004)

^d Selection of Human Health Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

[**Bold Face**] - Result exceeds "3x" Maximum Concentration from Media Background Sample

< - less than indicated value

Abbreviations and Acronyms

ft bgs = feet below ground surface

REG = regular sample

PGE - Portland General Electric

ug/kg - micrograms per kilogram

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to use a particular result in the event of a reanalysis.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

**Table 5-1
Comparison of Target No. 2 Soil Analytical Detections to
Background, Human Health and Ecological Screening Values^a
Boardman Air Force Range**

Location						030A002		030A003		PA/SI Sample ^b							
Sample Date						27-Feb-07		28-Feb-07		23-Jun-04		23-Jun-04		23-Jun-04		23-Jun-04	
Sample Number						NWO-030-0002		NWO-030-0003		SS-PS-003-0000		SB-PS-003-0015		SS-PS-005-0000		SB-PS-005-0015	
Sample Depth (ft bgs)						0 to 0.5		0 to 0.5		0 to 0.5		0.5 to 2.0		0 to 0.5		0.5 to 2.0	
Sample Purpose						REG		REG		REG		REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Levels ^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	Validation Qualifier	Result	Validation Qualifier	Result	Validation Qualifier	Result	Validation Qualifier	Result	Validation Qualifier	Result	Validation Qualifier
Metals	Aluminum	mg/kg	21900	50	76000	<i>6690</i>		<i>6400</i>		<i>6120</i>		<i>6270</i>		<i>6150</i>		<i>6840</i>	
Metals	Chromium	mg/kg	26.1	0.4	210	<i>10.2</i>		<i>10.2</i>		<i>8.1</i>		<i>8.4</i>		<i>8.9</i>		<i>9.1</i>	
Metals	Copper	mg/kg	33	50	3100	10		8.4		10.6		12		13.7		13.5	
Metals	Iron	mg/kg	36900	10	23000	<i>19200</i>		<i>19200</i>		<i>16400</i>		<i>16500</i>		<u>24500</u>		<i>18400</i>	
Metals	Lead	mg/kg	17.7	16	400	4.7		3.9		4.4		4		5.2		4.3	
Metals	Mercury	mg/kg	0.036	0.1	23	0.0051	J	0.0057	J	NA		NA		NA		NA	
Metals	Nickel	mg/kg	20.3	30	1600	9.7		8.5		8.3		9.2		9.6		9	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

^b Boardman Air Force Range FUDS Preliminary Assessment/Site Inspection Report, TDD: 01-08-0006, Weston Solutions for U.S. EPA Region X, September, 2004.

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

UTL = upper tolerance limit

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to use a particular result in the event of a reanalysis.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

**Table 5-2
Comparison of Target Area No. 2 Sediment Analytical Detections to
Background, Human Health and Ecological Screening Values
Boardman Air Force Range**

Location							PA/SI Sample ^b	
Sample Date							24-Jun-04	
Sample Number							SD-SC002-0000	
Sample Depth (ft bgs)							0 to 0.5	
Sample Purpose							REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Levels ^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	Validation Qualifier
Metals	Aluminum	mg/kg	10500	31500	280	76000	5620	
Metals	Chromium	mg/kg	13.2	39.6	37	210	8	
Metals	Copper	mg/kg	13.6	40.8	10	3100	9.9	
Metals	Iron	mg/kg	22400	67200	20	23000	16300	
Metals	Lead	mg/kg	7.1	21.3	35	400	4	
Metals	Mercury	mg/kg	.014	.042	0.2	23	NA	
Metals	Nickel	mg/kg	10.9	32.7	18	1600	8.1	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

^b Boardman Air Force Range FUDS Preliminary Assessment/Site Inspection Report , TDD: 01-08-0006, Weston Solutions for U.S. EPA Region X, September, 2004.

[**Bold Face**] = Result exceeds "3x" Maximum Concentration from Media Background Sample

[*Italicized*] = Result exceeds Site Inspection Ecological Screening Level

[UNDERLINED] = Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to use a particular result in the event of a reanalysis.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

Table 6-1
Comparison of Carty Reservoir Bomb Target Soil Analytical Detections to
Background, Human Health, and Ecological Screening Values
Boardman Air Force Range

Location						030A004	030A005			
Sample Date						27-Feb-07	26-Feb-07			
Sample Number						NWO-030-0004	NWO-030-0005			
Sample Depth (ft bgs)						0 to 0.5	0 to 0.5			
Sample Purpose						REG	REG			
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Levels ^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	Validation Qualifier	Result	Validation Qualifier	
Metals	Chromium	mg/kg	26.1	0.4	210	<i>11.3</i>		<i>12.5</i>		
Metals	Copper	mg/kg	33	50	3100	12.9		13		
Metals	Iron	mg/kg	36900	10	23000	<i>20700</i>		<i>20400</i>		
Metals	Lead	mg/kg	17.7	16	400	5.5		6.2		
Metals	Mercury	mg/kg	0.036	0.1	23	0.0056	J	0.0065	J	
Metals	Nickel	mg/kg	20.3	30	1600	11.7		12.3		

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

UTL = upper tolerance limit

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to use a particular result in the event of a reanalysis.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

Table 6-2
Comparison of Carty Reservoir Bomb Target Sediment Analytical Detections to
Background, Human Health and Ecological Screening Values
Boardman Air Force Range

Location							030A006		030A006	
Sample Date							27-Feb-07		27-Feb-07	
Sample Number							NWO-030-1001		NWO-030-1003	
Sample Depth (ft bgs)							0 to 0.5		0 to 0.5	
Sample Purpose							REG		FD	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Levels ^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	Validation Qualifier	Result	Validation Qualifier
Metals	Chromium	mg/kg	13.2	39.6	37	210	12.1		12.3	
Metals	Copper	mg/kg	13.6	40.8	10	3100	<i>15</i>		<i>15.2</i>	
Metals	Iron	mg/kg	22400	67200	20	23000	<i>20400</i>		<i>20900</i>	
Metals	Lead	mg/kg	7.1	21.3	35	400	5.8		6.3	
Metals	Mercury	mg/kg	.014	.042	0.2	23	0.0092	J	0.009	J
Metals	Nickel	mg/kg	10.9	32.7	18	1600	11.9		11.7	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

[**Bold Face**] = Result exceeds "3x" Maximum Concentration from Media Background Sample

[*Italicized*] = Result exceeds Site Inspection Ecological Screening Level

[UNDERLINED] = Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to use a particular result in the event of a reanalysis.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

**Table 7-1
Comparison of INPR Site No. 1 - Range Complex No. 1 Soil Analytical Detections to
Background, Human Health and Ecological Screening Values
Boardman Air Force Range**

Location						PA/SI Sample ^b		PA/SI Sample ^b		PA/SI Sample ^b	
Sample Date						23-Jun-04		23-Jun-04		23-Jun-04	
Sample Number						SS-PS-001-0000		SB-PS-001-0015		SS-PS-002-0000	
Sample Depth (ft bgs)						0 to 0.5		0.5 to 2.0		0 to 0.5	
Sample Purpose						REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ
Metals	Chromium	mg/kg	26.1	0.4	210	9		7		8.5	
Metals	Copper	mg/kg	33	50	3100	11.5		11.6		9.5	
Metals	Iron	mg/kg	36900	10	23000	<i>19700</i>		<i>16400</i>		<i>17400</i>	
Metals	Lead	mg/kg	17.7	16	400	3.7		6.1		4	
Metals	Mercury	mg/kg	0.036	0.1	23	NA		NA		NA	
Metals	Nickel	mg/kg	20.3	30	1600	9.3		8.1		8.3	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

^b Boardman Air Force Range FUDS Preliminary Assessment/Site Inspection Report , TDD: 01-08-0006, Weston Solutions for U.S. EPA Region X, September, 2004.

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

FD = field duplicate

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

UTL = upper tolerance limit

VQ = validation qualifier

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to use a particular result in the event of a reanalysis.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

**Table 7-1
Comparison of INPR Site No. 1 - Range Complex No. 1 Soil Analytical Detections to
Background, Human Health and Ecological Screening Values
Boardman Air Force Range**

Location						PA/SI Sample^b	
Sample Date						23-Jun-04	
Sample Number						SB-PS-002-0015	
Sample Depth (ft bgs)						0.5 to 2.0	
Sample Purpose						REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	VQ
Metals	Chromium	mg/kg	26.1	0.4	210	8	
Metals	Copper	mg/kg	33	50	3100	11.1	
Metals	Iron	mg/kg	36900	10	23000	<i>18000</i>	
Metals	Lead	mg/kg	17.7	16	400	4.4	
Metals	Mercury	mg/kg	0.036	0.1	23	NA	
Metals	Nickel	mg/kg	20.3	30	1600	8.8	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of

^b Boardman Air Force Range FUDS Preliminary Assessment/Site Inspection Report, TDD: 01-08-0006, Weston Solutions for

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

FD = field duplicate

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

UTL = upper tolerance limit

VQ = validation qualifier

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to report.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

**Table 7-2
Comparison of Demolition Area - Range Complex No. 1 Soil Analytical Detections to
Background, Human Health and Ecological Screening Values
Boardman Air Force Range**

Location						030A007		030A008		030A008	
Sample Date						28-Feb-07		28-Feb-07		28-Feb-07	
Sample Number						NWO-030-0006		NWO-030-0007		NWO-030-0013	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG		FD	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Levels ^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ
Metals	Chromium	mg/kg	26.1	0.4	210	8.2		<i>10.1</i>		<i>10.5</i>	
Metals	Copper	mg/kg	33	50	3100	20		11		11	
Metals	Iron	mg/kg	36900	10	23000	<i>22000</i>		<i>22900</i>		<i>21800</i>	
Metals	Lead	mg/kg	17.7	16	400	15.3		4.4		4.3	
Metals	Mercury	mg/kg	0.036	0.1	23	0.0042	J	0.0072	J	0.0045	J
Metals	Nickel	mg/kg	20.3	30	1600	8.7		9.3		9.1	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

FD = field duplicate

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

UTL = upper tolerance limit

VQ = validation qualifier

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to use a particular result in the event of a reanalysis.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

**Table 7-3
Comparison of Turret Gunnery Range - Complex No. 1 Soil Analytical Detections to
Background, Human Health and Ecological Screening Values
Boardman Air Force Range**

Location						030A009		030A010	
Sample Date						26-Feb-07		27-Feb-07	
Sample Number						NWO-030-0008		NWO-030-0009	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Levels ^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	Validation Qualifier	Result	Validation Qualifier
Metals	Chromium	mg/kg	26.1	0.4	210	<i>11.4</i>		<i>10.3</i>	
Metals	Copper	mg/kg	33	50	3100	9.1		8.1	
Metals	Iron	mg/kg	36900	10	23000	<i>17300</i>		<i>17200</i>	
Metals	Lead	mg/kg	17.7	16	400	4.7		3.9	
Metals	Mercury	mg/kg	0.036	0.1	23	0.0069	J	0.0046	J
Metals	Nickel	mg/kg	20.3	30	1600	9.8		8.7	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

UTL = upper tolerance limit

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to use a particular result in the event of a reanalysis.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

Table 8-1
Comparison of Demolition Area No. 2 Soil Analytical Detections to
Background, Human Health and Ecological Screening Values
Boardman Air Force Range

Location						030A011		030A012	
Sample Date						27-Feb-07		27-Feb-07	
Sample Number						NWO-030-0010		NWO-030-0011	
Sample Depth (ft bgs)						0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Levels ^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	Validation Qualifier	Result	Validation Qualifier
Metals	Chromium	mg/kg	26.1	0.4	210	<i>10.7</i>		<i>12.9</i>	
Metals	Copper	mg/kg	33	50	3100	11.2		15.7	
Metals	Iron	mg/kg	36900	10	23000	<i>17100</i>		<i>22100</i>	
Metals	Lead	mg/kg	17.7	16	400	6.4		6.7	
Metals	Mercury	mg/kg	0.036	0.1	23	0.0065	J	0.0064	J
Metals	Nickel	mg/kg	20.3	30	1600	9		11.5	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

ft bgs = feet below ground surface
mg/kg = milligram per kilogram
PRG = Preliminary Remediation Goal
REG = regular sample
UTL = upper tolerance limit

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.
R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process
U = The compound or analyte was analyzed for but not detected above the associated reporting limit.
UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

Table 9-1
Comparison of Impact Area Soil Analytical Detections to
Background, Human Health and Ecological Screening Values
Boardman Air Force Range

Location						030A013	
Sample Date						27-Feb-07	
Sample Number						NWO-030-0012	
Sample Depth (ft bgs)						0 to 0.5	
Sample Purpose						REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Levels^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	Validation Qualifier
Metals	Chromium	mg/kg	26.1	0.4	210	<i>17.5</i>	
Metals	Copper	mg/kg	33	50	3100	18.9	
Metals	Iron	mg/kg	36900	10	23000	<u>29100</u>	
Metals	Lead	mg/kg	17.7	16	400	11.8	
Metals	Mercury	mg/kg	0.036	0.1	23	0.013	J
Metals	Nickel	mg/kg	20.3	30	1600	15	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

UTL = upper tolerance limit

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

**Table 9-2
Comparison of Impact Area Sediment Analytical Detections to
Background, Human Health, and Ecological Screening Values
Boardman Air Force Range**

Location							030A014	
Sample Date							27-Feb-07	
Sample Number							NWO-030-1002	
Sample Depth (ft bgs)							0 to 0.5	
Sample Purpose							REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Levels^a	Human Health Screening Levels EPA Region 9 PRGs - Residential Soil	Result	Validation Qualifier
Metals	Chromium	mg/kg	13.2	39.6	37	210	15	
Metals	Copper	mg/kg	13.6	40.8	10	3100	<i>15.7</i>	
Metals	Iron	mg/kg	22400	67200	20	23000	<u>23800</u>	
Metals	Lead	mg/kg	7.1	21.3	35	400	8.1	
Metals	Mercury	mg/kg	.014	.042	0.2	23	0.013	J
Metals	Nickel	mg/kg	10.9	32.7	18	1600	12.7	

Notes

^a Selection of Ecological Screening Values is shown in the Final TPP Memorandum (Shaw, 2006) included as Appendix B of this SI Report.

[**Bold Face**] = Result exceeds "3x" Maximum Concentration from Media Background Sample

[*Italicized*] = Result exceeds Site Inspection Ecological Screening Level

[UNDERLINED] = Result exceeds EPA Region 9 PRG - Residential Soil

Abbreviations and Acronyms

ft bgs = feet below ground surface

mg/kg = milligram per kilogram

PRG = Preliminary Remediation Goal

REG = regular sample

Validation Qualifier Definitions

J = The compound or analyte was positively identified but the reported value is estimated.

R = The reported sample results are rejected because of one of the following: severe deficiencies in the supporting quality control data; anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data; the presence or absence of the constituent cannot be verified based on the data provided; to indicate not to use a particular result in the event of a reanalysis.

U = The compound or analyte was analyzed for but not detected above the associated reporting limit.

UJ = The compound or analyte was analyzed for but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.