

**U.S. Army Corps of Engineers
Omaha District**

**Draft Technical Project Planning
Memorandum
Boardman Air Force Range
FUDS ID 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 20, 2006


Shaw[®] Shaw Environmental, Inc.

9201 East Dry Creek Road
Centennial, CO 80112

Technical Project Planning Memorandum

**Site Inspection
Boardman Air Force Range
Formerly Used Defense Site
FUDS ID F10OR0160**

Military Munitions Response Program

Documentation for Technical Project Planning Meeting
Port of Morrow Riverfront Center
Boardman, Oregon
July 20, 2006

Hosted by U.S. Army Corps of Engineers

Prepared by Shaw Environmental, Inc.

September 20, 2006

Concurrences

USACE Omaha Design Center

Mike Watson

USACE Seattle District

Mike Nelson

Oregon Department of Environmental Quality

David Anderson

Shaw Environmental, Inc.

Peter Kelsall

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS	ii
ADMINISTRATIVE INFORMATION	1
SITE INSPECTION OBJECTIVES	5
Goal.....	6
Objectives	6
Roles & Responsibilities.....	6
Site Inspection Process	7
Technical Project Planning Process	7
BACKGROUND INFORMATION	8
Site Description and Regulatory History	9
Operational History and MEC/MC Characteristics	11
Groundwater	12
Surface Water.....	12
Terrestrial Exposure.....	13
Air	13
CONCEPTUAL SITE MODEL	14
Overview.....	15
Conceptual Site Model – Target No. 1 AOC.....	16
Conceptual Site Model – Target No. 2 AOC.....	21
Conceptual Site Model – Carty Reservoir Bomb Target AOC.....	26
Conceptual Site Model – Range Complex No. 1 AOC	31
Conceptual Site Model – Demolition Area No. 2 AOC	36
Conceptual Site Model – Impact Area AOC	40
Data Gaps.....	44
PROPOSED SAMPLING SCHEME	45
Proposed Field Investigation.....	46
TPP MEETING NOTES AND DATA QUALITY OBJECTIVES	49
Technical Project Planning and Development of Data Quality Objectives.....	50
TPP Phases.....	50
Data Quality Objectives.....	54
Next Steps	56
FIGURES	57
TABLES	58
DRAFT WORKSHEETS	59

ABBREVIATIONS AND ACRONYMS

AFR	Air Force Range
AOC	area of concern
ASR	Archives Search Report
BAIC	Boeing Agri-Industrial Company
bgs	below ground surface
CSM	Conceptual Site Model
DoD	Department of Defense
DOI	Department of the Interior
DQO	Data Quality Objective
EOD	Explosives Ordnance Disposal
ft	foot or feet
FS	Feasibility Study
°F	degrees Fahrenheit
FUDS	Formerly Used Defense Site
HRS	Hazard Ranking System
INPR	Inventory Project Report
lb	pound
MC	munitions constituents
MEC	munitions and explosives of concern
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
µg/L	microgram(s) per liter
mm	millimeter
MMRP	Military Munitions Response Program
MRSPP	Munitions Response Site Prioritization Protocol
Navy	Department of the Navy
NDAI	No Department of Defense Action Indicated
ODEQ	Oregon Department of Environmental Quality
PA	Preliminary Assessment
PCOC	potential contaminant of concern
PGE	Portland General Electric
PRG	Preliminary Remediation Goal
RAC	Risk Assessment Code
RBC	Risk-Based Concentration
RI	Remedial Investigation
Shaw	Shaw Environmental, Inc.
SHPO	State Historic Preservation Office
SI	Site Inspection
SSWP	Site-Specific Work Plan
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UXO	unexploded ordnance

Administrative Information

***Site Inspection
Boardman Air Force Range***

***Technical Project Planning Meeting
July 20, 2006***

The Technical Project Planning (TPP) Memorandum is one in a series of documents used during the Site Inspection (SI) process to document the information collected and processes used to evaluate Formerly Used Defense Sites (FUDS) for the possible presence of munitions and explosives of concern (MEC) and/or munitions constituents (MC). TPP Meeting information provided in the Memorandum reflects both the original version of information shared with meeting participants, as well as changes/updates to site-specific information obtained during the TPP Meeting.

The TPP Meeting for the former Boardman Air Force Range (Boardman AFR) was conducted on July 20, 2006 at the Port of Morrow Riverfront Center in Boardman, Oregon. Representatives from the U.S. Army Corps of Engineers (USACE) – Omaha Design Center and Seattle District, the Oregon Department of Environmental Quality (ODEQ), and Shaw Environmental, Inc. (Shaw) were in attendance. In addition, stakeholders from Portland General Electric, BAIC Inc., Threemile Canyon Farms, Inland Land Company, The Nature Conservancy, the Boeing Company, and the Oregon State Police were in attendance. A separate public meeting was held in the evening of the July 20, 2006. A site tour was not conducted as part of this meeting.

The TPP Memorandum documents discussions for the TPP meeting and includes the sections described below:

- **Administrative Information:** includes meeting logistics and the list of attendees;
- **Site Inspection Objectives:** provides the goal and objectives of the SI, roles and responsibilities, the SI process, and the TPP process;
- **Background Information:** includes site and project history, area physical setting, a summary of previous environmental work, and an introduction to the areas of concern (AOCs) addressed by the SI;
- **Conceptual Site Model (CSM):** identifies environmental attributes, potential human and ecological receptors in the area's environment, and the relationships between these factors;
- **Proposed Sampling Scheme:** describes the type and quantity of samples to be taken, and the analytical methods to be used for characterizing the AOC;
- **TPP Notes and Data Quality Objectives (DQOs):** captures project and site-specific information as discussed during the TPP Meeting to ensure the necessary and appropriate information is shared among meeting participants, and that meeting participants concur with the identified goal, objectives, and approach used to complete the SI process; and
- **Worksheets:** includes the **Site Information Worksheet, Draft Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps, and Hazard Ranking System (HRS) Data Gaps.**

Site: Boardman Air Force Range

Location: Boardman, Oregon

USACE District: Seattle

TPP #1 Meeting Location: Port of Morrow, River Front Center, Boardman, Oregon

TPP #1 Meeting Date: 7/20/06

Agenda

Monday, July 20, 2006

- **Convene at Port of Morrow River Front Center Meeting Room**
 - Introductions
 - Review Site Inspection Objectives
 - Goals, Objectives, Roles & Responsibilities
 - Site Inspection Process
 - Technical Project Planning (TPP) Process
 - Review of Background Information
 - Technical Project Planning Discussion

- **Public Meeting**

Technical Project Planning Meeting Minutes/Summary of Agreements

The TPP meeting for the former Boardman AFR was held at the Port of Morrow Riverfront Center in Boardman, Oregon on July 20, 2006. Representatives from the USACE – Omaha District and Seattle District, ODEQ, Oregon State Police, Portland General Electric, BAIC Inc., Threemile Canyon Farms, Inland Land Company, The Nature Conservancy, the Boeing Company and, Shaw were in attendance.

Shaw reviewed the site information and presented a summary of the site and the proposed approach for the SI, addressing munitions and explosives of concern (MEC) and munitions constituents (MC) sampling. All parties were in general agreement with the approach, but reserved judgment until the Draft TPP memo is issued. The property owners and lessees agreed to act on the requests for right-of-entry after they receive the Draft TPP Memo.

Specific discussions included:

AOCs: There was agreement in the AOCs presented (Target No. 1, Target No. 2, Carty Reservoir Bomb Target, Range Complex No. 1, and Demolition Area No. 2).

Potential AOC(s) were discussed based on information provided by The Nature Conservancy where MEC or debris have been located in areas within the FUDS boundary south of Demolition Area No. 2. Additional air photo review of this area is warranted along with evaluation of materials (topographic maps with MEC and MEC debris locations) provided by the Nature Conservancy on lands they manage.

A firing target for the Turret Gunnery Range was noted by a representative of the Nature Conservancy within the FUDS boundary. He stated that the target was an old car, making it a potential sampling location for lead.

Property Ownership: Ownership was clarified in the meeting. Much of the property is owned by BAIC, Inc. which leases the area for farming, grazing, resource management, and scientific research. Lessees include Inland Land Company, Threemile Canyon farms, the Boeing Company, The Nature Conservancy, and Portland General Electric.

Air Photo Imagery: ODEQ has 2005 imagery available, which they will provide.

Sampling: ODEQ would like to have one of the samples collected from Target No. 1 and Carty Reservoir Bomb Target also analyzed for explosives.

Background Sampling: Look at available soil data from area (ODEQ to provide) that may be used to supplement the proposed background data set.

Site Inspection Objectives

*Site Inspection
Boardman Air Force Range*

*Technical Project Planning Meeting
July 20, 2006*

Goal

- The USACE is conducting SIs of FUDS properties to determine if any MEC or related MC are present on property formerly owned or leased by the Department of Defense (DoD).

Objectives

- Determine if the site requires further response action because of the presence of MEC/MC.
- Collect minimum information needed to:
 - Eliminate a site from further consideration if:
 - No evidence of MEC and/or
 - Concentrations of MC in samples are below risk-based action levels, or below background concentrations; or
 - Determine the potential need for removal action or initiation of the Remedial Investigation/Feasibility Study (RI/FS) if:
 - MEC identified and/or
 - Concentrations of MC in samples exceed risk-based action levels and background concentrations.
 - Provide sufficient data to prioritize future actions using the HRS and MRSPP.

Roles & Responsibilities

- **USACE:** Acts as the executing agency for the DoD with regard to the FUDS program. In this role, the USACE has decision making authority and is responsible for ensuring work is conducted in accordance with applicable USACE and federal guidance. Additionally, USACE coordinates and works with project team members to meet needs expressed by regulatory agencies and stakeholders to the extent possible within programmatic guidelines.
- **Regulatory Agency:** Participates in planning of SI activities to ensure the project meets applicable state standards and requirements.
- **Property Owner(s):** Provides available and pertinent information about the area, provides in sight on current and anticipated future land uses for the property, and participates in project team discussions.
- **Shaw:** As a contractor to the USACE, conducts work on behalf of the USACE, provides TPP materials, makes site information available to the project team through a web-based information portal or other means, and conducts and reports SI activities.

Site Inspection Process

- Data review,
- TPP,
- Site-Specific Work Plan (SSWP),
- SI field activities – reconnaissance, sampling, and analysis, and
- SI Report.

Technical Project Planning Process

- Conduct TPP meeting(s)* with key organizations and stakeholders;
- Identify stakeholder(s) concerns;
- Identify all AOCs for this SI;
- Review site information;
- Verify current and anticipated future land use;
- Develop CSM;
- Identify data gaps;
- Plan how to address data gaps;
- Develop DQOs for meeting SI requirements; and
- Concur on SI field work approach.

* Second TPP meeting to be determined by team members during the 1st TPP meeting.

Background Information

***Site Inspection
Boardman Air Force Range***

***Technical Project Planning Meeting
July 20, 2006***

Site Description and Regulatory History

Historical information (including references to interviews and historical documents) contained in this package was obtained from the *Archives Search Report* (ASR) (USACE, 1997) and *ASR Supplement* (USACE, 2004) for the Boardman AFR. In addition, information obtained from the *Boardman AFR FUDS Preliminary Assessment/Site Inspection Report* (Weston Solutions, 2004) prepared for the USEPA was used in the preparation of this document.

Site Location

- The former Boardman AFR is located approximately 5.5 miles south Boardman, Oregon, in Morrow County (Figure 1). Boardman is in the north central portion of Oregon along the Columbia River.
- Originally Boardman AFR occupied 95,985 acres. In 1960, the Air Force declared the property surplus and portions of the site were transferred to the U. S. Department of Interior (DOI) (37,320.31 acres), USACE (290 acres), and Department of the Navy (Navy) (58,372.9 acres). The parcels transferred to the DOI and the Navy were aligned in a checkerboard pattern. 1963, the area was split into two parcels, with the Navy controlling the eastern portion and the State of Oregon owning the western portion. The USACE maintained ownership of a small parcel (290 acres) along the Columbia River. After the property redistribution, the Boardman AFR FUDS occupies an area of 48,976 acres.
- The former Boardman AFR has five AOCs: three bomb targets; one range complex consisting of a gunnery training range, demolition area, and a bomb target; and a separate demolition area.

Physical Setting

- Boardman AFR lies within the Columbia Basin Subprovince of the Columbia Intermontane Physiographic Province.
- The former Boardman AFR slopes gently from the Columbia River (approximately 310 feet [ft] elevation) near the northern boundary of the site to the southern boundary at about 1,000 ft elevation.
- The site is currently used for:
 - Irrigated agricultural and grazing purposes. The site currently is heavily used for farming of potatoes, onions, and other vegetables.
 - A restricted antennae test range owned by the Boeing Company.
 - A fossil fuel power generating plant owned by Portland General Electric Company (PGE).
 - Habitat management area for the protection of the Washington ground squirrel.
 - An airstrip at the site operated and maintained by the Morrow County Port Authority.

- Boardman, Oregon is the nearest incorporated community (approximately 5.5 miles north) with a population of 2,855 (2000 census).
- The climate in the Boardman area is semi-arid. It is warm and dry in the summer and cool and dry in the winter. The wettest month is generally December, with the driest month being July. The highest monthly average maximum temperature is 89.7 degrees Fahrenheit (°F) in July and the lowest monthly average minimum temperature is 27 °F in January. The average annual precipitation is 8.41 inches per year.
- The AOCs are located in fenced areas, however, access to most of them is unrestricted or uncontrolled. Access to other AOCs (INPR Site No. 1 and Demolition Area) is more restricted by access control to the Boeing Antennae Test Range.

Previous Investigations and Regulatory History

- The USACE prepared an Inventory Project Report (INPR) for Boardman AFR in September 1992, in which a potential hazard from unexploded ordnance (UXO) at the FUDS was identified.
- The USACE issued an ASR in 1997, which compiled available information for Boardman AFR with emphasis on types and areas of ordnance use and disposal.
- An ASR Supplement completed in 2004 identified specific AOCs. During 2006 TPP planning for the Boardman AFR, a new AOC (Demolition Area No. 2) was located that was not included in the ASR or ASR Supplement.
- A Risk Assessment Code (RAC) scoring was conducted by the USACE in 2004. Possible scores range from 5 (no risk) to 1 (high risk). The following table summarizes the RAC determinations for the AOCs and indications of whether MEC has been found at these AOCs since the end of training activities, as summarized in the 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
Demolition Area No. 2	Not Scored	Yes
Impact Area	Not Scored	No

- The USEPA completed a Preliminary Assessment/Site Inspection (PA/SI) for the former Boardman AFR in 2004. The scope of the PA/SI largely parallels the scope of this planned SI. To the extent possible, this SI will use data previously collected for the PA/SI. Additional reconnaissance and sampling activities will be planned only to address specific data needs identified during the TPP. The PA/SI collected samples from soil, surface water, and groundwater. Samples were analyzed for Target Analyte List metals, nitrogen-based explosives, and perchlorate. Table 1 summarizes the PA/SI sampling that was completed. No samples contained significant concentrations of metals and no

nitrogen-based explosive compounds were detected. Perchlorate was detected in all five surface water samples from Six-mile Canyon Creek. Surface water concentrations ranged between 0.32 micrograms per liter ($\mu\text{g/L}$) and 7.49 $\mu\text{g/L}$. Perchlorate was not detected in the surface water sample collected from Carty Reservoir. Perchlorate was detected in 18 of 25 groundwater samples and ranged in concentration between 0.46 $\mu\text{g/L}$ and 20.7 $\mu\text{g/L}$. Note the DoD action level for perchlorate is 24 $\mu\text{g/L}$. Due to the widespread occurrence of perchlorate in surface and groundwater, the Boardman AFR is not a likely source of the perchlorate.

- MEC has been reported recently (March 2006) at Target No. 2 AOC. These reports were made following the discovery of six AN-M57 General Purpose (G.P.) bombs (capable of detonating) at a local recycler. These 6 bombs and 15 additional bombs recovered from Target No. 2 were detonated by a Navy Explosive Ordnance Disposal (EOD) team at the nearby Navy Bombing Range. The bombs had been gathered from agricultural fields and placed in a pile by the agricultural workers.

Operational History and MEC/MC Characteristics

Historic Military Operations

- Between 1941 and 1943, the United States Army Air Corps acquired 95,985.51 acres through purchase of private land and transfer of DOI land for a bombing and gunnery range. It was used by the Walla Walla Army Air Base for air-to-ground gunnery practice during World War II. A small portion was also known to be used by the nearby Umatilla Army Ordnance Depot for the demolition of unserviceable/surplus munitions and small arms trace testing. After World War II, the Army Air Corps categorized the site as surplus land.
- During 1946, the site was inactive and discussions were held concerning authorizing livestock grazing on the range.
- In 1948, the Air Force withdrew the lands from surplus and used the range from 1948 to 1960. The area was renamed the Boardman Precision Bombing Range and was configured with five targets and exclusion areas.
- Between 1952 and 1956, the 57th Air Division, Fairchild Air Force Base, assumed the responsibility, control, and utilization of the Boardman AFR. A moving 20-mm target gunnery range with three mounted B-36 turrets were added in 1952. The gunners fired at remote controlled aerial target drones (OC aircraft) under daylight and night conditions. Practice bombing was also occurring during this time. Target No. 2 was the principal bomb target during this time.
- The degree of site usage between 1956 and 1958 is uncertain. However, in December 1958, the Air Force granted the Department of the Navy permission to use the site as a high altitude bombing range. In 1960, a permit was granted to the Umatilla Army Ordnance Depot to use two small areas for destruction of unusable munitions and small arms ammunition tracer testing.

- The Air Force placed the Boardman AFR in an excess category in 1960. Later that year, the Air Force transferred 37,320.31 acres to the DOI, 58,372.9 acres to the Navy, and 290 acres to the USACE.
- In 1963, following discussions between the Navy, the DOI, and the State of Oregon, an agreement was reached where the Navy would consolidate its needs to the eastern half of the site and release the western half. This allowed for single contiguous land use by the Navy and DOI. The western half ended up being jointly owned by the State of Oregon, Portland General Electric, and Morrow County.

MEC/MC Characteristics

- The MEC and MC used at the Boardman AFR are shown on Table 2. A disposal pit was used to destroy incendiary bombs (AN-50A2) and ammunition.
- The only hazardous substance found during the 2004 PA/SI was perchlorate in surface water and groundwater. Surface water concentrations ranged between 0.32 µg/L and 7.49 µg/L. Results from a surface water sample collected from Carty Reservoir indicated no perchlorate was detected. Perchlorate was detected in 18 of 25 groundwater samples; concentrations ranged between 0.46 µg/L and 20.7 µg/L. The DoD action level is 24.5 µg/L.

Groundwater

- The soils at Boardman AFR are composed of four different soil groups: the Quincy loamy fine sand, the Koehler loamy fine sand, the Hezel loamy fine sand, and the Tauton fine sandy loam.
- The soils of Boardman AFR are underlain by alluvium and bed rock consists of the basaltic flows for the Columbia River Basalt Group. The alluvium is up to 70 ft thick.
- Groundwater is primarily within the flow tops and interflow zones of members of the Columbia River Basalt group. Prior to construction of Carty Reservoir by PGE in 1977 only thin occurrences of groundwater within the alluvium were reported and Six-Mile Canyon Creek was dry. Leakage from Carty Reservoir has resulted in a perched groundwater zone above the uppermost basalt flow. Water levels in the alluvium were observed to rise up to 30 ft (40 ft below ground surface) in wells constructed near Carty reservoir. The water levels have now stabilized. There appears to be a groundwater mound beneath Carty Reservoir.
- There are no private irrigation wells, one drinking water source well and several monitoring wells located within the Boardman AFR (mostly associated with the PGE fossil fuel power plant).

Surface Water

- The Boardman AFR is located within the Middle Columbia-Lake Wallula Watershed.
- Carty Reservoir is located within Boardman AFR and portions of the Target No. 1 and Carty Reservoir AOCs are submerged under the reservoir. Carty Reservoir was created

when PGE dammed a portion of Six-mile Canyon Creek in 1977. There is no surface water outlet from the reservoir.

- Six-mile Canyon Creek traverses across the western portion of the Boardman AFR. The creek is not known to support fisheries. Historically the creek was dry except during periods of heavy rain and snow melt. With the creation of Carty Reservoir and the resulting groundwater mound, water now is present in Six-mile Canyon Creek. The creek flows into the Columbia River, which is a major river that support both federally and state threatened and listed species.
- Surface water samples were collected at five locations along Six-mile Canyon Creek during the PA/SI (Weston, 2004). Samples were analyzed for perchlorate. Perchlorate was detected in all stream samples. Perchlorate concentrations decreased downstream.

Terrestrial Exposure

- There are no residences or schools/day care facilities within 200 ft of the Boardman AFR.
- Listed below are threatened or endangered species listed by either the Oregon Department of Fish and Wildlife and the U.S. Fish and Wildlife Service that may be present in the Boardman AFR area.

Endangered or Threatened Wildlife	Endangered or Threatened Vegetation
American Peregrine Falcon Bald Eagle Washington Ground Squirrel Lower Columbia River Coho Salmon Lower Columbia River Steelhead Lower Columbia River Chinook Salmon Columbia White Tailed Deer Butterfly, Fender's Blue Butterfly, Oregon Silverspot	Catchfly, Spalding's Checker-mallow, Nelson's Desert-parsley, Bradshaw's Four-o'clock, MacFarlane's Fritillary, Gentner's Lomatium, Cook's Milk-vetch, Applegate's Wire-lettuce, Mahleur

- A 7-mile stretch of the Oregon Trail crosses the extreme southern portion of the Boardman AFR and has been labeled as "a high potential segment" for archeological resources. The State Historical Preservation Office (SHPO) is being contacted to provide up-to-date information on the site.

Air

- Boardman, Oregon is the nearest population center (approximately 5 miles).
- There are numerous farms and ranches located adjacent to and near the Boardman AFR.
- The prevailing wind direction is from the west.

Conceptual Site Model

*Site Inspection
Boardman Air Force Range*

*Technical Project Planning Meeting
July 20, 2006*

Overview

A site-specific CSM summarizes available site information and identifies relationships between exposure pathways and associated receptors. A CSM is used to determine the data types necessary to describe site conditions and quantify receptor exposure, and discusses the following information:

- Current site conditions and future land use;
- Potential contaminant sources (e.g., lead projectiles in an impact berm);
- Affected media;
- Governing fate and transport processes (e.g., surface water runoff and/or groundwater migration);
- Exposure media (i.e., media through which receptors could contact site-related contamination);
- Routes of exposure (e.g., inhalation, incidental ingestion, and dermal contact); and
- Potential human and/or representative ecological receptors at the exposure point. Receptors likely to be exposed to site contaminants are identified based on current and expected future land uses.

The CSM is evaluated for completeness and further developed as needed through TPP meetings. Based on a review of documents and interviews, the following AOCs have been identified within the Boardman AFR:

- Target No. 1,
- Target No. 2,
- Carty Reservoir,
- Range Complex No. 1,
- Demolition Area No. 2, and
- Impact Area.

Because of dissimilar historical use, site conditions, or prior investigations, a CSM is developed for each AOC. MEC and MC are analyzed individually within the CSM.

MEC has been reported recently (March 2006) at Target No. 2 AOC. These reports were made following the discovery of six AN-M57 General Purpose (G.P.) bombs (capable of detonating) at a local recycler. These 6 bombs and 15 additional bombs recovered from Target No. 2 were detonated by a Navy Explosive Ordnance Disposal (EOD) team at the nearby Navy Bombing Range. The bombs had been gathered from agricultural fields and placed in a pile by the agricultural workers.

Conceptual Site Model – Target No. 1 AOC

Target No. 1 consists of a single target configured with concentric circles with radii of 100, 200, and 300 ft, which was standard range layout for the time of use. The target name is consistent with the ASR Supplement (2004). The southern one-third of the AOC overlaps with Carty Reservoir Target AOC. Figure 1 shows the general location of Target No.1, and Figure 2 shows a more detailed view of the AOC using an aerial photo overlay.

Current and Future Land Use

- The Target No. 1 AOC is located on BAIC, Inc. and PGE property adjacent to Carty Reservoir. Approximately 40 percent of the safety zone is flooded by Carty Reservoir.
- The terrain is flat with a gradual slope toward the shoreline of Carty Reservoir.
- The area northeast of the safety zone has been extensively reworked during power plant construction and the building of an earthen dam for Carty Reservoir. The property to the north and west of the target is now used for irrigated farming.
- One groundwater monitoring well installed by the PGE Power Generating Station is located within the AOC. A water supply well is located approximately 650 ft northeast of the outer boundary of the AOC.
- Carty Reservoir is the nearest surface water body to the AOC. Six-mile Canyon Creek flows through the northeast corner of the target.
- The source of water for Carty Reservoir is from the upper reaches of Six-mile Canyon Creek and makeup water is supplied by a water supply well located approximately 650 ft northeast of the AOC boundary. The reservoir water is used for cooling at the PGE Power Generating Station.
- Future land use is expected to remain the same.

Former Range Use

- The target was used between 1948 and 1960 and is thought to be a replacement target for the Carty Reservoir Target, which was used between 1942 and 1945.
- It is unclear of the extent of use of this target. During the ASR field visit, no MEC or debris were identified within the target footprint or safety zone. The contractor that conducted the INPR for the USACE identified several small items whose description matched that of a 31-lb practice bomb, although the ASR team could not verify the information.

Potential Contaminant Sources – Target No. 1 AOC

- The ASR Supplement (USACE, 2004) identified the likely range munitions used at this AOC as being AN-Mk 5, AN-Mk 23, and AN-Mk 43 practice bombs. These practice bombs contained black powder and a spotting charge.

MEC Evaluation

Types of MEC

- No MEC or munitions debris were identified during the ASR site visit in 1997. However, the contractor that conducted the INPR for the USACE identified several small items whose description matched that of a 31-lb practice bomb.
- The potential for UXO to be present at this AOC is low, based on the lack of MEC or munitions debris located in the area.

Surface Exposure Pathway

- The potential route of human exposure (PGE and agricultural workers) to MEC or munitions debris includes direct contact by vehicles, agricultural tilling, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

Subsurface Exposure Pathway

- The potential routes of human exposure (PGE and agricultural workers) to MEC or munitions debris would be by intrusive drilling or digging activities (including agricultural tilling) or geologic instability (erosion, freeze-thaw, etc.).
- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

MEC Evaluation/Investigation Needed

- Visual field reconnaissance of the target area, particularly near the location of the target, will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer.

MC Evaluation

Types of MC

- Munitions debris from practice bombs consists primarily of light gauge sheet metal, cast iron, or lead. Iron is the primary constituent of sheet metal and cast iron. Other metals that may be present in sheet metal and cast iron include aluminum, chromium, copper, lead, manganese, molybdenum, nickel, and titanium.
- Spotting charges or signals used with practice bombs at this AOC primarily consist of a blank shotgun shell with black powder. Black powder consists of potassium nitrate, sulfur, and charcoal. A red or white phosphorous pyrotechnic charge may also have been used.
- Although not documented, other bomb munitions may have been used on this range that contained other explosives including nitroglycerin.

Overview of Pathways

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a secondary source of potential surface water, sediment, groundwater, or air contamination.
- Surface Water: Carty Reservoir may be potentially affected, although the MC from munitions used at this AOC may not pose a significant risk.
- Sediment: Sediment in Carty Reservoir may be potentially affected by surface water runoff from impacted soil areas or from MC in the soil present prior to inundation when Carty Reservoir was created. The migration of metals within the sediments is relatively low because of the low mobility of the metals in water and the arid climate.
- Groundwater: Groundwater is a potentially affected media since the creation of Carty Reservoir has resulted in a groundwater mound beneath the reservoir. Migration of MC directly to the groundwater via surface water infiltration is considered to be possible. However, the constituents of the MC may not pose a significant risk.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at the Boardman AFR include soil, surface water, sediment, groundwater, and air. A pathway evaluation for each media is discussed below and provided in Table 3.

Figure 3 illustrates the CSM for the Target No.1 AOC and potential pathways of MC contamination.

Soil Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- Workers (PGE and agricultural workers).
- Wildlife.

MC Soil Evaluation/Investigation Needed

- One soil sample will be collected from this AOC if MEC or munitions debris are located during the visual field reconnaissance survey. The provisional sample will be analyzed for explosives (including nitroglycerin) and select metals (aluminum,

chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc). This metals list is based on expected metals to be contained in the munitions (bomb casings, explosives, and fuzes) plus metals that may be used during background comparisons. Only black powder explosives and red or white phosphorous signals were used.

Surface Water Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated surface water include incidental ingestion of, dermal contact with, and inhalation of surface water.
- The potential routes of wildlife (including aquatic organisms) exposure to contaminated surface water include ingestion of and direct contact with surface water present at or near the AOC.

Receptors

- Workers (PGE and agricultural workers).
- Wildlife.

MC Surface Water Evaluation/Investigation Needed

- No water samples will be collected from Carty Reservoir from this AOC. One surface water sample was collected from Carty Reservoir during the USEPA's PA/SI (Weston, 2004) and analyzed for perchlorate. Analytical results indicated that no detectable concentrations of perchlorate were found in the surface water sample from Carty Reservoir. The samples were not analyzed for metals or explosives. However, water quality (including metals) of Carty Reservoir is monitored monthly by PGE. Lack of MEC and munitions debris resulting from use of Target No.1 suggest that the likelihood of MC impacts to surface water is low. Only black powder explosives and red or white phosphorous signals were known to have been used and the metals contained in the bomb casings consisted of either sheet metal, iron, or lead.

Sediment Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated sediment include incidental ingestion of and dermal contact with sediment.
- The potential routes of wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

Receptors

- Workers (PGE and agricultural workers).
- Wildlife.

MC Sediment Evaluation/Investigation Needed

- No sediment sample will be collected from Carty Reservoir for this AOC. A sediment sample will be collected as part of the Carty Reservoir Bomb Target evaluation.

Groundwater Exposure Pathway

Exposure Routes

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure to wildlife is not a concern.

Receptors

- Workers (PGE and agricultural workers).

MC Groundwater Evaluation/Investigation Needed

- No additional groundwater samples are planned for the Target No. 1 AOC. The PA/SI (Weston, 2004) addressed the groundwater pathway for the Boardman AFR. Two groundwater samples were collected from the Target No. 1 AOC vicinity. Results for both samples show concentrations of explosives and perchlorate were below analytical reporting limits. Metals analysis are included in the PGE groundwater monitoring program and are available for use in this SI.

Air Exposure Pathway

Exposure Routes

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

Receptors

- Workers (PGE and agricultural workers).
- Wildlife.

MC Sediment/Surface Water Evaluation/Investigation Needed

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be used in the evaluation of the air pathway. The USEPA's Region 9 Preliminary Remediation Goals (USEPA, 2004) incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

Conceptual Site Model – Target No. 2 AOC

Target No. 2 consists of a single target configured with concentric circles in 200- and 400-yard radii. In addition, there were three scoring towers 120 degrees apart near the target. This range was previously assessed during the USEPA's PA/SI (Weston, 2004). The target name is consistent with the ASR Supplement (2004). Figure 1 shows the general location of Target No. 2 and Figure 4 shows the configuration and current land uses in the vicinity of the target.

Current and Future Land Use

- The Target No. 2 AOC is located on agricultural property owned by Three-mile Canyon Farms. The area is currently used for irrigated farming.
- There are no groundwater wells located within the boundary of Target No 2.
- The nearest surface water is Six-mile Canyon Creek located approximately 1,800 ft west of the southwest boundary of the AOC.
- The future land use is not expected to change from the present use.

Former Range Use

- The target was used between 1942 and 1960 for practice bombing.

Potential Contaminant Sources – Target No. 2 AOC

- Likely range munitions used at this AOC are listed as AN-M50 incendiary bombs, M38A2 practice bombs and Mk 6 2.25-inch practice rockets. Recent MEC finds at Target No. 2 included AN-M57 G.P. bomb. Munitions debris from AN-47, and Mk-15 100lbs practice bombs has also been reported.
- The AN-M50 incendiary bombs were cased in a magnesium shell and contained a fuze and thermite. Thermite consists of a mixture of iron oxide, aluminum, and sulfur.
- The M38A2 practice bombs were a sand-filled, sheet metal cased, 100-lb practice bomb and contained a black powder spotting charge.
- The Mk 6 2.25-inch practice rockets were constructed from sheet metal. The propellant used in the rocket was Ballistite, which consists of nitrocellulose and nitroglycerin. There was no spotting charge with the Mk 6 rockets. The use of the Mk 6 practice rocket is thought to be limited at this target as evidenced by the scarcity of spent rocket motors (ASR, 1997).
- The AN-M57 G.P bomb contained Amatol or TNT.
- The AN-47 and Mk-15 practice bombs are inert.

MEC Evaluation

Types of MEC

- The types of munitions used at Target No. 2 are listed above. Debris from these munitions was observed during the ASR site visit in 1997, during the PA/SI investigation by Weston (2004), and in 2006 during a Navy EOD recovery. In addition, four 75 mm

HEAT, M66 projectiles were reported to have been destroyed in the target area by Army EOD in 1987. The ASR indicated that the 75 mm projectiles were likely brought to the site for disposal and not used at the site.

- MEC has been reported from this AOC as recently as March 2006.
- The potential for MEC to be present at this AOC is moderate. This is based on prior use, historical documents, interviews, identification of munitions debris, and results of the ASR site visit.

Surface Exposure Pathway

- The potential route of human exposure (agricultural workers) to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

Subsurface Exposure Pathway

- The potential routes of human exposure (agricultural workers) to MEC or munitions debris would be by intrusive drilling or digging activities, agricultural tilling, or geologic instability (erosion, freeze-thaw, etc.).
- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

MEC Evaluation/Investigation Needed

- No MEC reconnaissance surveys will be conducted at this AOC. The potential for MEC is indicated by previous and recent finds.

MC Evaluation

Types of MC

- MC from practice bombs consists primarily of light gauge sheet metal and magnesium metal. Iron is the primary constituent of sheet metal. The incendiary bomb casings are constructed from magnesium. Other metals that may be present in sheet metal include iron include aluminum, chromium, copper, lead, manganese, molybdenum, nickel, and titanium.
- Spotting charges or signals used with practice bombs at this AOC primarily consist of a black powder, which contains potassium nitrate, sulfur, and charcoal, and thermite, which contains iron oxide, aluminum, and sulfur. In addition, the AN-M57 GP bombs contained either Amatol (TNT and ammonium nitrate) or TNT.
- The propellant used in the Mk 6 2.25-inch practice rockets contained nitrocellulose and nitroglycerin.

Overview of Pathways

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a secondary source of potential air, surface water, or groundwater contamination.
- Surface Water: Six-mile Canyon Creek may be potentially affected by runoff from the target area.
- Sediment: Sediment in Six-mile Canyon Creek may be potentially affected by surface water runoff from impacted soil areas. However, Six-mile Canyon Creek is located approximately 1,800 ft west of the AOC boundary (Figure 4) and the target itself was located approximately 6,100 ft east. The potential for metals migration within the sediments is relatively low because of the low mobility of the metals in water and the arid climate.
- Groundwater: Groundwater is a potentially affected media, however there is no complete pathway. There are no groundwater withdrawals. While no groundwater depths are available for the Target No. 2 area, thin perched groundwater layers above the basalt bedrock are possible, particularly with the irrigated farming that is occurring in the area. There is the potential for MC migration to groundwater. No groundwater drinking water wells are within the AOC.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at the Boardman AFR include soil, surface water, sediment, groundwater, and air. A pathway evaluation for each media is discussed below and provided in Table 3.

Figure 3 illustrates the CSM for the Target No. 2 AOC and potential pathways of MC contamination.

Soil Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- Agricultural workers.
- Wildlife.

MC Soil Evaluation/Investigation Needed

- Two soil samples will be collected from Target No. 2. Samples will be located in untilled areas between crop circles. Samples will be analyzed for explosives (including

nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc). This metals list is based on expected metals to be contained in the munitions (bomb casings, explosives, and fuzes) plus metals that may be used during background comparisons. Soil samples were collected from near the Target No. 2 AOC during the PA/SI (Weston, 2004). However, the samples were not from within the AOC. Samples were analyzed for metals and perchlorate. There were no metals reported that significantly exceeded background concentrations. There were no detections of perchlorate in the soil samples collected within this AOC. Black powder, nitrocellulose, nitroglycerin, and TNT were the primary explosives used.

Surface Water Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated surface water include incidental ingestion of, dermal contact with, and inhalation of surface water.
- The potential routes of wildlife (including aquatic organisms) exposure to contaminated surface water include ingestion of and direct contact with surface water present at or near the AOC.
- There are no surface water bodies or streams within the AOC.

Receptors

- Agricultural workers.
- Wildlife.

MC Surface Water Evaluation/Investigation Needed

- Surface water sampling for metals is not warranted. The overland travel distance for water is at least 1,800 ft and it is doubtful that overland flow from the AOC to the stream would occur in this arid environment and silty/sandy soil type.

Sediment Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated sediment include incidental ingestion of and dermal contact with sediment.
- The potential routes of wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

Receptors

- Agricultural workers.
- Wildlife.

MC Sediment Evaluation/Investigation Needed

- No sediment samples will be collected from this AOC. A sediment sample was collected from a point near the AOC during the PA/SI (Weston, 2004). The sample was analyzed for metals only. Analytical results indicate that there were no metals

reported that significantly exceeded background concentrations. In addition, the overland travel distance for soil and water is at least 1,800 ft and it is doubtful that overland flow from the AOC to the stream would occur in this arid environment and silty/sandy soil type.

Groundwater Exposure Pathway

Exposure Routes

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure to wildlife is not a concern.

Receptors

- Agricultural workers.

MC Groundwater Evaluation/Investigation Needed

- No groundwater samples are planned for the Target No. 2 AOC. The PA/SI (Weston, 2004) addressed the groundwater pathway for the Boardman AFR. Groundwater samples were collected both up and downgradient of this AOC. Sample results show that no explosive compounds were detected. However, perchlorate was detected in both up and downgradient samples. Metals were not included in the PA/SI analytical suite. However, because of the types of metals contained in munitions used at Target No. 2, metals are not considered a concern for groundwater.

Air Exposure Pathway

Exposure Routes

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

Receptors

- Workers (agricultural workers).
- Wildlife.

MC Sediment/Surface Water Evaluation/Investigation Needed

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be used in the evaluation of the air pathway. The USEPA's Region 9 Preliminary Remediation Goals (USEPA, 2004) incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

Conceptual Site Model – Carty Reservoir Bomb Target AOC

Carty Reservoir Bomb Target consists of a single target configured with concentric circles (spacing not identified). This target is located on the western side of Carty Reservoir. Prior to the ASR, this target was not identified in any historical documents. It is thought that this target was the original target at the range. The ASR team believed that the original Target No. 1 was located in this area and then was relocated approximately 1 mile north in approximately 1946. The Carty Reservoir Bomb Target was located in a depression which made scoring difficult. The new target No. 1 location is much flatter and at a higher elevation. This range was assessed during the USEPA's PA/SI (Weston, 2004). The target name is consistent with the ASR Supplement (2004). Figure 1 shows the general location of Carty Reservoir Bomb Target and Figure 5 shows a more detailed view. The configuration and current land uses in the vicinity of the target. This AOC overlaps with Target No. 1.

Current and Future Land Use

- The Carty Reservoir Bomb Target AOC is located on PGE and BAIC, Inc (leased by Three-mile Canyon Farms) property. The western half of the AOC is currently used for irrigated farming and the southern and eastern portion is native vegetation consisting of grasses. There is evidence of one time livestock grazing in the area.
- The terrain slopes toward Carty Reservoir.
- There are no groundwater wells located within the boundary of this AOC.
- Carty Reservoir covers approximately 30 percent of the area.

Former Range Use

- The target is thought to have been used between 1942 and 1944 for practice bombing; however, the actual date of use is not known.

Potential Contaminant Sources – Carty Reservoir Bomb Target AOC

- Likely range munitions used at this AOC was the Mk 23, M38A2, and M75 practice bombs and the M84 target marker bomb.
- The Mk 23 practice bombs were constructed from cast iron and contained black powder and a red phosphorus pyrotechnic signal charge.
- The M38A2 practice bombs were a sand-filled sheet metal cased 100-lb practice bomb and contained a black powder spotting charge.
- The M75 and M84 practice bombs were cased in sheet metal and contained a burster and fuze and a charge of red iron ore (hematite) that was used as a marker.

MEC Evaluation

Types of MEC

- The types of munitions used at the Carty Reservoir Bomb Target are listed above. Large amounts of debris from these munitions were observed during the ASR site visit in 1997. This AOC was the only area where the ASR team observed relatively intact, fused, and suspected live munitions (M75/M84 practice bomb) during the 1997 site visit.
- The potential for UXO to be present at this AOC is moderate. This is based on prior use, historical documents, interviews, and results of the ASR site visit.

Surface Exposure Pathway

- The potential route of human exposure (PGE and agricultural workers) to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

Subsurface Exposure Pathway

- The potential routes of human exposure (primarily agricultural workers) to MEC or munitions debris would be by intrusive drilling or digging activities or geologic instability (erosion, freeze-thaw, etc.).
- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

MEC Evaluation/Investigation Needed

- No visual field reconnaissance survey of the target area will be conducted with the objective to locate MEC, however, a visual survey will be completed to clear soil sample locations. The survey will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer or metal detector.

MC Evaluation

Types of MC

- Munitions debris from practice bombs consists primarily of light gauge sheet metal and cast iron. Iron is the primary constituent of sheet metal and cast iron. Other metals that may be present in sheet metal include iron include aluminum, chromium, copper, lead, manganese, molybdenum, nickel, and titanium.
- Spotting charges or signals used with practice bombs at this AOC primarily consist of a black powder that contains potassium nitrate, sulfur, and charcoal.

Overview of Pathways

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a secondary source of potential air, surface water, or groundwater contamination.
- Surface Water: Carty Reservoir may be potentially affected by MC contained in soils prior to water inundation of portions of the target area.
- Sediment: Sediment in Carty Reservoir may be potentially affected by MC in soils prior to water inundation of portions of the target area.
- Groundwater: Groundwater is a potentially affected media since it is approximately 10 ft bgs at the site and migration of MC directly to the groundwater from the soil is considered to be possible.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at the Boardman AFR include soil, surface water, sediment, groundwater, and air. A pathway evaluation for each media is discussed below and provided in Table 3.

Figure 3 illustrates the CSM for the Carty Reservoir Bomb Target AOC and potential pathways of MC contamination.

Soil Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- PGE and agricultural workers.
- Wildlife.

MC Soil Evaluation/Investigation Needed

- Two soil samples are planned for the Carty Reservoir Bomb Target. Soil samples will be located near the target center where a high density of munitions debris has been reported. Samples will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc). This metals list is based on expected metals to be contained in the munitions (bomb casings, explosives, and fuzes) plus metals that may be used during background comparisons. Black powder was the only explosive used. During the TPP meeting the ODEQ representative requested that one of the samples also be analyzed for explosives. Based

on this request, one sample will also be analyzed for explosives (including nitroglycerin).

Surface Water Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated surface water include incidental ingestion of, dermal contact with, and inhalation of surface water.
- The potential routes of wildlife (including aquatic organisms) exposure to contaminated surface water include ingestion of and direct contact with surface water present at or near the AOC.

Receptors

- PGE and agricultural workers.
- Wildlife.

MC Surface Water Evaluation/Investigation Needed

- No surface water samples will be collected from Carty Reservoir. A water sample was collected from Carty Reservoir during the PA/SI (Weston, 2004) in 2004 and analyzed for perchlorate only. Perchlorate was not detected in the surface water sample.
- Sampling for metals and explosives is not required. Water samples from the reservoir are analyzed monthly for metals and other water quality parameters. The only documented explosive used at this target was black powder, whose constituents are nonhazardous.

Sediment Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated sediment include incidental ingestion of and dermal contact with sediment.
- The potential routes of wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

Receptors

- Agricultural workers.
- Wildlife.

MC Sediment Evaluation/Investigation Needed

- One sediment sample will be collected from Carty Reservoir and analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc). This metals list is based on expected metals to be contained in the munitions (bomb casings, explosives, and fuzes) plus metals that may be used during background comparisons. While only black powder explosives and red or white phosphorous signals were used, the ODEQ representative requested that the sample also be analyzed for explosives. Sampling for perchlorate is not required as no perchlorate was detected in the surface

water sample collected during the PA/SI (Weston, 2004) and perchlorate containing compounds were not part of the munitions used at this AOC.

Groundwater Exposure Pathway

Exposure Routes

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure to wildlife is not a concern.

Receptors

- PGE and agricultural workers.

MC Groundwater Evaluation/Investigation Needed

- No additional groundwater samples are planned for the Carty Reservoir Bomb Target AOC. The PA/SI (Weston, 2004) addressed the groundwater pathway for the Boardman AFR. Groundwater samples were collected both up and downgradient of this AOC. Sample results show that no explosive compounds were detected. Perchlorate was detected in an upgradient sample, but not in downgradient samples. Metals were not included in the PA/SI analytical suite. However, metals are routinely analyzed for in groundwater samples collected from nearby downgradient PGE monitoring wells.

Air Exposure Pathway

Exposure Routes

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

Receptors

- Workers (agricultural workers).
- Wildlife.

MC Sediment/Surface Water Evaluation/Investigation Needed

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be used in the evaluation of the air pathway. The USEPA's Region 9 Preliminary Remediation Goals (USEPA, 2004) incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

Conceptual Site Model – Range Complex No. 1 AOC

The Range Complex No. 1 AOC consists of a three areas: INPR Site No. 1, the Demolition Area, and the Turret Gunnery Training Range. Figure 1 shows the general location of the Range No. 1 Complex. Figures 6 through 8 show greater detail of the Range Complex.

The INPR Site No. 1 is a bomb target that was in use between 1946 and 1960. The ASR Supplement (USACE, 2004) indicated that the target was configured with concentric circles of 100, 200, and 300 ft. However, analysis of recent aerial photos shows faint concentric circles at 75, 500, and 1000 ft (see Figure 6). A portion of the safety zone for this site lies within the non-FUDS property currently used by the Navy Bombing Range. Soil samples were collected from INPR No.1 during the PA/SI (Weston, 2004).

The Demolition Area was used for the demolition of munitions between 1952 and 1960. The area consists of two rows, approximately 200 ft apart. Each row has 20 pits (craters) spaced 50 ft apart. Munitions debris is embedded in the crater walls and scattered in a wide radius from the craters.

The Turret Gunnery Training Range was used to train B-36 Bomber gunners to fire at target drones that flew across their front. The turret gun firing points were located on current Navy Bombing Range Property and are not FUDS property. Only the downrange portion of the range is within the Boardman AFR FUDS. A portion of the safety zone is outside of the FUDS boundary on the active Navy bombing range. The range name is consistent with the ASR Supplement (USACE, 2004).

Current and Future Land Use

- Range Complex No.1 is shown on Figures 6 through 8. Much of the northern and eastern portions of the range complex are currently being used for irrigated crops. The southern portion of the range is used for the Boeing Antennae Test Range, and wildlife conservation area managed by the Nature Conservancy.
- There are no groundwater wells located within the boundary of this AOC.
- Future land use is expected to remain the same as current land use.

Former Range Use

- The INPR No. 1 was active from 1946 to 1960 and was used for practice bombing.
- The Demolition Area was active from between 1952 and 1960 and was used for demolition and disposal of munitions.
- The Turret Gunnery Training Range was used between 1952 and 1960. It was used to train B-36 Bomber gunners.

Potential Contaminant Sources – Range Complex No. 1 AOC

- The likely range munitions used were:

- INPR No. 1 – Mk 23, Mk 76, Mk 84, Mk 89, Mk 106, M38A2, BDU 10, and BDU 33 practice bombs. In addition Weston (2004) reported finding a Mark-12 practice nuclear bomb (inert training bomb) and a Fuel-Air-Explosive BLU-95 bomb. The BLU-95 was likely a bomb that drifted over from the adjacent Navy Bomb Range.
- Demolition Area – C-4 Blocks, M60 igniter, detonation cord and time blasting fuze, blasting caps both electric and non-electric, all other munitions types used on the Boardman AFR.
- Turret Gunnery Training Range – 20 mm Ball practice ammunition. The projectile is machined from bar steel.
- Table 2 summarizes the constituents of the munitions.

MEC Evaluation

Types of MEC

- The types of munitions used at Range Complex No. 1 are listed above. Debris from these munitions were observed during the ASR site visit in 1997. The ASR noted that other than the Mk 23 practice bomb, the remaining bombs on the INPR No. 1 site are post Koran War vintage, particularly the BDU 10 practice nuclear bomb.
- The potential for UXO to be present at this AOC is moderate and primarily within INPR No.1 and the Demolition Area. This is based on prior use, historical documents, interviews, and results of the ASR site visit.

Surface Exposure Pathway

- The potential route of human exposure (Boeing, agricultural workers, and natural area workers) to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

Subsurface Exposure Pathway

- The potential routes of human exposure (Boeing, agricultural workers, and natural area workers) to MEC or munitions debris would be by intrusive drilling or digging activities or geologic instability (erosion, freeze-thaw, etc.).
- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

MEC Evaluation/Investigation Needed

- No visual field reconnaissance survey of the Range Complex No. 1 AOC will be conducted with the objective to locate MEC; however, a visual survey will be completed

to clear soil sample locations. The survey will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer or metal detector.

MC Evaluation

Types of MC

- Munitions debris from practice bombs consists primarily of light gauge sheet metal and cast iron. Iron is the primary constituent of sheet metal and cast iron. Other metals that may be present in sheet metal include aluminum, chromium, copper, lead, manganese, molybdenum, nickel, and titanium.
- Spotting charges or signals used with practice bombs at this AOC primarily consist of a black powder that contains potassium nitrate, sulfur, and charcoal. The BLU-95 contained ethylene oxide.
- Demolition charges C-4 and detonation cord contain explosives RDX and PETN.
- MC in the Turret Gunnery Training Range consists of metals from steel projectiles.

Overview of Pathways

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a secondary source of potential air, surface water, or groundwater contamination.
- Surface Water: The nearest surface water is Carty Reservoir located approximately 6 miles southwest of the center of the range complex. Because of the distance, there is no complete surface water pathway.
- Sediment: Because of the distance to the nearest surface water, there is no complete pathway for sediment.
- Groundwater: Groundwater is a potentially affected media since it is approximately 10 ft bgs at the site and migration of MC directly to the groundwater from the soil is considered to be possible.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at Range Complex No. 1 include soil, groundwater, and air. A pathway evaluation for each media is discussed below and provided in Table 3.

Figures 3 and 9 illustrate the CSMs for Range Complex No. 1 and potential pathways of MC contamination.

Soil Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- Agricultural workers.
- Wildlife.

MC Soil Evaluation/Investigation Needed

- Two soil samples are planned for the Range Complex No. 1. The soil samples will be collected from the Demolition Area and will be located near two of the detonation craters where a high density of munitions debris is present. The sampling locations will be selected following a visual survey conducted by a UXO technician aided by magnetometer. Samples will be analyzed for explosives (including nitroglycerin and PETN) and select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc). This metals list is based on expected metals to be contained in the munitions (bomb casings, explosives, and fuzes) plus metals that may be used during background comparisons.
- A soil sample was collected from INPR No. 1 during the PA/SI (Weston, 2004) and analyzed for metals, explosives, and perchlorate. Metals were not detected in significant concentrations and explosives and perchlorate were not detected. Additional soil samples are not required for this area.

Groundwater Exposure Pathway

Exposure Routes

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure to wildlife is not a concern.

Receptors

- Boeing and agricultural workers.

MC Groundwater Evaluation/Investigation Needed

- No additional groundwater samples are planned for Range Complex No. 1. The PA/SI (Weston, 2004) addressed the groundwater pathway for the Boardman AFR, and sufficient data exist to assess groundwater. Groundwater samples were collected within and downgradient of the Boardman AFR. Sample results show that no explosive compounds were detected in any sample. However, perchlorate was detected in some wells. Metals were not included in the PA/SI analytical suite. However, because of the types of metals contained in munitions used at this AOC, metals are not considered a concern for groundwater.

Air Exposure Pathway

Exposure Routes

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

Receptors

- Workers (agricultural workers).
- Wildlife.

MC Sediment/Surface Water Evaluation/Investigation Needed

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be used in the evaluation of the air pathway. The USEPA's Region 9 Preliminary Remediation Goals (USEPA, 2004) incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

Conceptual Site Model – Demolition Area No. 2 AOC

Demolition Area No. 2 is a newly identified AOC. The identification was made through interviews with a property leaseholder (the Nature Conservancy) and the Oregon State Police. The AOC consists of a number of detonation craters with munitions debris (Figure 10). Fuzes and munitions debris were recently destroyed by the Oregon State Police.

Current and Future Land Use

- Little is known of the Demolition Area No. 2 and who used it.
- There are no groundwater wells located within the boundary of this AOC.
- The land is currently used as a wildlife conservation area.
- Future land is expected to remain the same as current land use.

Former Range Use

- The area appears to have been used as an ordnance disposal/demolition area.
- It is unknown who was responsible for the demolition area.

Potential Contaminant Sources – Demolition Area No. 2

- The likely munitions used at this AOC are:
 - M83 Butterfly bombs, M66 base detonator fuzes, 100 lb GP bomb base plate, C-4 blocks, detonation cord and time blasting fuze, and blasting caps both electric and non-electric.

MEC Evaluation

Types of MEC

- The types of munitions used at the Demolition Area No. 2 are listed above. Debris from these munitions was located by employees of the Nature Conservancy who manage a portion of land for critical wildlife habitat.
- Ordnance disposal of the M83 Butterfly bomb was completed by the Oregon State Police in June 2006.

Surface Exposure Pathway

- The potential route of human exposure to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

Subsurface Exposure Pathway

- The potential routes of human exposure to MEC or munitions debris would be by intrusive drilling or digging activities or geologic instability (erosion, freeze-thaw, etc.).

- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

MEC Evaluation/Investigation Needed

- No visual reconnaissance survey of Demolition Range No. 2 is necessary. MEC and munitions debris has been identified at the AOC. Prior to collection of soil samples a visual MEC avoidance survey will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer.

MC Evaluation

Types of MC

- Munitions debris from the M83 Butterfly Bombs consists primarily of light gauge sheet metal.
- Demolition charges C-4 and detonation cord contain explosives RDX and PETN.
- TNT is found in the M83 bomblets.
- Other explosive MC not identified above.

Overview of Pathways

Affected media and potential pathways for MC include:

- **Soil:** Soil is the primary medium of concern because of possible MC in the soil from demolition activities. The soil also serves as a secondary source of potential air, surface water, or groundwater contamination.
- **Surface Water:** The nearest surface water is Carty Reservoir, located approximately 4 miles to the southwest. Because of this distance, there is no complete surface water pathway.
- **Sediment:** Because of the distance to the nearest surface water, there is no complete pathway for sediment.
- **Groundwater:** Groundwater is a potentially affected media since it is approximately 10 ft bgs at the site and migration of MC directly to the groundwater from the soil is considered to be possible.
- **Air:** Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at Demolition Area No. 2 include soil, groundwater, and air. A pathway evaluation for each media is discussed below and provided in Table 3. Figure 9 illustrates the CSM for the Demolition Area No. 2 AOC.

Soil Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- Agricultural workers.
- Wildlife.

MC Soil Evaluation/Investigation Needed

- Two soil samples are planned for the Demolition Area No. 2 AOC. A soil sample will be collected near two of the demolition craters. The sampling location will be selected following visual reconnaissance UXO survey utilizing a magnetometer to avoid UXO. Samples will be analyzed for explosives (including nitroglycerin and PETN) and select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc). This metals list is based on expected metals to be contained in the munitions (bomb casings, explosives, and fuzes) plus metals that may be used during background comparisons.

Groundwater Exposure Pathway

Exposure Routes

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure to wildlife is not a concern.

Receptors

- Workers.

MC Groundwater Evaluation/Investigation Needed

- No additional groundwater samples are planned for this AOC. The PA/SI (Weston, 2004) addressed the groundwater pathway for the Boardman AFR, and sufficient data exist to assess groundwater. Groundwater samples were collected within and downgradient of the Boardman AFR. Sample results show that no explosive compounds were detected in any sample. However, perchlorate was detected in some wells. Metals were not included in the PA/SI analytical suite. However, because of the types of metals contained in munitions used at this AOC, metals are not considered a concern for groundwater.

Air Exposure Pathway

Exposure Routes

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

Receptors

- Workers (agricultural workers).
- Wildlife.

MC Sediment/Surface Water Evaluation/Investigation Needed

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be used in the evaluation of the air pathway. The USEPA's Region 9 Preliminary Remediation Goals (USEPA, 2004) incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

Conceptual Site Model – Impact Area AOC

The Impact Area is a newly identified AOC. The identification was made through interviews with a property leaseholder (the Nature Conservancy). The AOC consists of a number of impact craters with a small amount of munitions debris (Figure 11). The AOC is locally known as the “Ship in the Desert”. Impact craters are also visible on aerial photographs (Figure 11).

Current and Future Land Use

- Little is known of the Impact Area and who used it.
- There are one groundwater well is located approximately 1 mile south (upgradient) of the AOC.
- The land is currently used as a wildlife conservation area.
- Future land is expected to remain the same as current land use.

Former Range Use

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

Potential Contaminant Sources – Impact Area

- The potential munitions used at this AOC are:
 - AN-Mk 5, AN-Mk 23, and AN-Mk 43 practice bombs. These practice bombs contained black powder and a pyrotechnic charge. The use of other practice bombs is possible.

MEC Evaluation

Types of MEC

- The types of munitions used at the Impact Area are listed above. The nature of the debris found at the AOC is unknown, however, it was described as only a small amount.

Surface Exposure Pathway

- The potential route of human exposure to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

Subsurface Exposure Pathway

- The potential routes of human exposure to MEC or munitions debris would be by intrusive drilling or digging activities or geologic instability (erosion, freeze-thaw, etc.).

- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

MEC Evaluation/Investigation Needed

- A visual field reconnaissance survey of the Impact Area will be complete to identify and MEC and munitions debris on the ground surface. The survey will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer.

MC Evaluation

Types of MC

- Munitions debris is thought to be from AN-Mk 5, AN-Mk 23, and AN-Mk 43 practice bombs. The bomb consists of a cast iron body. These practice bombs contained black powder and a pyrotechnic charge. Additional munitions may have been used.

Overview of Pathways

Affected media and potential pathways for MC include:

- **Soil:** Soil is the primary medium of concern because of possible MC in the soil from demolition activities. The soil also serves as a secondary source of potential air, surface water, or groundwater contamination.
- **Surface Water:** Surface water is a potentially affected media. However the pathway is considered incomplete because, the upper portion of Six-mile Canyon Creek flows only during high precipitation events and the creek is dry much of the time.
- **Sediment:** Sediment is a potentially affected media. The upper portion of Six-mile Canyon Creek is adjacent to the AOC. However, flow is seasonal and the creek is dry much of the time.
- **Groundwater:** Groundwater is a potentially affected media. However, it is considered an incomplete pathway due to no wells in the area. The nearest groundwater use point is at the PGE power plant approximately 2 miles north of the AOC. Topographic maps show an artesian well
- **Air:** Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at the Impact Area include soil, sediment, and air. A pathway evaluation for each media is discussed below and provided in Table 3. Figure 3 illustrates the CSM for the Impact Area.

Soil Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- Agricultural workers.
- Wildlife.

MC Soil Evaluation/Investigation Needed

- One soil sample will be collected from the Impact Area AOC. A soil sample will be collected near one of the impact craters where munitions debris is located. The sampling location will be selected following visual field reconnaissance survey utilizing a magnetometer. Samples will be analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc). This metals list is based on expected metals to be contained in the munitions (bomb casings, explosives, and fuzes) plus metals that may be used during background comparisons.

Sediment Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated sediment include incidental ingestion of and dermal contact with sediment.
- The potential routes of wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

Receptors

- Agricultural workers.
- Wildlife.

MC Sediment Evaluation/Investigation Needed

- One sediment sample will be collected from this AOC. The sample will be collected from the bottom of the Six-mile Canyon Creek drainage at a probable point of entry. The sample will be analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc). This metals list is based on expected metals to be contained in the munitions (bomb casings, explosives, and fuzes) plus metals that may be used during background comparisons.

Air Exposure Pathway

Exposure Routes

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

Receptors

- Workers (agricultural workers).
- Wildlife.

MC Sediment/Surface Water Evaluation/Investigation Needed

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be used in the evaluation of the air pathway. The USEPA's Region 9 Preliminary Remediation Goals (USEPA, 2004) incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

Data Gaps

- The presence of MEC and munitions debris has been established in all AOCs except Target No 1. MEC has been reported as recently as March 2006 at Target No. 2 and June 2006 at Demolition Area No. 2.
- Some sampling for MC has been completed as part of the USEPA's PA/SI (Weston, 2004). Perchlorate has been detected in surface water and groundwater. Table 1 summarizes the PA/SI sampling that was performed and notes the data gaps.

Results of the current status of data requirements with respect to MEC and MC for the AOCs located at the former Boardman AFR are summarized below:

AOC	Presence of MEC	Presence of MC	Proposed Inspection Activities
Target No. 1	Unknown	Unknown	A visual field reconnaissance survey and soil sampling.
Target No. 2	Established	Unknown	UXO avoidance survey for sample locations. Soil and sediment sampling.
Carty Reservoir Bomb Target	Established	Unknown	UXO avoidance survey for sample locations. Soil and sediment sampling.
Range Complex No. 1	Established	Absent on INPR Site No.1, Unknown at Demolition pits. Only small arms used on Turret Gunnery Range	UXO avoidance survey for sample locations. Soil sampling in Demolition Area.
Demolition Area No. 2	Established	Unknown	UXO avoidance survey for sample locations. Soil sampling.
Impact Area	Unknown	Unknown	A visual field reconnaissance survey and soil sampling

Note: Analytical data gathered through previous investigations may, or may not, meet fully the DQOs of the current SI (i.e., the analytical methodology and analyte list may, or may not, conform to the USACE Programmatic Sampling and Analysis Plan). Therefore, those analytical results previously collected are not interpreted with the sole purpose of making a determination that no further investigation is required at a particular AOC. However, the previous data collected can be used reasonably to make a recommendation for further action beyond the scope of this SI.

Proposed Sampling Scheme

*Site Inspection
Boardman Air Force Range*

*Technical Project Planning Meeting
July 20, 2006*

Proposed Field Investigation

The proposed field investigation sampling to be conducted at the former Boardman AFR is detailed below. The investigation approach will be defined in more detail in an SSWP that will be submitted to ODEQ and other stakeholders for review. The SSWP will reference technical details including sampling and analytical methods that are described in the *Type I Work Plan, Site Inspections at Multiple Sites*, prepared by Shaw and submitted to USACE as final in February 2006.

Reconnaissance Survey

A visual field reconnaissance survey by a trained UXO technician using a hand-held magnetometer will be completed at Target No.1 and the Impact Area AOCs to locate MEC and munitions debris. The objective of the visual field reconnaissance survey will be to determine whether MEC or munitions debris are present at the AOC. If MEC or munitions debris are located, then a soil sample will be collected at or near the location. If no MEC or munitions debris are located a soil sample will be collected near the reported target center. A global positioning system will be used to record the visual field reconnaissance survey route and discovered MEC and munitions debris. Digital photographs will be taken to document significant features.

Visual reconnaissance surveys will also be performed at other sampling locations to aid in sample location selection and to allow the sampler to work safely.

Soils

Surface soil samples will be collected at a depth of approximately 0 to 6 inches bgs. Surface soil samples will be composite samples (7-point, wheel pattern with 2-ft radius). No subsurface samples are planned. Sediment samples will be collected from a 0- to 6-inch depth but will be discrete samples in order to retrieve material from specific, localized, surface water drainage features.

One soil sample will be collected from the Target No. 1 AOC at the location of MEC or munitions debris. If no MEC or munitions debris is located a soil sample will be collected near the reported target center. The sample will be collected from one location and analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc).

Two soil samples will be collected from Target No. 2 AOC and analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc). The sample locations will be in untilled areas to minimize deep soil mixing. The PA/SI (Weston, 2004) sample locations from this area were not within the AOC and are thus not representative of Target No. 2.

Two soil samples will be collected from the Carty Reservoir Bomb Target and analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc). One sample will be analyzed for explosives including nitroglycerin.

Two soil samples will be collected from the Demolition Area within Range Complex No. 1 to determine impacts to soil from explosive compounds used during demolition activities. Samples will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc) and explosives including nitroglycerin and PETN. Sample locations will be selected near disposal craters following UXO avoidance.

Two soil samples will be collected from the Demolition Area No. 2 and analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc) and explosives (including nitroglycerin and PETN). Samples will be collected from near disposal craters following UXO avoidance.

One soil sample will be collected from the Impact Area and analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc) and explosives (including nitroglycerin). The sample will be collected from near an impact crater where munitions debris is located.

No soil samples will be collected from INPR No. 1 or the Turret Gunnery Range. INPR No. 1 was sampled previously for metals, nitrogen-based explosive compounds, and perchlorate. There were no metals detected that significantly exceeded background concentrations and no explosives or perchlorate were detected in the soils. The Turret Gunnery Range consists only of the downrange area and the firing positions were located on what is now Navy property and not part of this FUDS. In addition, the 20 mm munitions fired utilized a steel projectile, which contained only trace concentrations of hazardous metals (e.g., chromium).

Surface Water and Sediment

One sediment sample will be collected from Carty Reservoir. The sample will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc) and explosives including nitroglycerin.

One sediment sample will be collected from the Impact Area AOC in the Six-Mile Canyon Creek drainage. The location will be at a probable point of entry from the AOC. The sample will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc) and explosives (including nitroglycerin).

Groundwater

No groundwater sampling is planned for this site. Groundwater sampling for the Boardman AFR was completed during the USEPA's PA/SI (Weston, 2004) sufficient to meet data objectives.

Background Sampling

No background samples are to be collected from the Boardman AFR. An existing soil background set has been supplied by the ODEQ for use. The one surface water sample is to be analyzed for explosives only and no background information is necessary. A sediment background sample was collected during the PA/SI and will be used for this SI.

TPP Meeting Notes and Data Quality Objectives

***Site Inspection
Boardman Air Force Range***

***Technical Project Planning Meeting
July 20, 2006***

Technical Project Planning and Development of Data Quality Objectives

- The USACE TPP process is a four-phase process:
 - Identify the current project,
 - Determine data needs,
 - Develop data collection options, and
 - Finalize data collection program.
- The purpose of TPP is to develop DQOs that document how the project makes decisions.
- DQOs are intended to capture project-specific information such as the intended data use(s), data needs, and how these items will be achieved.
- Information captured through DQOs will be used as a benchmark for determining whether identified objectives are met.

TPP Phases

Phase I: Identify the Current Project

1. Team members identified to date include: USACE – representatives from the Omaha Design Center and the Seattle District; Shaw Environmental, Inc. as a USACE contractor; ODEQ; USEPA Region 10; Portland General Electric; BAIC, Inc; and Inland Land Company, Three-Mile Farms, The Nature Conservancy, and other BAIC, Inc. leaseholders.

Question: Is there any person or organization missing from this Team?

Umatilla Confederated Tribes

2. The AOCs are identified as:
 - Target No. 1,
 - Target No. 2.
 - Carty Reservoir,
 - Range Complex No. 1
 - INPR site No. 1
 - Demolition Area
 - Turret Gunnery Training Range,
 - Demolition Area No. 2, and
 - Impact Area (note this AOC was added after the TPP meeting based on interviews with the Nature Conservancy).

All areas, except the Demolition Area No. 2 and the Impact Area, were assigned a RAC of 4 during the ASR study. The Demolition Area No. 2 and the Impact Area is a newly identified

AOC and were not scored. A list of munitions used at Boardman AFR is provided on Table 2. Based on interviews with former personnel and site owners, MEC has been found on site.

Question: Are there any other AOCs to be identified?

Potential for several new AOCs in southern portion of FUDS based on preliminary information provided from The Nature Conservancy. Some areas may be related to sorts from the adjacent Navy range and additional demolition areas. Additional review of air photo coverage is required.

Following review of aerial photos and information provided by the Nature Conservancy, the Impact Area AOC was added.

3. Based on information available about the site and shared through discussions with USACE, concerns about this area have been expressed by the landowners.

Question: Are there additional concerns or issues from landowners or other stakeholders regarding the Boardman AFR area?

Concern was expressed about the potential impacts to the agricultural industry if MEC or MC impacts are found

Question: Are there any administrative or stakeholder concerns or constraints that would prevent site inspection activities from going forward on the decision path for this site?

None

Phase II: Determine Data Needs

4. Existing site information includes an ASR and ASR Supplement both prepared by the USACE in 1997 and 2004, respectively and a PA/SI prepared for the USEPA by Weston in 2004.

Question: Are there any other pertinent documents relating to the site available?

The Nature Conservancy to provide additional maps (provided at meeting) and shape files for Southern Demolition Sites.

PGE to provide locations for 2 MEC finds (*provided on July 31, 2006*).

A new groundwater report concerning perchlorate in groundwater for the Umatilla Basin will be provided by ODEQ.

Information on new report is available on the Web and results were incorporated into this TPP memo.

Comprehensive Range Evaluation Report issued by Navy in February 2006. *Electronic Copy provided at meeting.*

5. The site-specific approach for this SI involves collating and assessing available site information, to include site geology, hydrogeology, groundwater, surface water, ecological information, human use/access, and current and future land uses; as well as considering conduct of site inspection and sampling activities.

Question: Are there any other site aspects/information that should be considered?

None

6. Based on prior site investigations, soil are the primary affected medium at the Boardman AFR. Surface water is a potential pathway of MC because of the existence of Carty Reservoir and Six-mile Canyon Creek within or near several AOCs. Groundwater is a potential pathway, however the depth to the shallow water bearing zone in the alluvium is highly variable but at least 40 ft depth near Carty Reservoir. Air is also a potential pathway if soil particles become airborne. Considering current and future land use, primary receptors of any contaminants that may be present would most likely be agricultural workers and wildlife.

Question: Do team members concur with the CSM?

- **MEC and MC are to be evaluated at Target No. 1.** Yes, only one soil sample to be analyzed for explosives.
 - **MC is to be evaluated at Target No. 2, Carty Reservoir Bomb Target, the Demolition Area, and Demolition Area No. 2.** Sample for metals and explosives. Only one soil sample from Carty Reservoir Bomb Target to be analyzed for explosives. Need to evaluate CSM and sampling for southern demolition areas identified in this meeting.
 - **MC contaminants of concern are metals, explosives, and perchlorate.** Agree, however, perchlorate has been adequately evaluated.
 - **Exposure pathways are through soils, surface water, sediment, and potentially groundwater.** Also include air pathway.
7. Technical considerations and/or constraints need to be identified and addressed before conducting any additional sampling, and would depend on the approach and additional data needs decided upon by team members.

Questions:

- **Are any data missing?** Need to include explosive analysis for one soil sample only at Target No. 1 and Carty Reservoir Bomb Target. Need to evaluate the potential demolition areas in southern part of FUDS

- **What is the nature of needed data?** Explosive data, recent air photos, historical air photos
- **What data gaps would additional data meet for making a decision about the site?** Provide better certainty that all AOCs have been identified.
- **Are there any considerations/constraints that need to be addressed for collecting additional data?** None

Phase III: Develop Data Collection Options

8. Proposed approach:

1. Conduct surface reconnaissance in the Target No. 1 AOC to identify MEC and munitions debris.
2. Collect composite soil samples from the identified AOCs to be analyzed as detailed on Table 4.

Question: Based on the desired decision endpoints and information known to date, what additional information is needed to reach a determination of No Department of Defense Action Indicated (NDAI) or further action?

The potential AOCs need to be evaluated for inclusion in SI.

Question: What evidence of MEC is necessary to result in recommendation for the site to proceed to the RI stage relative to MEC and what is required for NDAI?

Presence of MEC or MEC debris is adequate. Presence of small arms munitions is not

Question: Are the stakeholders in agreement with the sampling approach program?

Agree

Question: Are the stakeholders in agreement that no background data are required to make a decision?

Will utilize existing data that will be made available by the ODEQ. May need to supplement with site specific data

Phase IV: Finalize Data Collection Program

9. What concentrations of COCs lead to decision end-points?

Note: Oregon State accepted standards are provided in Tables 5 through 10. These standards are consistent with those previously accepted for Camp Adair and Camp Abbot.

Question: Are these the correct standards to be applied as screening values for human health and ecological risk assessment?

ODEQ recommends that industrial standards be used rather than residential. Future use is agricultural, power production, and environmental conservation.

Shaw proposes that use of residential standards is more conservative and should be used at least for a first cut.

Question: Are there any additional sampling and analysis methodologies needed for all team members to arrive at a decision end-point?

None

The ODEQ has commented in previous TPPs for Camp Abbot and Camp Adair that it prefers using Risk-Based Concentrations (RBCs) based on guidance for *Risk-based Decision Making Process for the Remediation of Petroleum-Contaminated Sites* for evaluation of human health risk. Where RBC values are not available, USEPA Region 9 industrial Preliminary Remediation Goals (PRGs) may be used.

Concentrations to be used for human health and screening concentrations for ecological receptors are provided in the Tables 5 through 10.

Question: Given the additional sampling and analysis methodologies, are there impacts to the project schedule that need to be accommodated?

Submittal of the Right of Entry request should be made concurrent with Draft TPP memo to allow stakeholder review of both.

Data Quality Objectives

Upon agreement at the TPP meeting, the following decision rules will be applied with regard to MC sampling results:

- Below risk-based screening levels = NDAI;
- Above risk-based screening levels and background = RI/FS.

The following expanded project objectives have been developed.

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

DQO #1 – Utilizing trained UXO personnel and handheld magnetometers, a visual reconnaissance Survey of Target No. 1 will be conducted to identify physical evidence to indicate the presence of MEC (e.g., MEC on the surface and munitions debris). The visual

search will consist of a meandering path within the primary target area. The following decision rules will apply:

- If no evidence of explosive MEC is found, the AOC will be recommended for NDAI relative to MEC.
- If evidence of explosive MEC is confirmed, the AOC will be recommended for additional investigation.
- If there is indication of an imminent MEC hazard, the site may be recommended for a time critical removal action (TCRA).

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

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

DQO #3 – Soil samples will be collected and analyzed as proposed in Table 4 at Target No. 1, Target No. 2, Carty Reservoir Bomb Target, the Range Complex No. 1 Demolition Area, Demolition Area No. 2, and the Impact Area. Analytical results will be compared to screening values for human health and ecological risk assessment and to background and ambient samples collected during the SI, the PA/SI (Weston, 2004), and ODEQ supplied soil background data set for naturally occurring substances. The following decision rules will apply:

- If sample results are less than human health and ecological screening values, the site will be recommended for NDAI relative to MC.
- If sample results exceed both human health screening values and background values, the site will be recommended for additional investigation.
- If sample results do not human health screening values but do exceed both ecological screening values and background values, additional evaluation of the data will be conducted in conjunction with the stakeholders to determine if additional investigation is warranted.

Objective 3: Obtain data required for HRS scoring.

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

Objective 4: Obtain data required for MRSPP ranking.

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

Note: After the TPP Meeting, Shaw has received additional guidance from USACE regarding the approach to be used for ecological risk assessment. An initial assessment will be based on the presence or absence of sensitive ecological habitats or receptors. If there are no sensitive ecological habitats or receptors, comparison of analytical data to ecological screening values will not be necessary.

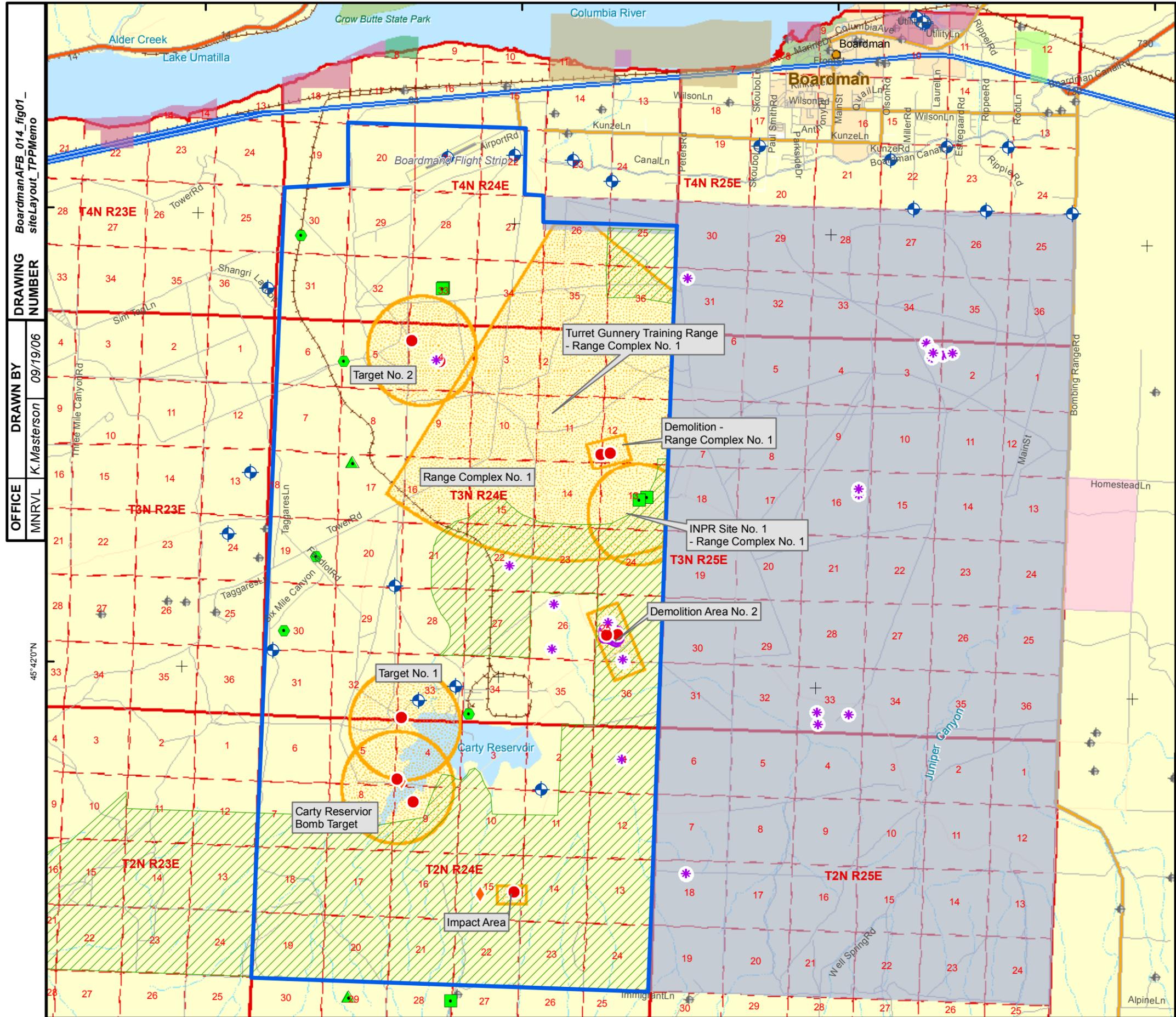
Next Steps

- Scheduling of a 2nd TPP meeting will occur as agreed upon by team members.
- Shaw will prepare the TPP Memorandum and distribute for concurrence.
- Shaw will prepare the SSWP for review and comment.
- Shaw will collect samples.
- Shaw will prepare the SI Report.

Figures

*Site Inspection
Boardman Air Force Range*

*Technical Project Planning Meeting
July 20, 2006*



Boardman AFB 014_fig01_ siteLayout_TPPMemo
 DRAWING NUMBER
 DRAWN BY
 OFFICE

MNRVL
 K.Masterson
 09/19/06
 45°42'0"N
 45°48'0"N

Legend

Boardman Air Force Range Boundary	Groundwater Well	
Boardman Air Force Range AOCs	Reported MEC Find	
Bureau of Reclamation	Proposed Soil Sample	
Oregon Dept. of Fish and Wildlife	Proposed Sediment Sample	
Oregon Dept. State Lands	PA/SI Sample Location	
U.S. Navy Bombing Range	Groundwater Sample	
United States Corps of Engineers	Sediment Sample	
United States Fish and Wildlife Service	Soil Sample	
The Nature Conservancy Lease	Surface Water Sample	
	Reported MEC Find	
	Demolition Craters	

NOTES:

- 1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement and interviews with site workers.
- 2) Groundwater well data were obtained from Oregon Water Resource Department.
- 3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.

45°48'0"N

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 1
SITE LAYOUT
 BOARDMAN AIR FORCE RANGE

Shaw® Shaw Environmental, Inc.

119°50'53"W 119°50'24"W 119°49'55"W 119°49'26"W 119°48'58"W 119°48'29"W

BoardmanAFR_015_fig02_trg1_TPPMemo
DRAWING NUMBER

DRAWN BY
K.Masterson 09/08/06

OFFICE
MNRVL
45°40'48"N



Legend

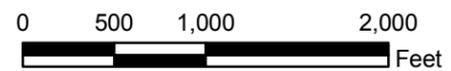
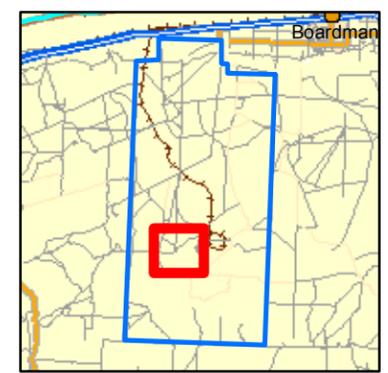
- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Taxlot Parcel
- The Nature Conservancy Lease
- Groundwater Well
- Proposed Soil Sample

PA/SI Sample Locations

- Groundwater Sample
- Surface Water Sample

NOTES:

- 1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
- 2) Groundwater well data were obtained from Oregon Water Resource Department.
- 3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
- 4) Aerial photo was obtained from the Oregon Dept. of Environmental Quality. The photo is dated Sept. 11, 2005.



REFERENCE/PROJECTION: NAD 83 UTM Zone 11N



U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

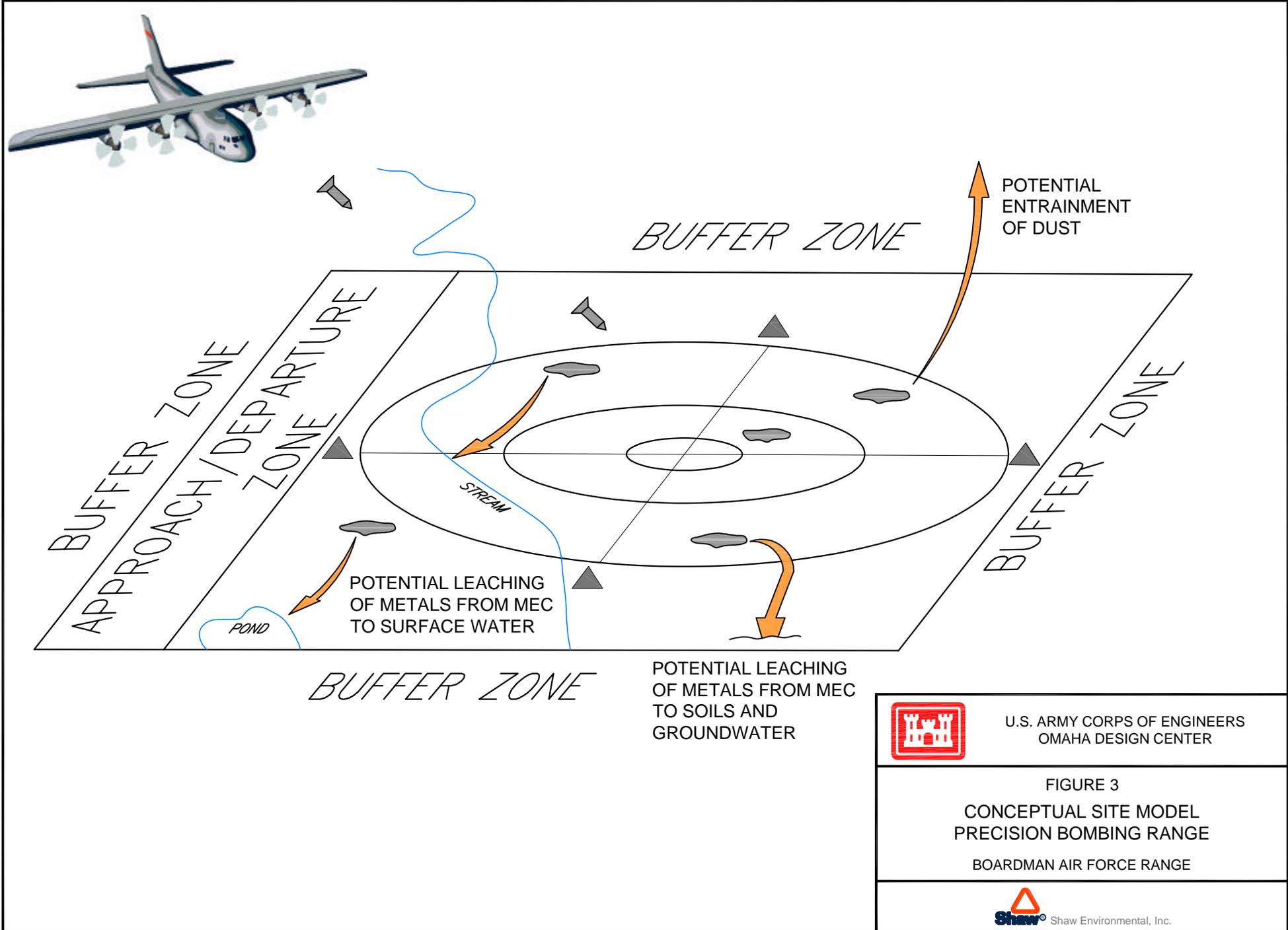
FIGURE 2

TARGET NO. 1

BOARDMAN AIR FORCE RANGE



OFFICE	DRAWN BY	DRAWING NUMBER
Cent	MEC	07/11/06
		030003A02



119°51'0"W 119°50'24"W 119°49'48"W 119°49'12"W 119°48'36"W



BOARDMAN AFR 016_fig04_trg2_TPPMemo
 DRAWING NUMBER
 DRAWN BY K.Masterson 09/14/06
 OFFICE MNRVL
 45°46'N
 45°45'36"N

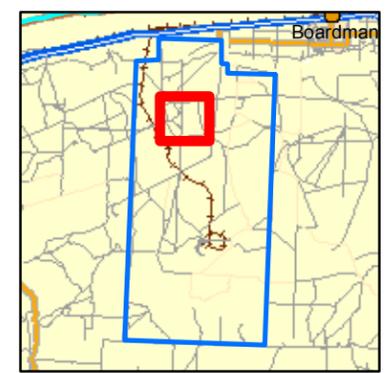
Legend

- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Taxlot Parcel
- * Reported MEC Find
- Proposed Soil Sample

PA/SI Sample Locations

- Soil Sample

- NOTES:**
- 1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
 - 2) Groundwater well data were obtained from Oregon Water Resource Department.
 - 3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
 - 4) Aerial photo was obtained from the Oregon Dept. of Environmental Quality. The photo is dated Sept. 11, 2005.



45°46'48"N
45°46'12"N

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

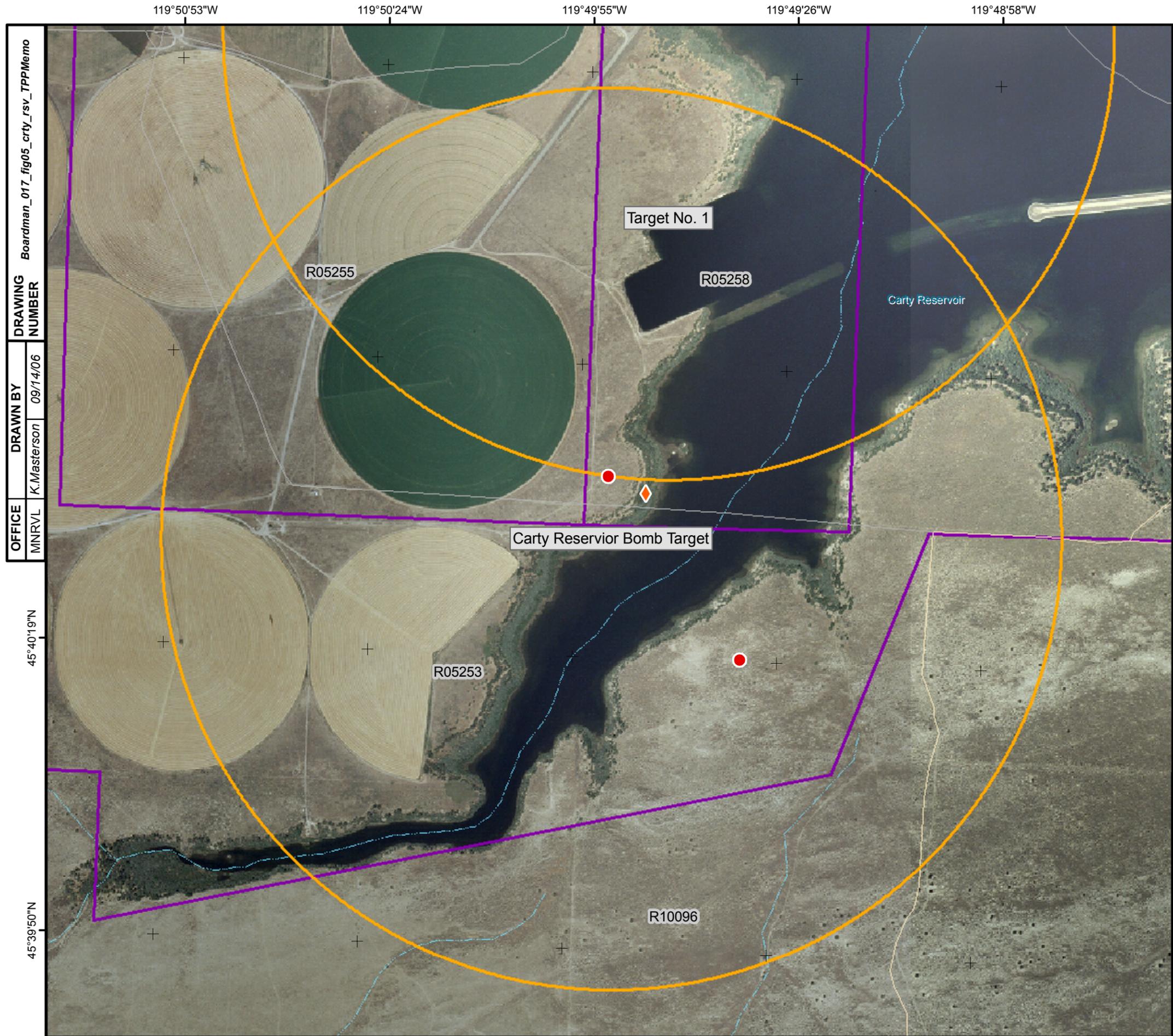


U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 4
TARGET NO. 2
BOARDMAN AIR FORCE RANGE



Shaw Shaw Environmental, Inc.



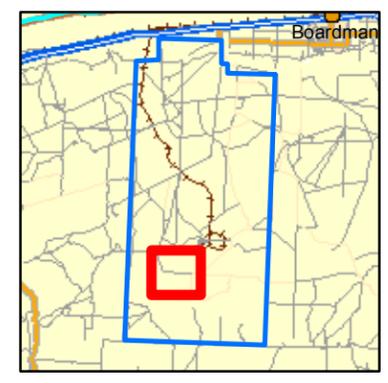
Boardman_017_fig05_crtv_rsv_TPP/Memo
DRAWING NUMBER
 09/14/06
DRAWN BY
 K.Masterson
OFFICE
 MNRVL

Legend

- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Taxlot Parcel
- Proposed Soil Sample
- Proposed Sediment Sample

NOTES:

- 1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
- 2) Groundwater well data were obtained from Oregon Water Resource Department.
- 3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
- 4) Aerial photo was obtained from the Oregon Dept. of Environmental Quality. The photo is dated Sept. 11, 2005.



REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

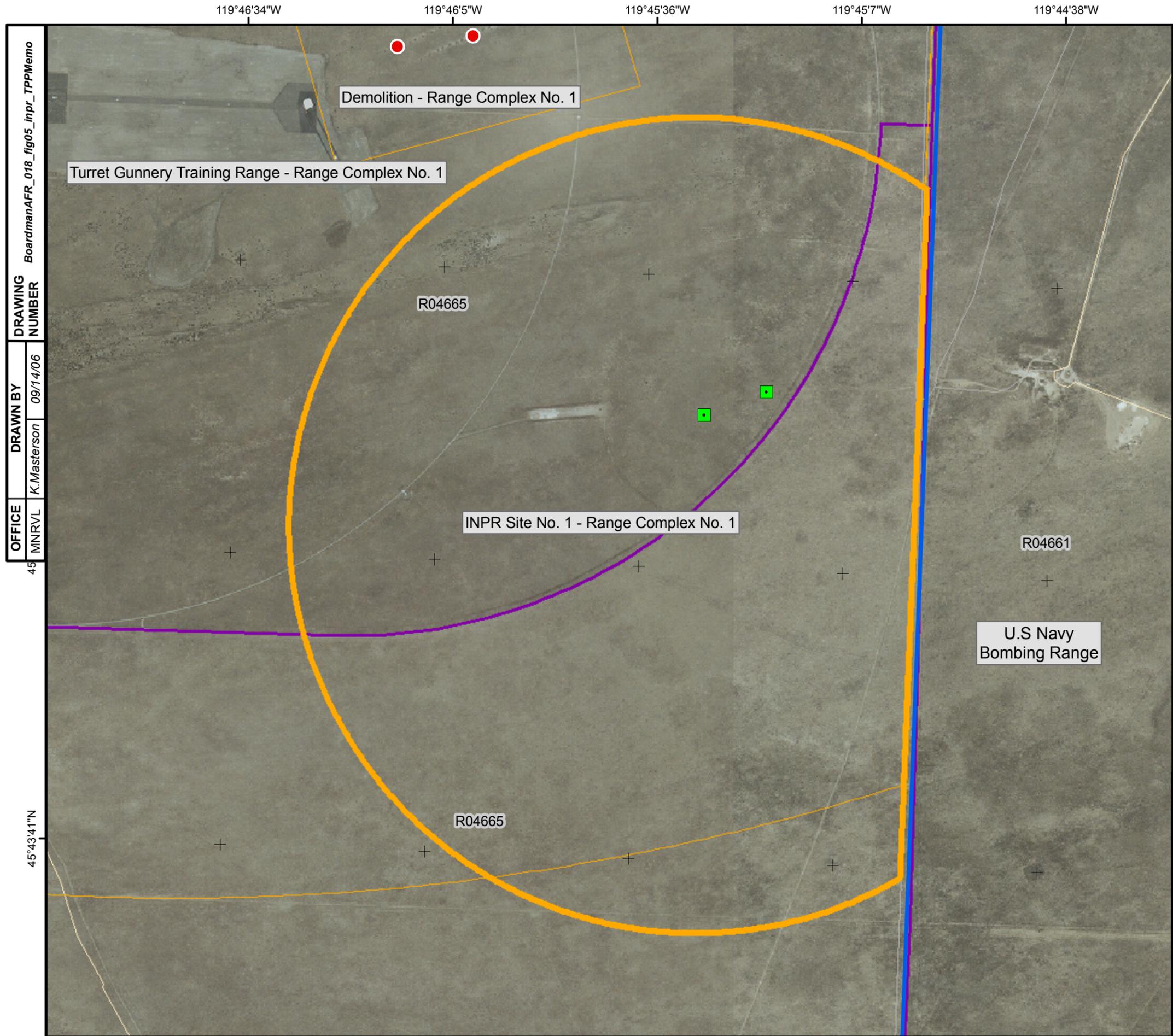


U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 5
CARTY RESERVOIR BOMB TARGET
 BOARDMAN AIR FORCE RANGE

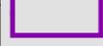


Shaw® Shaw Environmental, Inc.



BoardmanAFR_018_fig05_inpr_TPPMemo
 DRAWING NUMBER
 DRAWN BY
 OFFICE
 MNRVL
 K.Masterson
 09/14/06

Legend

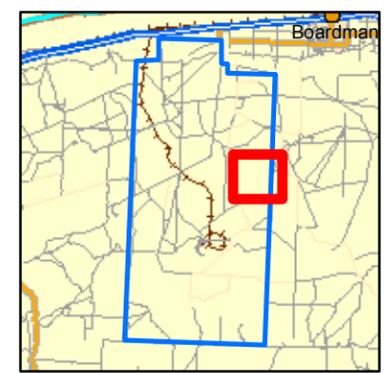
-  Boardman Air Force Range Boundary
-  Boardman Air Force Range AOCs
-  Taxlot Parcel
-  Proposed Soil Sample

PA/SI Sample Locations

-  Soil Sample

- NOTES:
- 1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
 - 2) Groundwater well data were obtained from Oregon Water Resource Department.
 - 3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
 - 4) Aerial photo was obtained from the Oregon Dept. of Environmental Quality. The photo is dated Sept. 11, 2005.

45°44'38"N
 45°44'10"N



REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

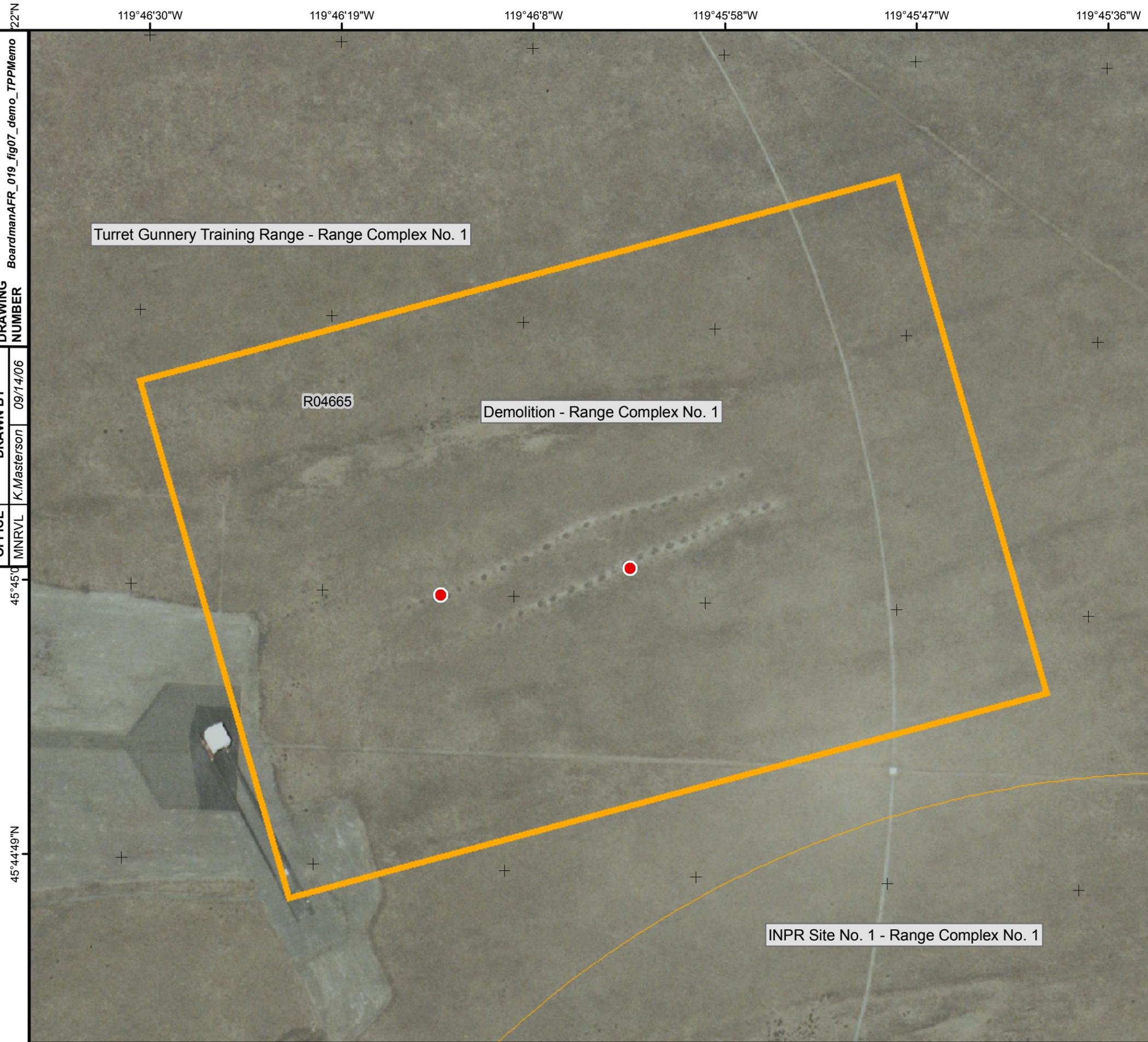


U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 6
INPR SITE NO. 1
RANGE COMPLEX NO. 1
 BOARDMAN AIR FORCE RANGE



Shaw® Shaw Environmental, Inc.



119°46'30"W 119°46'19"W 119°46'8"W 119°45'58"W 119°45'47"W 119°45'36"W

45°45'22"N
45°45'11"N
45°45'0"N
45°44'49"N

BoardmanAFR_019_fig07_demo_TPPMemo
DRAWING NUMBER
DRAWN BY
OFFICE

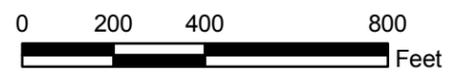
MNRVL
K.Masterson
09/14/06

Legend

-  Boardman Air Force Range Boundary
-  Boardman Air Force Range AOCs
-  Taxlot Parcel
-  Proposed Soil Sample

NOTES:

- 1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
- 2) Groundwater well data were obtained from Oregon Water Resource Department.
- 3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
- 4) Aerial photo was obtained from the Oregon Dept. of Environmental Quality. The photo is dated Sept. 11, 2005.



REFERENCE/PROJECTION: NAD 83 UTM Zone 11N



U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 7
DEMOLITION AREA
RANGE COMPLEX NO. 1
BOARDMAN AIR FORCE RANGE



BOARDMAN AFR_020_fig08_rc1_tgrt_TPPMemo
 DRAWING NUMBER
 DRAWN BY
 OFFICE

MNRVL
 K.Masterson
 09/14/06

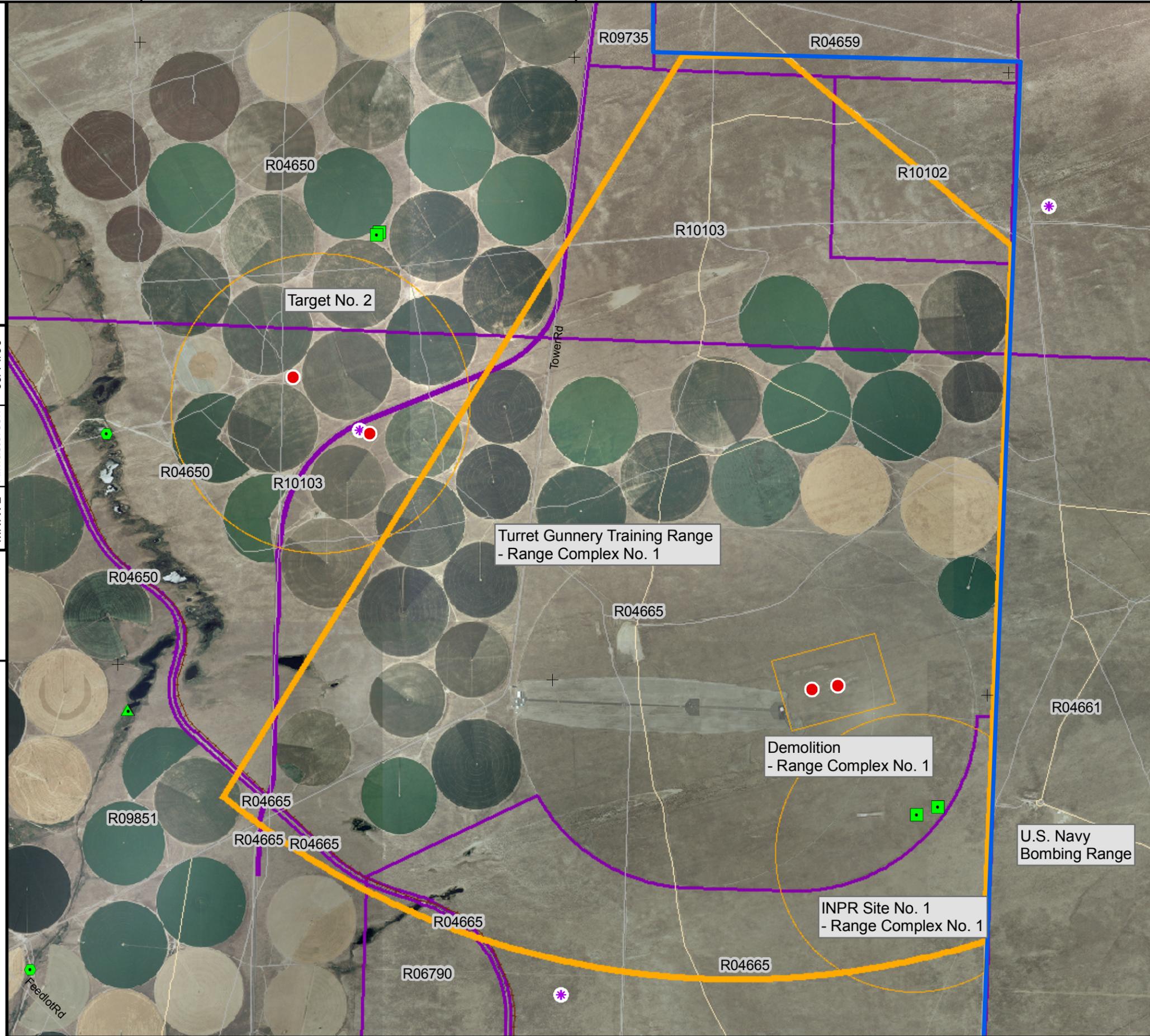
119°51'0"W

119°48'0"W

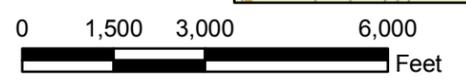
119°45'0"W

45°48'0"N

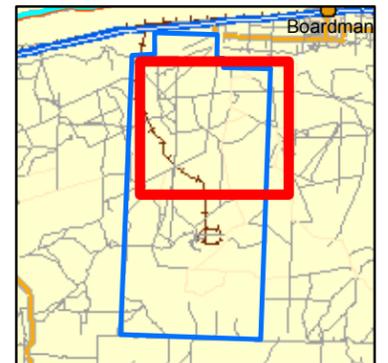
45°45'0"N



- NOTES:
- 1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
 - 2) Groundwater well data were obtained from Oregon Water Resource Department.
 - 3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
 - 4) Aerial photo was obtained from the Oregon Dept. of Environmental Quality. The photo is dated Sept. 11, 2005.



REFERENCE/PROJECTION: NAD 83 UTM Zone 11N



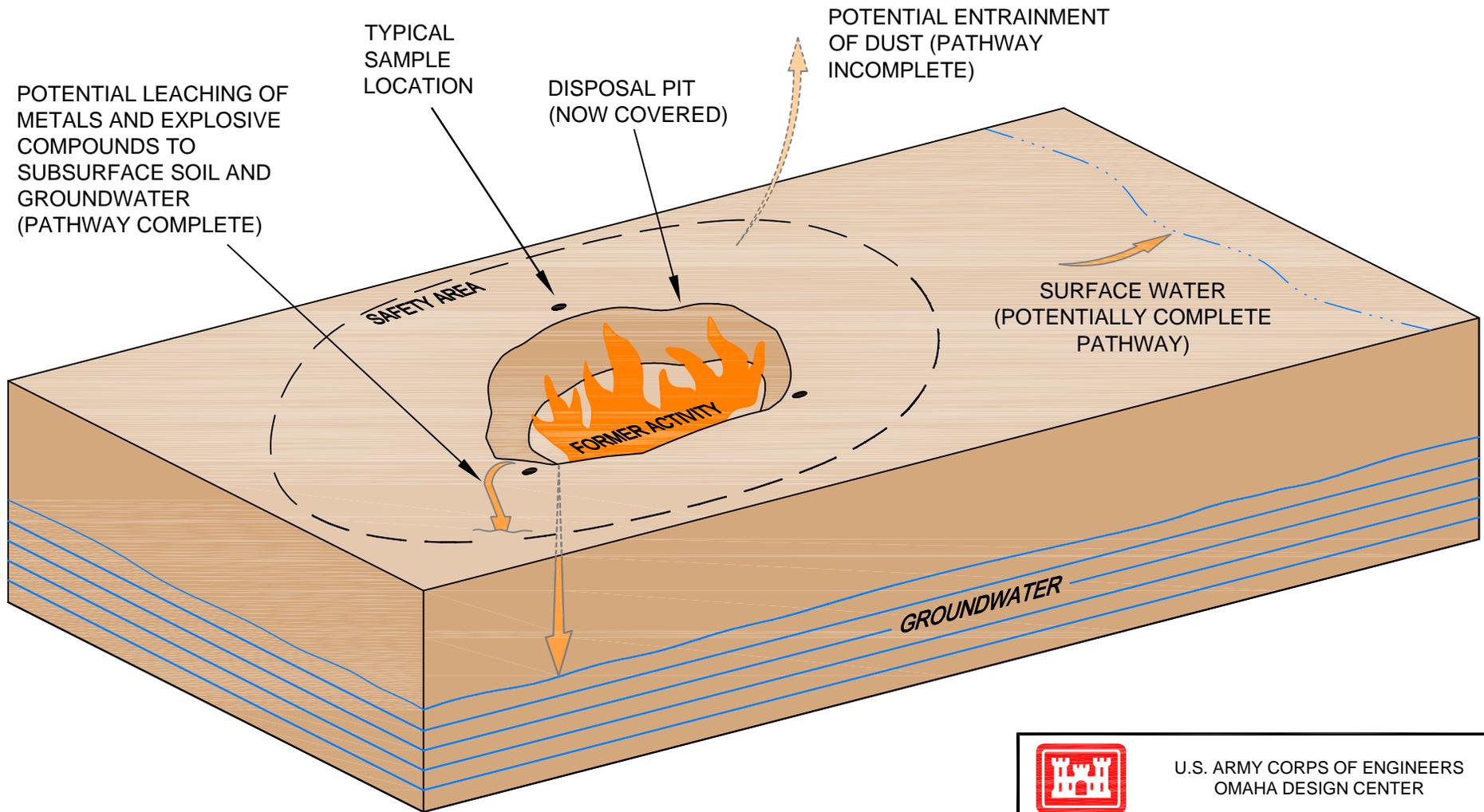
U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 8
TURRET GUNNERY TRAINING RANGE
RANGE COMPLEX NO. 1

BOARDMAN AIR FORCE RANGE



OFFICE	DRAWN BY	DRAWING NUMBER
Cent	MEC	030003A01
	7-11-06	



RECEPTORS:

- Site Users/Workers/Farmers
- Biota (deer)



U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 9
CONCEPTUAL SITE MODEL
DEMOLITION AREA

BOARDMAN AIR FORCE RANGE

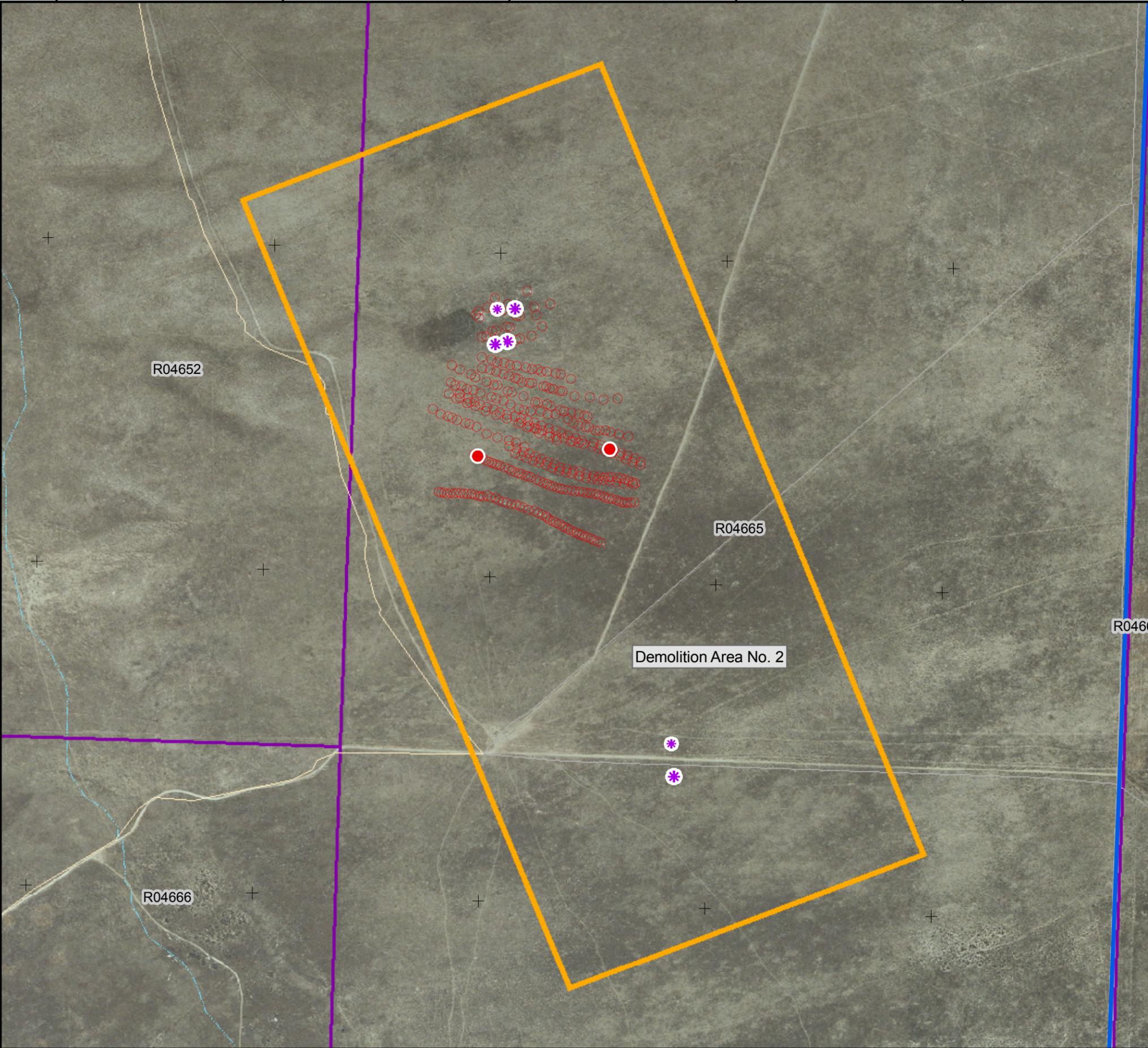


119°46'41"W 119°46'19"W 119°45'58"W 119°45'36"W 119°45'14"W

BoardmanAFR_021_fig08_demo2_TPPMemo
DRAWING NUMBER
DRAWN BY
OFFICE

45°42'N

45°42'7"N



Legend

-  Boardman Air Force Range Boundary
-  Boardman Air Force Range AOCs
-  Taxlot Parcel
-  Proposed Soil Sample
-  Reported MEC Find
-  Demolition Craters

45°42'50"N

45°42'29"N

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N



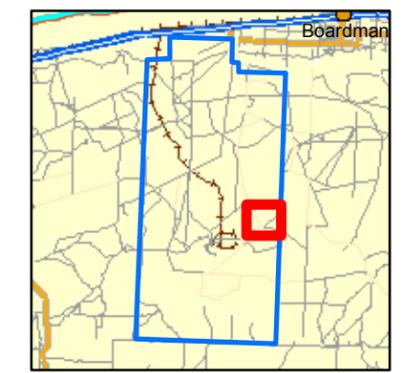
U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 10
DEMOLITION AREA NO. 2
BOARDMAN AIR FORCE RANGE



Shaw Shaw Environmental, Inc.

- NOTES:
- 1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
 - 2) Groundwater well data were obtained from Oregon Water Resource Department.
 - 3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
 - 4) Aerial photo was obtained from the Oregon Dept. of Environmental Quality. The photo is dated Sept. 11, 2005.



Tables

***Site Inspection
Boardman Air Force Range***

***Technical Project Planning Meeting
July 20, 2006***

Table 1
Summary of EPA PA/SI Sampling and Potential Data Gaps

AOC	Sub Range	EPA PA/SI Designation	Soil Sampling	Sediment Sampling	Surface Water Sampling	Groundwater Sampling	Potential Data Gaps	Comments
Target No. 1	Target No. 1	Areas A & B	Not sampled	Not sampled	1 surface water sample from Carty Reservoir, analyzed for perchlorate only	Groundwater sampled for NBEC and perchlorate	Need surface soil and sediment samples for metals and explosives. No groundwater metals data	No perchlorate detected in Carty Reservoir sample. Groundwater samples were less than detection limits for perchlorate and NBEC.
Target No. 2	Target No. 2	Areas C & D	Area C - 2 surface and 2 subsurface samples, all samples analyzed for metals and perchlorate. Samples were collected outside of AOC boundary	Not sampled	Not sampled	Not sampled	Need surface soil samples for metals and explosives	No significant metals concentrations, no detections of perchlorate. Soil samples collected were outside of AOC boundary. No drainages or surface water within AOC.
Carty Reservoir	Carty Reservoir	Areas G & H	Not sampled	Not sampled	1 surface water sample from Carty Reservoir, analyzed for perchlorate only	Nearby groundwater wells sampled for NBEC and perchlorate	Need surface soil and sediment samples for metals and explosives.	No perchlorate detected in Surface water sample. No detections of perchlorate or NBEC in groundwater
Range Complex No. 1	INPR Site No. 1	Areas E & F	Area E - 2 surface and 2 subsurface samples, all samples analyzed for metals and perchlorate, 1 surface and one subsurface sample analyzed for NBEC, No samples from Area F	Not sampled	Not sampled	Not sampled	None	No significant metals concentrations, no detections of NBEC or perchlorate. No drainages or surface water bodies within AOC.
	Demolition Area	Area I	Not Sampled	Not sampled	Not sampled	Not sampled	Need surface soil data for metals and explosives.	No drainages or surface water bodies within AOC.
	Turret Gunnery Range	Area J	Not Sampled	Not sampled	Not sampled	Not sampled	None	Only small – medium arms firing

**Table 1 (Cont.)
Summary of EPA PA/SI Sampling and Potential Data Gaps**

AOC	Sub Range	EPA PA/SI Designation	Soil Sampling	Sediment Sampling	Surface Water Sampling	Groundwater Sampling	Potential Data Gaps	Comments
Demolition Area No. 2	Demolition Area No. 2	Not Addressed	Not Sampled	Not sampled	Not sampled	Not sampled	Need surface soil metals and explosives data	No drainages or surface water bodies within AOC.
Impact Area	Impact Area	Not Addressed					Need surface soil metals and explosives data	
Other Areas		Area M	Not Sampled	One sediment sample along Six-mile Canyon Creek analyzed for metals	5 surface water samples along Six-mile Canyon creek, analyzed for perchlorate only.	5 Groundwater sample collected from around FUDS property, 18 other sample collected from wells located outside of FUDS. Sample analyzed for NBEC and perchlorate	None	No significant metals concentrations in sediment samples, Perchlorate detected in all surface water samples from Six-mile Canyon Creek, concentrations decreased down stream. Perchlorate was detected in 2 of 5 wells within FUDS boundary max conc. 3.56 ug/L. Perchlorate detected in 13 of 15 offsite wells. Max conc. 20.7 ug/L
Background		Background	1 sample collected and analyzed for metals, NBEC, and perchlorate	1 sample collected and analyzed for metals	Not sampled	Not sampled	None	Samples collected at southern boundary of FUDS.

AOC – Area of Concern

EPA PA/SI – *U.S. Environmental Protection Agency Preliminary Assessment/Site Inspection* (Weston, 2004)

NBEC – Nitrogen based explosive compounds

**Table 2
Potential MEC and MC at Boardman AFR AOCs**

AOC	Range Munitions	Munitions Constituents	Land Use Controls
Target No. 1	Practice Bombs: AN-Mk 5, AN-Mk 23, AN-Mk 43, Mk 4 (signal charge)	Steel, cast iron, or lead, black powder (potassium nitrate, sulfur, charcoal), red phosphorus	None
Target No. 2	AN-M50 Incendiary bomb, 4 lb	Magnesium alloy casing, 0.63 lb thermite (powdered aluminum metal and ferric oxide)	None
	AN-M52 Incendiary bomb, 2 lb	Magnesium alloy, 0.4 lb thermite (powdered aluminum metal and ferric oxide)	
	M38A2 practice bomb, 100 lb	sheet metal, inert sand filled, 3 lb black powder (potassium nitrate, sulfur, charcoal)	
	AN M-47	Steel Sheet metal, inert	
	MK-15	Steel sheet metal, Inert	
	2.25-inch Practice Rocket MK6	sheet metal, Ballistite (nitrocellulose and nitroglycerin)	
Carty Reservoir	AN-Mk 23	Cast iron, black powder (potassium nitrate, sulfur, charcoal), red phosphorus	None
	M38A2	sheet metal, inert sand filled, 3 lb black powder (potassium nitrate, sulfur, charcoal)	
	M75	sheet metal, iron oxide	
	M89	sheet metal, black powder (potassium nitrate, sulfur, charcoal)	

**Table 2 (Cont.)
Potential MEC and MC at Boardman AFR AOCs**

AOC	Range Munitions	Munitions Constituents	Land Use Controls
Range Complex No. 1	Small Arms - M2 ball, M1 Tracer, M10 Tracer	Soft Steel, lead, single (nitrocellulose) or double base (nitrocellulose and nitroglycerin) powder, tracer (calcium resinate, strontium peroxide, magnesium powder, strontium nitrate)	None
	BDU-33, MK 76	Cast iron, steel sheet metal, 10 gauge shotgun shell	
	Mk-84	Inert, steel sheet metal	
	BLU-95 (likely drift over from adjacent Navy range)	Ethylene oxide	
	Mark-12 Practice Nuclear bomb	Inert, concrete filled, steel sheet metal	
	Mk 106 5 lb	Sheet metal, single- (nitrocellulose) or double- base (nitrocellulose and nitroglycerin) powder	
	Mk 89, 56 lb	Soft steel, 10 gauge shotgun shell, red phosphorus	
	Medium caliber practice - 20 mm Ball Mk 1	Soft Steel, 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 sheet metal, TNT	None
	M66, M68 detonating fuzes		
	100 lb GP Bomb	Cast iron, TNT	
	Explosives C-4 blocks	RDX	
	Explosives Detonating Cord, M60 Igniter	PETN	

**Table 2 (Cont.)
Potential MEC and MC at Boardman AFR AOCs**

AOC	Range Munitions	Munitions Constituents	Land Use Controls
Impact Area (note munitions listed are only suspected)	Practice Bombs: AN-Mk 5, AN-Mk 23, AN-Mk 43, Mk 4 (signal charge)	Steel, cast iron, or lead, black powder (potassium nitrate, sulfur, charcoal), red phosphorus	None
Suspected Use but no AOC Specified	Practice bomb BDU-10 series, 2,025 lb	Inert (hot gas generator in folding fins configuration)	None
	75 mm HEAT, M66 projectiles	1 lb TNT or 50/50 Pentolite	

**Table 3
MEC and MC Exposure Pathway Analysis**

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Biota)		
Target No. 1 – Practice Bombing Range	MEC	MEC in the form of <i>unexploded</i> practice bomb spotting charges may exist on land surface.	Surface Soil <ul style="list-style-type: none"> MEC (unexploded practice bombs) are a hazard. MEC reported on surface during INPR 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Vehicle & foot traffic. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Foot traffic. 	<ul style="list-style-type: none"> No verified MEC found in the AOC. 	Visual field reconnaissance aided by magnetometer will be conducted to look for evidence of buried MEC.
			Subsurface Soil <ul style="list-style-type: none"> MEC may be buried. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Intrusive activities Agricultural tilling. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Burrowing activities Agricultural tilling. 	<ul style="list-style-type: none"> No verified MEC found in the AOC. 	Visual field reconnaissance aided by magnetometer will be conducted to look for evidence of buried MEC.
	MC	Black powder, sheet metal, cast iron, lead, red/white phosphorus	Soil <ul style="list-style-type: none"> Directly affected media. Potential metals contamination from munitions used. Spotting charges do not contain hazardous components. Fate & Transport: secondary source of potential surface water, sediment, and air contamination. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, Dermal contact, and Inhalation of soil particulates during intrusive work. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> Analytical data for metals or explosives in soil for this AOC does not exist. Field data for Screening Level Ecological Risk Assessment do not exist. 	One soil sample will be collected at location of MEC/munitions debris during the visual reconnaissance. If no MEC/munitions debris is identified sample from near target center will be collected Soil samples will be analyzed for select metals(aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc). Samples will be analyzed for explosives including nitroglycerin.
			Surface Water <ul style="list-style-type: none"> Potentially affected media – Carty Reservoir. Potential metals contamination. Spotting charges do not contain hazardous components. Fate & Transport: via surface runoff from impacted soil. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, Dermal contact, and Inhalation of surface water. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, Direct contact by area fauna, and Direct contact by aquatic organisms. 	<ul style="list-style-type: none"> Existing surface water data available from PGE. 	No surface water samples will be collected.
			Sediment <ul style="list-style-type: none"> Potentially affected media – Carty Reservoir. Potential metals contamination. Spotting charges do not contain hazardous components. Fate & Transport: via surface runoff from impacted soil. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, and Dermal contact. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> Analytical data for metals in sediments does not exist for Carty Reservoir. Field data for Screening Level Ecological Risk Assessment do not exist. 	No sediment samples will be collected from this AOC. A sediment sample from Carty Reservoir Bomb Target AOC will be collected.
			Groundwater <ul style="list-style-type: none"> Potentially affected media. Potential metals contamination. Spotting charges do not contain hazardous components. Fate & Transport: migration of metals directly to groundwater is possible due to downward flow gradient from Carty Reservoir to groundwater. 	<ul style="list-style-type: none"> Potentially complete pathway. local wells 	<ul style="list-style-type: none"> Incomplete pathway. No local wells 	<ul style="list-style-type: none"> Incomplete pathway. No exposure to groundwater 	<ul style="list-style-type: none"> None, groundwater metals analytical data exist from PGE. 	<ul style="list-style-type: none"> No groundwater samples planned. PGE has existing data set. Perchlorate sample collected during PA/SI was less than detection limits.
			Air <ul style="list-style-type: none"> Potentially affected media due to blowing soil and dust. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	<ul style="list-style-type: none"> Incomplete pathway: No residents 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	No soil analytical data to evaluate dust impacts	Will utilize soil analytical data in risk screening

**Table 3 (Cont.)
MEC and MC Exposure Pathway Analysis**

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Biota)		
Target No. 2 – Practice Bombing Range	MEC	MEC in the form of <i>unexploded</i> practice bomb spotting charges and general purpose bombs may exist on land surface.	Surface Soil <ul style="list-style-type: none"> MEC (unexploded practice and general purpose bombs) are a hazard. MEC and munitions debris reported on surface. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Vehicle & foot traffic. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Foot traffic. 	None	No visual field reconnaissance surveys aided by magnetometer will be completed, presence of past MEC finds and munitions debris indicates high probability of MEC
			Subsurface Soil <ul style="list-style-type: none"> MEC may be buried. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Intrusive activities Agricultural tilling. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Burrowing activities Agricultural tilling. 	None	No visual field reconnaissance surveys aided by magnetometer will be completed, presence of past MEC finds and munitions debris indicates high probability of MEC.
	MC	Black powder, sheet metal, cast iron, red/white phosphorus, thermite, rocket propellant containing nitrocellulose, nitroglycerin, and TNT.	Soil <ul style="list-style-type: none"> Directly affected media. Potential metals contamination from munitions used. Spotting charges do not contain hazardous components Potential explosives contamination (nitrocellulose, nitroglycerin, and TNT) Fate & Transport: secondary source of potential surface water, sediment, and air contamination. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, Dermal contact, and Inhalation of soil particulates during intrusive work. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> Analytical data for metals in soil do not exist for this AOC. Analytical data for explosives in soil do not exist for this AOC. Field data for Screening Level Ecological Risk Assessment do not exist. 	Two soil samples will be collected. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc) and explosives including nitroglycerin.
			Surface Water <ul style="list-style-type: none"> Potentially affected media – Six-mile Canyon Creek. Potential metals contamination. Spotting charges do not contain hazardous components Potential explosives contamination (nitrocellulose, nitroglycerin, and TNT) Fate & Transport: via surface runoff from impacted soil. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, Dermal contact, and Inhalation of surface water. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, Direct contact by area fauna, and Direct contact by aquatic organisms. 	<ul style="list-style-type: none"> Analytical data for explosives in surface water does not exist. Field data for Screening Level Ecological Risk Assessment do not exist. 	One surface water sample will be collected from Six-mile Canyon Creek and analyzed for explosives including nitroglycerin.
			Sediment <ul style="list-style-type: none"> Potentially affected media –Six-mile Canyon Creek. Potential metals contamination. Spotting charges do not contain hazardous components. Potential explosives contamination (nitrocellulose, nitroglycerin, and TNT) Fate & Transport: via surface runoff from impacted soil. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, and Dermal contact. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> Analytical data for metals in sediments does exist for Six-mile Canyon Creek. However, sample location is upgradient of this AOC. Analytical data for explosives in sediment does not exist. Field data for Screening Level Ecological Risk Assessment do not exist. 	No sediment sample will be collected from this AOC. The travel distance from the target area to the surface water body is approximately 1,800 ft and surface transport of soil over that distance is not likely to cause a detections of MC.
			Groundwater <ul style="list-style-type: none"> Potentially affected media. Potential metals contamination. Spotting charges do not contain hazardous components. Potential explosives contamination (nitrocellulose, nitroglycerin, and TNT) Fate & Transport: migration of metals directly to groundwater is possible. 	<ul style="list-style-type: none"> Potentially complete pathway. No local wells 	<ul style="list-style-type: none"> Incomplete pathway. No local wells 	<ul style="list-style-type: none"> Incomplete pathway. No local wells 	<ul style="list-style-type: none"> No groundwater analytical data exist for metals or explosives. 	<ul style="list-style-type: none"> No groundwater samples planned.
			Air <ul style="list-style-type: none"> Potentially affected media due to blowing soil and dust. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	<ul style="list-style-type: none"> Incomplete pathway: No residents 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	No soil analytical data to evaluate dust impacts	Will utilize soil analytical data in risk screening
			Soil <ul style="list-style-type: none"> Potentially affected media. Potential metals contamination from munitions used. Spotting charges do not contain hazardous components Potential explosives contamination (nitrocellulose, nitroglycerin, and TNT) Fate & Transport: secondary source of potential surface water, sediment, and air contamination. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, Dermal contact, and Inhalation of soil particulates during intrusive work. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> Analytical data for metals in soil do not exist for this AOC. Analytical data for explosives in soil do not exist for this AOC. Field data for Screening Level Ecological Risk Assessment do not exist. 	Two soil samples will be collected. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc) and explosives including nitroglycerin.

**Table 3 (Cont.)
MEC and MC Exposure Pathway Analysis**

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Biota)		
Carty Reservoir Bomb Target – Practice Bombing Range	MEC	MEC in the form of <i>unexploded</i> practice bomb spotting charges may exist on land surface.	Surface Soil <ul style="list-style-type: none"> MEC (unexploded practice bombs) are a hazard. MEC reported on surface during ASR 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Vehicle & foot traffic. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Foot traffic. 	<ul style="list-style-type: none"> None 	No visual field reconnaissance surveys aided by magnetometer will be completed, presence of past MEC finds and munitions debris indicates probability of MEC
			Subsurface Soil <ul style="list-style-type: none"> MEC may be buried. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Intrusive activities Agricultural tilling. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Burrowing activities Agricultural tilling. 	<ul style="list-style-type: none"> None 	No visual field reconnaissance surveys aided by magnetometer will be completed, presence of past MEC finds and munitions debris indicates high probability of MEC
	MC	Black powder, sheet metal, cast iron, lead, red/white phosphorus.	Soil <ul style="list-style-type: none"> Directly affected media. Potential metals contamination from munitions used. Spotting charges do not contain hazardous components Fate & Transport: secondary source of potential surface water, sediment, and air contamination. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, Dermal contact, and Inhalation of soil particulates during intrusive work. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> Analytical data for metals in soil for this AOC does not exist. Field data for Screening Level Ecological Risk Assessment do not exist. 	Two soil samples will be collected from target area. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc). One samples will be analyzed for explosives including nitroglycerin per agreement during TPP meeting.
			Surface Water <ul style="list-style-type: none"> Potentially affected media – Carty Reservoir. Potential metals contamination. Spotting charges do not contain hazardous components Fate & Transport: via surface runoff from impacted soil. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, Dermal contact, and Inhalation of surface water. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, Direct contact by area fauna, and Direct contact by aquatic organisms. 	<ul style="list-style-type: none"> None. 	No surface water samples will be collected. Surface water is routinely monitored by PGE and results are available for use.
			Sediment <ul style="list-style-type: none"> Potentially affected media – Carty Reservoir. Potential metals contamination. Spotting charges do not contain hazardous components Fate & Transport: via surface runoff from impacted soil. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, and Dermal contact. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> Analytical data for metals in sediments does not exist for Carty Reservoir. Field data for Screening Level Ecological Risk Assessment do not exist. 	A sediment sample from Carty Reservoir will be collected. The sediment sample will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc) and explosives including nitroglycerin.
			Groundwater <ul style="list-style-type: none"> Potentially affected media. Potential metals contamination. Spotting charges do not contain hazardous components Fate & Transport: migration of metals directly to groundwater is possible due to downward flow gradient from Carty Reservoir to groundwater. 	<ul style="list-style-type: none"> Potentially complete pathway. local wells 	<ul style="list-style-type: none"> Incomplete pathway. No residents 	<ul style="list-style-type: none"> Incomplete pathway. No local wells 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> No groundwater samples planned. No perchlorate was detected in water sample collected during PA/SI by Weston from nearby wells. Existing data for metals are available from nearby PGE Power Plant groundwater monitoring wells.
			Air <ul style="list-style-type: none"> Potentially affected media due to blowing soil and dust. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	<ul style="list-style-type: none"> Incomplete pathway: No residents 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	<ul style="list-style-type: none"> No soil analytical data to evaluate dust impacts 	Will utilize soil analytical data in risk screening

**Table 3 (Cont.)
MEC and MC Exposure Pathway Analysis**

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Biota)		
Range Complex No. 1 – INPR Site No. 1 (Practice Bombing Range), Demolition Area, Turret Gunnery Range	MEC	MEC in the form of <i>unexploded</i> practice bomb spotting charges and other munitions may exist on land surface, kickouts from demolition crater may exist.	Surface Soil <ul style="list-style-type: none"> MEC (unexploded practice bombs and other munitions) are a hazard. Munitions debris reported on surface. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Vehicle & foot traffic. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Foot traffic. 	None	No visual field reconnaissance surveys aided by magnetometer will be completed, presence of past MEC finds and munitions debris indicates probability of MEC in INPR Site No. 1 and Demolition Area.
			Subsurface Soil <ul style="list-style-type: none"> MEC may be buried. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Intrusive activities Agricultural tilling. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Burrowing activities Agricultural tilling. 	None	No magnetometer-assisted, visual inspection will be conducted to attempt to locate buried MEC. Presence of munitions debris indicates high probability of MEC in INPR Site No. 1 and Demolition Area.
	MC	Black powder, sheet metal, cast iron, red/white phosphorus, thermite, rocket propellant (nitrocellulose and nitroglycerin), C-4 (RDX), Detonation cord (PETN.)	Soil <ul style="list-style-type: none"> Directly affected media. Potential metals contamination from munitions used. Potential explosives contamination (nitrocellulose, nitroglycerin, RDX, PETN) Fate & Transport: secondary source of potential surface water, sediment, and air contamination. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, Dermal contact, and Inhalation of soil particulates during intrusive work. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> Analytical data for metals and explosives in soil do not exist for Demolition Area. Field data for Screening Level Ecological Risk Assessment do not exist from Demolition Area. 	No soil samples will be collected from INPR No.1. AOC was sampled during PA/SI. Two soil samples will be collected near detonation craters at the Demolition Area. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc) and explosives including nitroglycerin and PETN. No soil samples will be collected from the Turret Gunnery Training Range. MC is only steel
			Surface Water <ul style="list-style-type: none"> Not a potentially affected media because of the distance from surface water. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Incomplete pathway. 	None	No sampling
			Sediment <ul style="list-style-type: none"> Not a potentially affected media because of the distance from surface water. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Incomplete pathway. 	None	No sampling
			Groundwater <ul style="list-style-type: none"> Potentially affected media. Potential metals contamination. Potential explosives contamination (nitroglycerin, PETN, RDX) Fate & Transport: migration of metals directly to groundwater is possible, however depth to groundwater may be as much as 70 ft. 	<ul style="list-style-type: none"> Incomplete pathway. <ul style="list-style-type: none"> No local wells 	<ul style="list-style-type: none"> Incomplete pathway. <ul style="list-style-type: none"> No local wells 	<ul style="list-style-type: none"> Incomplete pathway. <ul style="list-style-type: none"> No local wells 	None	<ul style="list-style-type: none"> No groundwater samples planned.
			Air <ul style="list-style-type: none"> Potentially affected media due to blowing soil and dust. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	<ul style="list-style-type: none"> Incomplete pathway: <ul style="list-style-type: none"> No residents 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	No soil analytical data to evaluate dust impacts	Will utilize soil analytical data in risk screening

**Table 3 (Cont.)
MEC and MC Exposure Pathway Analysis**

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Biota)		
Demolition Area No 2	MEC	MEC in the form of <i>unexploded</i> munitions may exist on land surface, kickouts from demolition craters may exist.	Surface Soil <ul style="list-style-type: none"> MEC (unexploded munitions) are a hazard. Munitions debris reported on surface. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Vehicle & foot traffic. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Foot traffic. 	None	No visual field reconnaissance surveys aided by magnetometer will be completed, presence of past MEC finds, munitions debris, and detonation craters indicates high probability of MEC.
			Subsurface Soil <ul style="list-style-type: none"> MEC may be buried. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Intrusive activities Agricultural tilling. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Burrowing activities Agricultural tilling. 	None	No visual field reconnaissance surveys aided by magnetometer will be completed, presence of past MEC finds, munitions debris, and detonation craters indicates high probability of MEC.
	MC	Black powder, sheet metal, cast iron, explosives (nitroglycerin, TNT, RDX, PETN)	Soil <ul style="list-style-type: none"> Directly affected media. Potential metals contamination from munitions used. Potential explosives contamination (nitroglycerin, TNT, RDX, PETN) Fate & Transport: secondary source of potential surface water, sediment, and air contamination. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, Dermal contact, and Inhalation of soil particulates during intrusive work. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> No analytical data for metals or explosives in soil exists for this AOC. Field data for Screening Level Ecological Risk Assessment do not exist. 	Two soil samples will be collected near detonation craters. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc), and explosives including nitroglycerin and PETN.
			Surface Water <ul style="list-style-type: none"> Not a potentially affected media because of the distance from surface water. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Incomplete pathway. 	None	No sampling
			Sediment <ul style="list-style-type: none"> Not a potentially affected media because of the distance from surface water. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Incomplete pathway. 	None	No sampling
			Groundwater <ul style="list-style-type: none"> Potentially affected media. Potential metals contamination. Potential explosives contamination (nitroglycerin, PETN, RDX) Fate & Transport: migration of metals directly to groundwater is possible because of mobility of some metals and depth of groundwater (~10 ft bgs). 	<ul style="list-style-type: none"> Incomplete pathway. <ul style="list-style-type: none"> No local wells 	<ul style="list-style-type: none"> Incomplete pathway. <ul style="list-style-type: none"> No local wells 	<ul style="list-style-type: none"> Incomplete pathway. <ul style="list-style-type: none"> No local wells 	None	<ul style="list-style-type: none"> No groundwater samples planned.
			Air <ul style="list-style-type: none"> Potentially affected media due to blowing soil and dust. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	<ul style="list-style-type: none"> Incomplete pathway: <ul style="list-style-type: none"> No residents 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	No soil analytical data to evaluate dust impacts	Will utilize soil analytical data in risk screening

**Table 3 (Cont.)
MEC and MC Exposure Pathway Analysis**

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Biota)		
Impact Area	MEC	MEC in the form of <i>unexploded</i> munitions may exist on land surface.	Surface Soil <ul style="list-style-type: none"> MEC (unexploded munitions) are a hazard. Munitions debris reported on surface. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Vehicle & foot traffic. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Foot traffic. 	Presence/absence of MEC unknown	Visual field reconnaissance surveys aided by magnetometer will be completed to located MEC or MEC debris
			Subsurface Soil <ul style="list-style-type: none"> MEC may be buried. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Intrusive activities 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Burrowing activities 	Presence/absence of MEC unknown	Visual field reconnaissance surveys aided by magnetometer will be completed to located MEC or MEC debris
	MC	Black powder, sheet metal, cast iron, explosives (nitroglycerin)	Soil <ul style="list-style-type: none"> Directly affected media. Potential metals contamination from munitions used. Potential explosives contamination (nitroglycerin, PETN) Fate & Transport: secondary source of potential surface water, sediment, and air contamination. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, Dermal contact, and Inhalation of soil particulates during intrusive work. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> No analytical data for metals or explosives in soil exists for this AOC. Field data for Screening Level Ecological Risk Assessment do not exist. 	One soil sample will be collected near detonation craters. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc), and explosives including nitroglycerin and PETN.
			Surface Water <ul style="list-style-type: none"> Potentially affected media – Six-mile Canyon Creek. Potential metals contamination. Spotting charges do not contain hazardous components Fate & Transport: via surface runoff from impacted soil. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Incomplete pathway. 	None	Incomplete pathway. Six-mile Canyon Creek is an intermittent stream with flow occurring only during high precipitation events.
			Sediment <ul style="list-style-type: none"> Potentially affected media –Six-mile Canyon Creek. Potential metals contamination. Spotting charges do not contain hazardous components Fate & Transport: via surface runoff from impacted soil. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Incidental ingestion, and Dermal contact. 	<ul style="list-style-type: none"> Incomplete pathway. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Ingestion, and Direct contact by area fauna. 	<ul style="list-style-type: none"> Analytical data for metals in sediments does not exist for this section of Six-mile Canyon Creek. Field data for Screening Level Ecological Risk Assessment do not exist. 	A sediment sample from the Six-mile Canyon Creek drainage, at the probable point of entry will be collected. Sample will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc) and explosives including nitroglycerin.
			Groundwater <ul style="list-style-type: none"> Potentially affected media. Potential metals contamination. Potential explosives contamination (nitroglycerin) Fate & Transport: migration of metals directly to groundwater is possible. Depth to groundwater is unknown. 	<ul style="list-style-type: none"> Incomplete pathway. <ul style="list-style-type: none"> No local wells 	<ul style="list-style-type: none"> Incomplete pathway. <ul style="list-style-type: none"> No local wells 	<ul style="list-style-type: none"> Incomplete pathway. <ul style="list-style-type: none"> No local wells 	None	<ul style="list-style-type: none"> No groundwater samples planned.
			Air <ul style="list-style-type: none"> Potentially affected media due to blowing soil and dust. 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	<ul style="list-style-type: none"> Incomplete pathway: <ul style="list-style-type: none"> No residents 	<ul style="list-style-type: none"> Potentially complete pathway. Exposure routes: <ul style="list-style-type: none"> Inhalation 	No soil analytical data to evaluate dust impacts	Will utilize soil analytical data in risk screening

**Table 4
Proposed Sampling Approach
Boardman Air Force Range**

AOC	Media	Contaminants of Concern		Comments
		Metals*	Explosives	
Target No. 1	Soil	1	1	Actual sample numbers and locations based on site reconnaissance. Soil samples will be composite.
	Sediment	--	--	Sediment sample will be collected as part of the Carty Reservoir Bomb Target.
Target No. 2	Soil	2	2	Actual sample locations based on site reconnaissance. Soil samples will be composite.
	Sediment	--	--	No sediment pathway.
Carty Reservoir Bomb Target	Soil	2	1	Actual sample locations based on site reconnaissance. Soil samples will be composite.
	Sediment	1	1	Actual sample location based on site reconnaissance. Sediment samples will be discrete.
Range Complex No. 1	Soil	2	2	Samples to be collected from the Demolition Area. Sample location based on site reconnaissance.
	Sediment	--	--	No sediment pathway.
Demolition Area No. 2	Soil	2	2	Sample location based on site reconnaissance.
	Sediment	--	--	No sediment pathway.
Impact Area	Soil	1	1	Actual sample location based on site reconnaissance. Soil samples will be composite
	Sediment	1	1	Actual sample location based on site reconnaissance. Soil samples will be discrete
Sample Totals		12	11	

Notes:

Quality control samples will be addressed in the SSWP.

* Metals to be analyzed include aluminum, chromium, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc).

Table 5
Human Health Screening Criteria for Soil/Sediment at Oregon Sites

Analyte	Abbreviation	CAS No.	Region 9 Human Health Screening Values ^a			Laboratory Method Detection Limit (mg/kg)
			Residential PRG ^b (mg/kg) ^b	SSLs ^c DAF=1 (mg/kg)	SSLs ^c DAF=2 0 (mg/kg)	
Aluminum	Al	7429-90-5	76,000			20.0
Chromium ^e	Cr	7440-47-3	210	2	38	1.0
Copper	Cu	7440-50-8	3,100			1.0
Iron	Fe	7439-89-6	23,000			15.0
Lead	Pb	7439-92-1	400 ^f			1.0
Manganese	Mn	7439-96-5	1,800			25.0
Magnesium	Mg	7439-95-4				0.5
Mercury	Hg	7439-97-6	23			0.5
Molybdenum	Mo	7439-98-7	390			0.06
Nickel	Ni	7440-02-0	1,600	7	130	1.0
Zinc	Zn	7440-66-6	23,000	620	12,000	2.0
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4	4.4			0.075
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0	3,100			0.050
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7	16			0.040
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4	1,800			0.020
1,3-Dinitrobenzene	1,3-DNB	99-65-0	6.1			0.020
2,4-Dinitrotoluene ^d	2,4-DNT	121-14-2	0.72	0.00004	0.0008	0.040
2,6-Dinitrotoluene ^d	2,6-DNT	606-20-2	0.72	0.00004	0.0008	0.040
2-Amino-4,6-dinitrotoluene	2-Am-DNT	35572-78-2	12			0.040
2-Nitrotoluene	2-NT	88-72-2	0.88			0.075
3-Nitrotoluene	3-NT	99-08-1	730			0.050
4-Amino-2,6-dinitrotoluene	4-Am-DNT	19406-51-0	12			0.040
4-Nitrotoluene	4-NT	99-99-0	12			0.040
Nitrobenzene	NB	98-05-3	20	0.007	0.1	0.020
Nitroglycerin	NG	55-63-0	35			
PETN	PETN	78-11-5	0.50	NVA	NVA	
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8	610			0.065

DAF = Dilution Attenuation Factor.
PRG = Preliminary Remediation Goal.
SSL = Soil Screening Level.

mg/kg = milligrams per kilogram.
mg/L = milligrams per liter.

a If laboratory cannot meet any of the preferred QLs with routine SW 846 methodology (as supported by MDLs that are no greater than 1/3 QL), laboratory's QL must be identified in laboratory submittal as failing to meet the QL. Some screening values cannot be obtained with routine methodology to the QL. In those cases, the QL achievable with a routine SW 846 methodology would be accepted.

b PRGs from Region 9 PRG Table dated October 2004 and addendum dated 28 December 2004, based on single chemical.

c SSLs from Region 9 PRG Table dated October 2004 and revision note dated 28 December 2004.

d Carcinogenic DNT mixture values used if more conservative than noncarcinogenic isomer-specific values.

e Total chromium values used.

f Values listed from Oregon risk-based concentrations: 400 mg/kg (residential)

Table 6
Human Health Screening Criteria for Groundwater at Oregon Sites^a

Analyte	Abbreviation	CAS No.	Laboratory Method Detection Limit (µg/L)	Region 9 Tap Water PRG ^b (µg/L)	Federal Drinking Water Criteria MCLs ^c (µg/L)
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4	0.8	0.61	
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0	0.4	1,800	
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7	0.3	2.2	
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4	0.2	1,100	
1,3-Dinitrobenzene	1,3-DNB	99-65-0	0.2	3.6	
2,4-Dinitrotoluene ^d	2,4-DNT	121-14-2	0.3	0.099	
2,6-Dinitrotoluene ^d	2,6-DNT	606-20-2	0.3	0.099	
2-Amino-4,6-dinitrotoluene	2-Am-DNT	35572-78-2	0.2	7.3	
2-Nitrotoluene	2-NT	88-72-2	0.4	0.049	
3-Nitrotoluene	3-NT	99-08-1	0.8	120	
4-Amino-2,6-dinitrotoluene	4-Am-DNT	19406-51-0	0.2	7.3	
4-Nitrotoluene	4-NT	99-99-0	0.4	0.66	
Nitrobenzene	NB	98-05-3	0.2	3.4	
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8	0.75	360	
Nitroglycerin	NG	55-63-0	0.5		
PETN	PETN	78-11-5	1.3		
Aluminum	Al	7429-90-5	60	36,000	50 ^e
Chromium ^f	Cr	7440-47-3	2.0	110	100
Copper	Cu	7440-50-8	3.0	1,500	1,000 ^e 1,300 ^g
Iron	Fe	7439-89-6	5.0	11,000	300 ^e
Lead	Pb	7439-92-1	1.0		15 ^g
Magnesium	Mg	7439-95-4	100		
Manganese	Mn	7439-96-5	2.0	880	50 ^e
Mercury	Hg	7439-97-6	0.3		
Molybdenum	Mo	7439-98-7	5.0	180	
Nickel	Ni	7440-02-0	1.0	730	
Zinc	Zn	7440-66-6	0.1	11,000	5,000 ^e

Table 6 (Cont.)
Human Health Screening Criteria for Groundwater at Oregon Sites

MCL = Maximum Contaminant Level

PRG = Preliminary Remediation Goal

µg/L = micrograms per liter

a If laboratory cannot meet these QLs with routine SW 846 methodology (as supported by MDLs that are no greater than 1/3 QL), laboratory's QL must be identified in laboratory submittal as failing to meet the QL. Some screening values cannot be obtained with routine methodology to the QL.

Note that no surface water samples are planned at this time. If surface water is collected, additional human health screening criteria will be compiled.

b Region 9 PRG Table dated October 2004 and revision note dated 28 December 2004, based on single chemical.

c Primary MCL from the 2004 Edition of the Drinking Water Standards and Health Advisories, dated Winter 2004, is listed unless otherwise indicated.

d Carcinogenic DNT mixture values used if more conservative than noncarcinogenic isomer-specific values.

e Secondary MCL from the 2004 Edition of the Drinking Water Standards and Health Advisories, dated Winter 2004.

f Total chromium values used if available.

g Action level from the 2004 Edition of the Drinking Water Standards and Health Advisories, dated Winter 2004.

Table 7
Human Health Screening Criteria for Surface Water at Oregon Sites^a

Analyte	Abbreviation	CAS Number	USEPA Region 9 Tap Water PRG ^b (µg/L)	Oregon DEQ Water Quality Criteria ^c	
				Water and Fish Ingestion ^d (µg/L)	Fish Consumption Only ^e (µg/L)
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4	0.61		
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0	1,800		
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7	2.2		
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4	1,100		
1,3-Dinitrobenzene	1,3-DNB	99-65-0	3.6		
2,4-Dinitrotoluene ^e	2,4-DNT	121-14-2	0.099	0.11 ^h	9.1 ^h
2,6-Dinitrotoluene ^e	2,6-DNT	606-20-2	0.099		
2-Amino-4,6-dinitrotoluene	2-Am-DNT	35572-78-2	7.3		
2-Nitrotoluene	2-NT	88-72-2	0.049		
3-Nitrotoluene	3-NT	99-08-1	120		
4-Amino-2,6-dinitrotoluene	4-Am-DNT	19406-51-0	7.3		
4-Nitrotoluene	4-NT	99-99-0	0.66		
Nitrobenzene	NB	98-05-3	3.4	19,800	
Nitroglycerin	NG	55-63-0	4.8		
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8	360		
Pentaerythritol tetranitrate	PETN	78-11-5			
Aluminum	Al	7429-90-5	36,000		
Chromium ⁱ	Cr	7440-47-3	110	50	
Copper	Cu	7440-50-8	1,500		
Iron	Fe	7439-89-6	11,000	300	
Lead	Pb	7439-92-1		50	
Magnesium	Mg	7439-95-4			
Manganese	Mn	7439-96-5	880	50	100
Mercury	Hg	7439-97-6	11	0.144	0.146
Molybdenum	Mo	7439-98-7	180		
Nickel	Ni	7440-02-0	730	13.4	100

Table 7
Human Health Screening Criteria for Surface Water at Oregon Sites^a

Analyte	Abbreviation	CAS Number	USEPA Region 9 Tap Water PRG ^b (µg/L)	Oregon DEQ Water Quality Criteria ^c	
				Water and Fish Ingestion ^d (µg/L)	Fish Consumption Only ^e (µg/L)
Zinc	Zn	7440-66-6	11,000		

MCL = Maximum Contaminant Level

PRG = Preliminary Remediation Goal

µg/L = micrograms per liter

^a If laboratory cannot meet these QLs with routine SW 846 methodology (as supported by MDLs that are no greater than 1/3 QL), laboratory's QL must be identified in laboratory submittal as failing to meet the QL. Some screening values cannot be obtained with routine methodology to the QL.

^b Preliminary Remediation Goal (PRG) table, dated October 2004 and revision note dated 28 December 2004. Values are based on a single chemical.

^c Values from Oregon DEQ Water Quality Criteria (OAR 340 Division 41, Table 20).

^d Values represent the maximum ambient water concentration for consumption of both contaminated water and fish or other aquatic organisms.

^e Values represent the maximum ambient water concentration for consumption of fish or other aquatic organisms.

^f Values represent the drinking water Maximum Contaminant Level.

^g Carcinogenic DNT mixture values used if more conservative than noncarcinogenic isomer-specific values.

^h Value is based on a cancer risk of 1.0×10^{-6} .

ⁱ Because the form of chromium has not yet been determined, the values for Chromium VI are used as a conservative measure.

^j Value based on memorandum from Department of Defense entitled "Policy on DoD Required Actions Related to Perchlorate." Dated 26 January 2006.

Table 8
Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Level II Screening Level ^a	Proposed Benchmarks									Potential Bio accumulative Constituent? ^h	Final Ecological Screening Value Soil ⁱ (mg/kg)	Practical Quantitation Limit (mg/kg)
	Lowest Value for Plants/Inverts./ Birds/Mammals (mg/kg)	Region 5 ESLs ^b (2003) (mg/kg)	Region 7 ^c (mg/kg)	Region 8 ^d (mg/kg)	Region 10 ^e (mg/kg)	Other Values: Talmage et al. (1999) ^f or LANL (2005) ^g (mg/kg)							
Metals/Inorganics													
Aluminum	50	NVA	50	EPA-R4	NVA		50	EPA-R4	5.5	LANL		50	20.0
Chromium (total)	0.4	0.4	26	SSL	26	SSL	26	SSL	2.3	LANL	Yes	0.4	1.0
Copper	50	5.4	60	ORNL	190	Dutch	60	ORNL	10	LANL	Yes	50	1.0
Iron	10	NVA	200	EPA-R4	NVA		200	EPA-R4	NVA			10	15.0
Lead	16	0.0537	11	SSL	11	SSL	11	SSL	14	LANL	Yes	16	1.0
Magnesium	NVA	NVA	440000	EPA-R4	NVA		440000	EPA-R4	NVA			NVA/Nutrient	25.0
Manganese	100	NVA	100	EPA-R4	NVA		100	EPA-R4	50	LANL		100	0.5
Mercury	0.1	0.1	0.00051	ORNL	0.00051	ORNL	0.00051	ORNL	0.013	LANL	Yes	0.1	0.06
Molybdenum	2	NVA	2	ORNL	2	ORNL	2	ORNL	NVA			2	0.5
Nickel	30	13.6	30	ORNL	30	ORNL	30	ORNL	20	LANL	Yes	30	1.0
Zinc	50	6.62	8.5	ORNL	8.5	ORNL	8.5	ORNL	10	LANL	Yes	50	2.0

Table 8 (Cont.)
Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Level II Screening Level ^a	Proposed Benchmarks									Potential Bio accumulative Constituent? ^h	Final Ecological Screening Value Soil ⁱ (mg/kg)	Practical Quantitation Limit (mg/kg)
	Lowest Value for Plants/Inverts./ Birds/Mammals (mg/kg)	Region 5 ESLs ^b (2003) (mg/kg)	Region 7 ^c (mg/kg)	Region 8 ^d (mg/kg)	Region 10 ^e (mg/kg)	Other Values: Talmage et al. (1999) ^f or LANL (2005) ^g (mg/kg)							
Explosive													
2,4-Dinitrotoluene	NVA	1.28	1.28	EPA-R4	NVA		1.28	EPA-R4	0.52	LANL		1.28	0.040
2,6-Dinitrotoluene	NVA	0.0328	0.0328	EPA-R4	NVA		0.0328	EPA-R4	0.37	LANL		0.0328	0.040
2-Amino-4,6-Dinitrotoluene	NVA	NVA	NVA		NVA		NVA		2.1	LANL		2.1	0.040
4-Amino-2,6-Dinitrotoluene	NVA	NVA	NVA		NVA		NVA		0.73	LANL		0.73	0.040
1,3-Dinitrobenzene	NVA	0.655	0.655	EPA-R4	NVA		0.655	EPA-R4	0.073	LANL		0.655	0.020
HMX	NVA	NVA	NVA		NVA		NVA		27	LANL		27	0.050
Nitrobenzene	8	1.31	1.31	EPA-R4	NVA		1.31	EPA-R4	2.2	LANL		8	0.020
RDX	NVA	NVA	NVA		NVA		NVA		7.5	LANL		7.5	0.075
1,3,5-Trinitrobenzene	NVA	0.376	0.376	EPA-R4	NVA		0.376	EPA-R4	6.6	LANL		0.376	0.020
2,4,6-Trinitrotoluene	NVA	NVA	NVA		NVA		NVA		6.4	LANL		6.4	0.040
2-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		2.0	LANL		2.0	0.075
3-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		2.4	LANL		2.4	0.050
4-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		4.4	LANL		4.4	0.040
Tetryl	NVA	NVA	NVA		NVA		NVA		0.99	LANL		0.99	0.065
PETN	NVA	NVA	NVA		NVA		NVA		8600	LANL		8600	0.50
Nitroglycerin	NVA	NVA	NVA		NVA		NVA		71	LANL		71	10

NVA: No value available

Table 8 (Cont.)
Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

- a Oregon Department of Environmental Quality Screening Level Values (December 2001).
- b Ecological Screening Levels (ESLs), U.S.EPA Region 5, August 2003.
- c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: USEPA EcoSSLs; ORNL Efrogmson values; USEPA Region 4 values; other published values.
- d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: USEPA SSLs; Dutch Intervention Values or ORNL Efrogmson values.
- e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.
- f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel, 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values, **'Revisions Environmental Contaminant Toxicology.'**
- g Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005.
- h Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation. Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).
- i Final Screening Value selected using the following hierarchy:
 1. State Value (Oregon)
 2. USEPA Region State Located In (USEPA Region 10)
 3. Lower of Talmage et al. (1999) or LANL (2005) values.

EPA-R4=USEPA Region 4

LANL= Los Alamos National Laboratory

SSL=USEPA Eco Soil Screening Levels

Dutch=Dutch Intervention Values

ORNL= Oak Ridge National Laboratory Ecological PRGs (Efrogmson et al)

Other References:

U.S. Environmental Protection Agency, 2005, Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs), Office of Solid Waste and Emergency Response, website version last updated March 15, 2005: <http://www.epa.gov/ecotox/ecossl>.

U.S. Environmental Protection Agency, 2001, Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published November 1995. Website version last updated November 30, 2001: <http://www.epa.gov/region4/waste/ots/ecolbul.htm>.

Efrogmson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. Preliminary Remediation Goals for Ecological Endpoints. Lockheed Martin Energy Systems, Inc. (ORNL) ES/ER/TM-162/R2.

Dutch Intervention Values:

Swartjes, F.A. 1999. Risk-based Assessment of Soil and Groundwater Quality in the Netherlands: Standards and Remediation Urgency. Risk Analysis 19(6): 1235-1249

The Netherlands Ministry of Housing, Spatial Planning and Environment's Circular on target values and intervention values for soil remediation

http://www2.minvrom.nl/Docs/internationaal/S_I2000.pdf and Annex A:

Target Values, Soil Remediation Intervention Values and Indicative Levels for Serious Contamination http://www2.minvrom.nl/Docs/internationaal/annexS_I2000.pdf were also consulted.

Table 9
Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values ^a (mg/L) Freshwater	Region 5 Ecological Screening Levels ^b (mg/L)	EPA Region 7 ^c (mg/L)		EPA Region 8 ^d (mg/L)		EPA Region 10 ^e (mg/L)		Other Values: Talmage et al. (1999) ^f or LANL (2005) ^g (mg/L)		Potential Bioaccumulative Constituent? ^g	Final Ecological Value Surface Water ^h (mg/L)	Practical Quantitation Limit (mg/L)
Metals/Inorganics													
Aluminum	8.70E-02	NVA	8.70E-02	AWQC	8.70E-02	AWQC	8.70E-02	AWQC	8.70E-02	LANL		8.70E-02	6.0E-02
Chromium (Cr-III)	7.40E-02	4.20E-02	7.40E-02	AWQC	7.40E-02	AWQC	7.40E-02	AWQC	7.70E-02	LANL	Yes	7.40E-02	2.0E-03
Copper	9.00E-03	1.58E-03	9.00E-03	AWQC	9.00E-03	AWQC	9.00E-03	AWQC	5.00E-03	LANL	Yes	9.00E-03	3.0E-03
Iron	1.00E+00	NVA	1.00E+00	AWQC	1.00E+00	AWQC	1.00E+00	AWQC	1.00E+00	LANL		1.00E+00	5.0E-02
Lead	2.50E-03	1.17E-03	2.50E-03	AWQC	2.50E-03	AWQC	2.50E-03	AWQC	1.20E-03	LANL	Yes	2.50E-03	1.0E-03
Magnesium	8.20E+01	NVA	NVA		NVA		NVA		NVA			8.20E+01	1.0E-01
Manganese	1.20E-01	NVA	1.20E-01	EPRG	1.20E-01	Tier II	1.20E-01	EPRG	8.00E-02	LANL		1.20E-01	2.0E-03
Mercury	7.70E-04	1.30E-06	7.70E-01	AWQC	7.70E-01	AWQC	7.70E-01	AWQC	7.70E-04	LANL	Yes	7.70E-04	3.0E-04
Molybdenum	3.70E-01	NVA	3.70E-01	EPRG	3.70E-01	Tier II	3.70E-01	EPRG	NVA			3.70E-01	5.0E-03
Nickel	5.20E-02	2.89E-02	5.20E-02	AWQC	5.20E-02	AWQC	5.20E-02	AWQC	2.80E-02	LANL	Yes	5.20E-02	1.0E-03
Zinc	1.20E-01	6.57E-02	1.20E-01	AWQC	1.20E-01	AWQC	1.20E-01	AWQC	6.60E-02	LANL	Yes	1.20E-01	1.0E-02

Table 9 (Cont.)
Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values ^a (mg/L) Freshwater	Region 5 Ecological Screening Levels ^b (mg/L)	EPA Region 7 ^c (mg/L)	EPA Region 8 ^d (mg/L)	EPA Region 10 ^e (mg/L)	Other Values: Talmage et al. (1999) ^f or LANL (2005) ^g (mg/L)	Potential Bioaccumulative Constituent? ^g	Final Ecological Value Surface Water ^h (mg/L)	Practical Quantitation Limit (mg/L)
Explosives									
RDX	NVA	NVA	NVA	NVA	NVA	1.90E-01	TAL	1.90E-01	8.0E-04
HMX	NVA	NVA	NVA	NVA	NVA	3.30E-01	TAL	3.30E-01	4.0E-04
1,3-Dinitrobenzene	NVA	2.20E-02	NVA	NVA	NVA	2.00E-02	TAL	2.00E-02	2.0E-04
1,3,5-Trinitrobenzene	NVA	NVA	NVA	NVA	NVA	1.00E-02	TAL	1.00E-02	2.0E-04
2-Nitrotoluene	NVA	NVA	NVA	NVA	NVA	8.00E+00	LANL	8.00E+00	4.0E-04
3-Nitrotoluene	NVA	NVA	NVA	NVA	NVA	9.60E+00	LANL	9.60E+00	8.0E-04
4-Nitrotoluene	NVA	NVA	NVA	NVA	NVA	1.70E+01	LANL	1.70E+01	4.0E-04
2,4-Dinitrotoluene	2.30E-01	4.40E-02	NVA	NVA	NVA	3.10E-01	LANL	2.30E-01	3.0E-04
2,6-Dinitrotoluene	2.30E-01	8.10E-02	NVA	NVA	NVA	6.00E-02	LANL	2.30E-01	3.0E-04
2-Amino,4,6-Dinitrotoluene	NVA	NVA	NVA	NVA	NVA	2.00E-02	TAL	2.00E-02	2.0E-04
4-Amino-2,6-Dinitrotoluene	NVA	NVA	NVA	NVA	NVA	8.60E+00	LANL	8.60E+00	2.0E-04
2,4,6-Trinitrotoluene	NVA	NVA	NVA	NVA	NVA	9.00E-02	TAL	9.00E-02	3.0E-04
Nitrobenzene	5.40E-01	2.20E-01	NVA	NVA	NVA	2.70E-01	LANL	5.40E-01	2.0E-04
Tetryl	NVA	NVA	NVA	NVA	NVA	5.80E+00	LANL	5.80E+00	7.5E-04
Nitroglycerin	NVA	NVA	NVA	NVA	NVA	4.30E+02	LANL	4.30E+02	5.0E-02
PETN	NVA	NVA	NVA	NVA	NVA	2.60E+04	LANL	2.60E+04	1.3E-03

NVA = No Value Available

Table 9 (Cont.)

Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

- a Oregon Department of Environmental Quality Screening Level Values (December 2001).
- b Ecological Screening Levels (ESLs), U.S.EPA Region 5, August 2003.
- c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: National Ambient Water Quality Criteria; ORNL Efroymsen values (ORNL, 1977).
- d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: National Ambient Water Quality Criteria; Great Lakes Tier II Values; Canadian Environmental Quality Guidelines (CCME, 2003) or ORNL Efroymsen values (ORNL, 1977).
- e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.
- f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel (TAL), 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. Revisions Environmental Contaminant Toxicology.'
- g Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005.
- h Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation. Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).
 - i Final Screening Value selected using the following hierarchy:
 1. State Value (Oregon)
 2. USEPA Region State Located In (USEPA Region 10)
 3. Lower of Talmage et al. [TAL] (1999) or LANL (2005) values.

AWQC=National Ambient Water Quality Criteria

LANL= Los Alamos National Laboratory

Tier II=Great Lakes Tier II Water Quality Criteria

EPRGs=Oak Ridge National Laboratory Ecological PRGs

TAL=Talmage et al (1999)

CCME=Canadian Council of Ministers of the Environment, Environmental Quality Guidelines

Other References:

Efroymsen, R.A., et al., 1997, Preliminary Remediation Goals (EPRGs), ORNL, ES/ER/TM-162/R2,

Canadian Environmental Quality Guidelines (for Freshwater) Summary Table, CCME, December 2003.

Great Lakes Tier II Values from Suter, G.W. and C.L. Tsao, 1996, Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Rev, ES/ER/TM-96/R2.

National AWQC from USEPA Water Quality Criteria Web Site: <http://www.epa.gov/waterscience/criteria/wqcriteria.html>.

Table 10
Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values ^a (mg/kg) Freshwater	Region 5 Ecological Screening Levels ^b (mg/kg)	EPA Region 7 ^c (mg/kg)		EPA Region 8 ^d (mg/kg)		EPA Region 10 ^e (mg/kg)		Other Values: Talmage et al. (1999) ^f or LANL (2005) ^g (mg/kg)		Potential Bioaccumulative Constituent? ^g	Final Ecological Screening Value Sediment ^h (mg/kg)	Practical Quantitation Limit (mg/kg)
Metals/Inorganics													
Aluminum	NVA	NVA	NVA		NVA		NVA		2.80E+02	LANL		2.80E+02	20.0
Chromium	3.70E+01	4.34E+01	4.34E+01	MAC	4.34E+01	MAC	4.34E+01	MAC	5.60E+01	LANL	Yes	3.70E+01	1.0
Copper	1.00E+01	3.16E+01	3.16E+01	MAC	3.16E+01	MAC	3.16E+01	MAC	1.70E+01	LANL	Yes	1.00E+01	1.0
Iron	NVA	NVA	NVA		NVA		NVA		2.00E+01	LANL		2.00E+01	15.0
Lead	3.50E+01	3.58E+01	3.58E+01	MAC	3.58E+01	MAC	3.58E+01	MAC	2.70E+01	LANL	Yes	3.50E+01	1.0
Magnesium	NVA	NVA	NVA		NVA		NVA		NVA			NVA	25.0
Manganese	1.10E+03	NVA	NVA		NVA		NVA		7.20E+02	LANL		1.10E+03	0.5
Mercury	2.00E-01	1.74E-01	1.80E-01	MAC	1.80E-01	MAC	1.80E-01	MAC	1.80E-02	LANL	Yes	2.00E-01	0.06
Molybdenum	NVA	NVA	NVA		NVA		NVA		NVA			NVA	0.5
Nickel	1.80E+01	2.27E+01	2.27E+01	MAC	2.27E+01	MAC	2.27E+01	MAC	3.90E+01	LANL	Yes	1.80E+01	1.0
Zinc	3.00E+00	1.21E+02	1.21E+02	MAC	1.21E+02	MAC	1.21E+02	MAC	3.70E+01	LANL	Yes	3.00E+00	2.0

Table 10 (Cont.)
Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values ^a (mg/kg) Freshwater	Region 5 Ecological Screening Levels ^b (mg/kg)	EPA Region 7 ^c (mg/kg)	EPA Region 8 ^d (mg/kg)	EPA Region 10 ^e (mg/kg)	Other Values: Talmage et al. (1999) ^f or LANL (2005) ^g (mg/kg)	Potential Bioaccumulative Constituent? ^h	Final Ecological Screening Value Sediment ⁱ (mg/kg)	Practical Quantitation Limit (mg/kg)
Explosives									
RDX	NVA	NVA	NVA	NVA	NVA	1.30E-01	TAL	1.30E-01	0.075
HMX	NVA	NVA	NVA	NVA	NVA	4.70E-02	TAL	4.70E-02	0.050
1,3,5-Trinitrobenzene	NVA	NVA	NVA	NVA	NVA	2.40E-02	TAL	2.40E-02	0.020
1,3-Dinitrobenzene	NVA	8.61E-03	NVA	NVA	NVA	6.70E-02	TAL	6.70E-02	0.020
2,4-Dinitrotoluene	NVA	1.44E-03	NVA	NVA	NVA	2.90E-01	LANL	2.90E-01	0.040
2,6-Dinitrotoluene	NVA	3.98E-03	NVA	NVA	NVA	1.90E+00	LANL	1.90E+00	0.040
2,4,6-TNT	NVA	NVA	NVA	NVA	NVA	9.20E-01	TAL	9.20E-01	0.040
2-Amino-4,6,-Dinitrotoluene	NVA	NVA	NVA	NVA	NVA	7.00E+00	LANL	7.00E+00	0.040
4-Amino-2,6,-Dinitrotoluene	NVA	NVA	NVA	NVA	NVA	1.90E+00	LANL	1.90E+00	0.040
2-Nitrotoluene	NVA	NVA	NVA	NVA	NVA	5.60E+00	LANL	5.60E+00	0.075
3-Nitrotoluene	NVA	NVA	NVA	NVA	NVA	4.90E+00	LANL	4.90E+00	0.050
4-Nitrotoluene	NVA	NVA	NVA	NVA	NVA	1.00E+01	LANL	1.00E+01	0.040
Nitrobenzene	NVA	1.45E-01	NVA	NVA	NVA	3.20E+01	LANL	3.20E+01	0.020
Tetryl	NVA	NVA	NVA	NVA	NVA	1.00E+02	LANL	1.00E+02	0.065
Nitroglycerin	NVA	NVA	NVA	NVA	NVA	1.70E+03	LANL	1.70E+03	10
PETN	NVA	NVA	NVA	NVA	NVA	1.20E+05	LANL	1.20E+05	0.50

NVA = No Value Available

Table 10 (Cont.)

Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

- a Oregon Department of Environmental Quality Screening Level Values (December 2001).
- b Ecological Screening Levels (ESLs), U.S.EPA Region 5, August 2003.
- c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: MacDonald Consensus Values (MacDonald, 2000); ORNL Efrogmson values (ORNL, 1977).
- d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: MacDonald Consensus Values (MacDonald, 2000); Canadian ISQG values (CCME, 2003) or ORNL Efrogmson values (ORNL, 1977).
- e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.
- f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel (TAL), 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values, Revisions Environmental Contaminant Toxicology.
- g Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005.
- h Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation. Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).
- i Final Screening Value selected using the following hierarchy:
 - 1. State Value (Oregon)
 - 2. USEPA Region State Located In (USEPA Region 10)
 - 3. Lower of Talmage et al. [TAL] (1999) or LANL (2005) values.

Note: The Talmage [TAL] screening values assume 10% organic carbon in the sediment.

MAC=MacDonald Consensus Values

EPRGs=Oak Ridge National Laboratory Ecological PRGs

ISQGs=Canadian Interim Sediment Quality Guidelines

LALN=Los Alamos National Laboratory

TAL=Talmage et al (1999)

Other References:

Efrogmson, R.A., et al., 1997, Preliminary Remediation Goals (EPRGs), ORNL, ES/ER/TM-162/R2,

Canadian Interim Sediment Quality Guidelines (ISQGs) Summary Table, CCME, December 2003.

MacDonald, D.D, C.G. Ingersoll and T.A. Berger, 2000, Development and Evaluation of Consensus-Based Sediment Quality Criteria for Freshwater Ecosystems, Archives of Environmental Contamination and Toxicology 39:20-31.

Draft Worksheets

Site Information Worksheet ***MRSPP Data Gaps*** ***HRS Data Gaps***

Site Inspection
Boardman Air Force Range

Technical Project Planning Meeting
July 20, 2006

Site Information Worksheet

Site: Boardman Air Force Range

Project: Boardman Air Force Range

	Site Information Needed^a	Suggested Means to Obtain Site Information	Potential Source(s) of Site Information	Responsible for Obtaining	Deadline for Obtaining Site Information
1	Identify type of munitions destroyed at Demolition Area # 2	Research Army records	Review historical documents, Results from field sampling	Shaw	For inclusion in SI report
2	Schedule for sampling	Consultation	ODEQ and landowners	Shaw	Prior to field work
3	Lat/Long and x,y on all maps	GIS	Add to maps	Shaw	For inclusion in final TPP Memo
4	Point of contact for community	Not applicable	USACE	USACE	Before start of field work
5	Access agreements	Letters, call, or visit stakeholders	Letters/conversations with stakeholders	USACE	Before start of field work
6	Areas of cultural significance within AOC	SHPO	Phone SHPO	Shaw	For inclusion in final TPP Memo

^a Refer to EM 200-1-2, Paragraphs 1.1.3 and 2.2.

**Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CFR Part 179**

Installation: Boardman Air Force Range
 AOC: Target No. 1
 RMIS Range ID: F10OR0160

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Explosives, propellant, pyrotechnic
	2	Source of Hazard			x	Practice bombing range
	3	Location of Munitions	x	Reconnaissance survey		
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	8	Activities/Structures			x	Agricultural - crops, livestock grazing
	9	Ecological and/or Cultural Resources	x	Inquire USFW and Oregon F&W		
	10	EHE Module Score				60 to 70 EHE Rating D (Preliminary)
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources			x	Ecological resources present
	20	CHE Module Score				< 38 CHE Rating G (Preliminary)
Health Hazard Evaluation (HHE)	21	Groundwater Data Element			x	PA/SI data show perchlorate impacts
	22	Surface Water (Human Endpoint) Data Element			x	PA/SI data show perchlorate impacts
	23	Sediment (Human Endpoint) Data Element Table			x	PA/SI data show no impacts to sediments
	24	Surface Water (Ecological Endpoint) Data Element	x	Evaluation Pending		
	25	Sediment (Ecological Endpoint) Data Element	x	Evaluation Pending		
	26	Surface Soil Data Element	x	Evaluation Pending		
	27	Supplemental Contaminant Hazard Factor	x	Evaluation Pending		
	28	HHE Module Score	x	Module Score Pending		
MRS Priority	29	MRS Priority (Based on Highest Hazard Evaluation Module Rating)	x	Final Score Pending		
	A	MRS Background Information	x	Pending		

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps

32 CFR Part 179

Installation: Boardman Air Force Range
 AOC: Target No. 2
 RMIS Range ID: F10OR0160

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Pyrotechnic, explosives, propellants
	2	Source of Hazard			x	Practice bombing range
	3	Location of Munitions			x	Confirmed surface
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	8	Activities/Structures			x	Agricultural - crops, livestock grazing
	9	Ecological and/or Cultural Resources	x	Inquire USFW and Oregon F&W		
	10	EHE Module Score				60 to 70 EHE Rating D (Preliminary)
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources			x	Ecological resources present
	20	CHE Module Score				< 38 CHE Rating G (Preliminary)
Health Hazard Evaluation (HHE)	21	Groundwater Data Element			x	PA/SI data show perchlorate impacts
	22	Surface Water (Human Endpoint) Data Element			x	PA/SI data show perchlorate impacts
	23	Sediment (Human Endpoint) Data Element Table			x	PA/SI data show no impacts to sediments
	24	Surface Water (Ecological Endpoint) Data Element	x	Evaluation Pending		
	25	Sediment (Ecological Endpoint) Data Element	x	Evaluation Pending		
	26	Surface Soil Data Element	x	Evaluation Pending		
	27	Supplemental Contaminant Hazard Factor	x	Evaluation Pending		
	28	HHE Module Score	x	Module Score Pending		
MRS Priority	29	MRS Priority (Based on Highest Hazard Evaluation Module Rating)	x	Final Score Pending		
	A	MRS Background Information	x	Pending		

**Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CFR Part 179**

Installation: Boardman Air Force Range
AOC: Carty Reservoir
RMIS Range ID: F10OR0160

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Pyrotechnic, explosives, propellants
	2	Source of Hazard			x	Practice bombing range
	3	Location of Munitions			x	Confirmed surface
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	8	Activities/Structures			x	Agricultural - crops, livestock grazing
	9	Ecological and/or Cultural Resources	x	Inquire USFW and Oregon F&W		
	10	EHE Module Score				60 to 70 EHE Rating D (Preliminary)
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources			x	Ecological resources present
	20	CHE Module Score				< 38 CHE Rating G (Preliminary)
Health Hazard Evaluation (HHE)	21	Groundwater Data Element			x	PA/SI data show perchlorate impacts
	22	Surface Water (Human Endpoint) Data Element			x	PA/SI data show perchlorate impacts
	23	Sediment (Human Endpoint) Data Element Table			x	PA/SI data show no impacts to sediments
	24	Surface Water (Ecological Endpoint) Data Element	x	Evaluation Pending		
	25	Sediment (Ecological Endpoint) Data Element	x	Evaluation Pending		
	26	Surface Soil Data Element	x	Evaluation Pending		
	27	Supplemental Contaminant Hazard Factor	x	Evaluation Pending		
	28	HHE Module Score	x	Module Score Pending		
MRS Priority	29	MRS Priority (Based on Highest Hazard Evaluation Module Rating)	x	Final Score Pending		
	A	MRS Background Information	x	Pending		

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CFR Part 179

Installation: Boardman Air Force Range
AOC: Range Complex No. 1
RMIS Range ID: F10OR0160

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Pyrotechnic, explosives, propellants
	2	Source of Hazard			x	Practice bombing range
	3	Location of Munitions			x	Confirmed surface
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	8	Activities/Structures			x	Agricultural - crops, livestock grazing
	9	Ecological and/or Cultural Resources	x	Inquire USFW and Oregon F&W		
	10	EHE Module Score				60 to 70 EHE Rating D (Preliminary)
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources			x	Ecological resources present
	20	CHE Module Score				< 38 CHE Rating G (Preliminary)
Health Hazard Evaluation (HHE)	21	Groundwater Data Element			x	PA/SI data show perchlorate impacts
	22	Surface Water (Human Endpoint) Data Element			x	PA/SI data show perchlorate impacts
	23	Sediment (Human Endpoint) Data Element Table			x	PA/SI data show no impacts to sediments
	24	Surface Water (Ecological Endpoint) Data Element	x	Evaluation Pending		
	25	Sediment (Ecological Endpoint) Data Element	x	Evaluation Pending		
	26	Surface Soil Data Element	x	Evaluation Pending		
	27	Supplemental Contaminant Hazard Factor	x	Evaluation Pending		
	28	HHE Module Score	x	Module Score Pending		
MRS Priority	29	MRS Priority (Based on Highest Hazard Evaluation Module Rating)	x	Final Score Pending		
	A	MRS Background Information	x	Pending		

**Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CFR Part 179**

Installation: Boardman Air Force Range
AOC: Demolition Area No. 2
RMIS Range ID: F10OR0160

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Explosives, propellants
	2	Source of Hazard			x	Burning/open detonation
	3	Location of Munitions			x	Confirmed surface
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	8	Activities/Structures			x	wildlife area
	9	Ecological and/or Cultural Resources	x	Inquire USFW and Oregon F&W		
	10	EHE Module Score				60 to 70 EHE Rating D (Preliminary)
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources			x	Ecological resources present
	20	CHE Module Score				< 38 CHE Rating G (Preliminary)
Health Hazard Evaluation (HHE)	21	Groundwater Data Element			x	PA/SI data show perchlorate impacts
	22	Surface Water (Human Endpoint) Data Element			x	PA/SI data show perchlorate impacts
	23	Sediment (Human Endpoint) Data Element Table			x	PA/SI data show no impacts to sediments
	24	Surface Water (Ecological Endpoint) Data Element	x	Evaluation Pending		
	25	Sediment (Ecological Endpoint) Data Element	x	Evaluation Pending		
	26	Surface Soil Data Element	x	Evaluation Pending		
	27	Supplemental Contaminant Hazard Factor	x	Evaluation Pending		
	28	HHE Module Score	x	Module Score Pending		
MRS Priority	29	MRS Priority (Based on Highest Hazard Evaluation Module Rating)	x	Final Score Pending		
	A	MRS Background Information	x	Pending		

Boardman Air Force Range HRS Data Gaps

Information required to complete the MEC-HRS data collection form:

Item	Number	Comment – Missing Data Element
1	1.8	Confirm the latitude / longitude of potential source(s) and the accuracy of the information (in meters)
2		Source scale (i.e., 1:24,000, etc.)
3	1.12	Site Permits
4	2.3	Confirm no tribal lands within 4 miles or surface water within 15 miles
5	2.4	Confirm if there are other NPL sites within 1 mile of the site
6	2.5	Confirm property owners
7	5.3	Population within 1 mile, within 4 miles
8	6	Water use (GW within 4 miles, SW within 15 miles)
9	6.1	Total drinking water population served
10	6.2	Type of drinking water supply system (GW or SW?)
11	6.3	Other water uses of GW within 4 miles
12	6.4	Depth to aquifer within 4 miles
13	7.1	Confirm existence of sensitive or potentially vulnerable environment