



U.S. Army
Corps of Engineers
Omaha District



FINAL SITE INSPECTION REPORT

Camp Abbot

Deschutes County, OR

FUDS Property No. F10OR0041

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

June 2007



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

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June 2007
Submitted to:

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

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List of Acronyms

°F	degrees Fahrenheit
AOC	area of concern
ASR	Archives Search Report
bgs	below ground surface
CAIS	Chemical Agent Identification Sets
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CSM	conceptual site model
DERP	Defense Environmental Response Program
DMM	discarded military munitions
DoD	Department of Defense
DQO	data quality objective
EDR	Environmental Data Resources, Inc.
EPA	Environmental Protection Agency
ER	Engineering Regulation
ERTC	Engineer Replacement Training Center
FR	Federal Register
ft	foot or feet
FUDS	Formerly Used Defense Sites
GPS	Global Positioning System
HRS	Hazard Ranking System
HTRW	hazardous, toxic, or radioactive wastes
IEP	Important Ecological Places
INPR	Inventory Project Report
MC	munitions constituents
MDL	method detection limit
MEC	munitions and explosives of concern
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mm	millimeter
MMRP	Military Munitions Response Program
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
NCP	National Contingency Plan
NDAI	No Department of Defense Action Indicated
NWO	Northwest Region (Omaha District Military Munitions Design Center)
OB/OD	ordnance burial/ordnance disposal
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
PA/SI	Preliminary Assessment/Site Inspection

List of Acronyms (Cont.)

PETN	pentaerythritol tetranitrate
PQL	practical quantitation limit
RAC	Risk Assessment Code
RI/FS	remedial investigation/feasibility study
Shaw	Shaw Environmental, Inc.
SHPO	State Historic Preservation Office
SI	Site Inspection
SLERA	Screening-Level Ecological Risk Assessment
SSWP	Site-Specific Work Plan
TAL	target analyte list
TPP	Technical Project Planning
UTL	upper tolerance limit
USACE	U.S. Army Corps of Engineers
USC	United States Code
UXO	unexploded ordnance

Glossary of Terms

Comprehensive Environmental Response, Compensation, and Liability Act of 1980

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

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

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

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

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

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

The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, other than non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.) have been completed (10 USC 101(e)(4)(A) through (C)).

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

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

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

Munitions Response Area (MRA) – Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples are former ranges and munitions burial areas. An MRA comprises one or more munitions response sites (32 CFR§179.3).

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

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

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

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

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

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

1 *Executive Summary*

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

10 *SI Objectives and Scope*

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

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

24 *Camp Abbot*

25 This report presents the results of an SI conducted at Camp Abbot, FUDS property number
26 F10OR0041, located approximately 15 miles south of Bend, Deschutes County, Oregon. Camp
27 Abbot was commissioned in 1943 and was used primarily for training engineer soldiers. Camp
28 Abbot was decommissioned in June 1944. In November 1947, the Army relinquished its permits
29 for use of Forest Service land.

30 *Technical Project Planning*

31 The approach for the SI was developed by Shaw in consultation with site stakeholders. A
32 Technical Project Planning (TPP) meeting conducted in April 2006 was attended by
33 representatives from the USACE Omaha Design Center; USACE Hazardous, Toxic, and
34 Radioactive Waste Center of Expertise; USACE Seattle District; Oregon Department of
35 Environmental Quality (ODEQ); Shaw; Sunriver Owners Association; and Sunriver Resort. The

36 stakeholders agreed to the approach and identified seven areas of concern (AOCs) – Range
37 Complex No. 1, Anti-Tank Range, Demolition Area, Mortar Range, Grenade Courts, Burial Pit,
38 and Chemical Training Area – for further evaluation in the SI.

39 SI Field Activities

40 SI field activities, conducted in September 2006, included a site reconnaissance to look for
41 evidence of MEC and to avoid MEC during sampling. Samples were collected from
42 groundwater, surface water, sediment, and surface soil and analyzed for metals, explosives,
43 and/or perchlorate depending on the media and AOC sampled.

44 No MEC or munitions debris was identified at Range Complex No. 1 or the Grenade Courts
45 during the visual reconnaissance. Since MEC has been previously confirmed at the Anti-Tank
46 Range, Demolition Area, and Mortar Range (Explosives Munitions Ranges), no further
47 reconnaissance was performed. A visual reconnaissance for the site of the Burial Pit did not
48 reveal its location. No visual reconnaissance was performed for the Chemical Training Area
49 based on its close location to the former cantonment area, the current development that has
50 occurred in the area, and the limited activities that occurred in the area.

51 SI Recommendations

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

54 *Range Complex No. 1 (Small Arms Ranges)*

55 Based on historical evidence and results from the SI field activities, the MEC risks are low and
56 Range Complex No. 1 is recommended for No Department of Defense Action Indicated (NDAI)
57 with respect to MEC.

58 Ecological screening of analytical results from soil samples indicate that lead, mercury, and zinc
59 results from soil samples that also exceeded background concentrations, indicate that adverse
60 ecological impacts may occur. An elevated lead detection from a sediment sample collected
61 during a Preliminary Assessment (PA)/SI (Weston, 2005) exceeded the ecological screening
62 value. However, the PA/SI determined that the elevated lead result was an outlier and was not
63 due to activities occurring at the FUDS. There are no human health impacts indicated.

64 Following consultation with ODEQ, a recommendation of NDAI with respect to MC is made.
65 Although, ecological screening values were exceeded and a potential for ecological impact is
66 present, the risk is not considered to be sufficient to warrant a Remedial Investigation/Feasibility
67 Study (RI/FS).

68 *Explosive Munitions Ranges (Anti-Tank Range, Demolition Area, and Mortar Range)*

69 Based on historical evidence and results of the SI field activities, there is evidence of MEC,
70 munitions debris, and use of explosives occurring within the Anti-Tank Range, the Mortar

71 Range, and the Demolition Area. Based on the historical occurrence of MEC, the Anti-Tank
72 Range, the Mortar Range, and the Demolition Area are recommended for RI/FS.

73 Iron was detected at concentrations above the background and human health screening value in
74 soil samples from the Demolition Area and the Mortar Range. Iron is a common rock forming
75 mineral and the bedrock at Camp Abbot is basaltic, which has high iron content. These elevated
76 iron concentrations may reflect natural variation in the soils. Additionally, iron is not a
77 Comprehensive Environmental Response Compensation, and Liability Act (CERCLA)
78 hazardous substance and therefore a recommendation based on iron alone cannot be used to
79 recommend RI/FS.

80 The Camp Abbot background concentration and ecological screening value was exceeded for
81 barium, chromium, and lead in soil samples. The exceedances indicate that adverse ecological
82 impacts may occur in soil. Following consultation with ODEQ, a recommendation of NDAI
83 with respect to MC is made. Although, ecological screening values were exceeded and a
84 potential for ecological impact may be present, the risk is not considered to be sufficient to
85 warrant an RI/FS.

86 *Grenade Courts*

87 Historically, no MEC or munitions debris, other than a grenade spoon and expended lead bullets,
88 have been found at the Grenade Courts. Based on the types of MEC that may be present and the
89 limited investigation that has been conducted, the overall MEC risk is considered to be moderate
90 and the Grenade Courts area is recommended for RI/FS.

91 All analytical results for MC were below human health screening values. The ecological
92 screening value was exceeded for nickel in a sediment sample, which may indicate adverse
93 ecological impacts in sediments. However, the detected concentration may reflect the natural
94 variation of nickel in sediment. Following consultation with ODEQ, a recommendation of
95 NDAI with respect to MC is made. Although, ecological screening values were exceeded and a
96 potential for ecological impact may be present, the risk is not considered to be sufficient to
97 warrant an RI/FS.

98 *Burial Pit*

99 The Burial Pit was identified in the ASR as occurring east of the Deschutes River and east of the
100 ordnance area, and described as follows: "The potential pit was horseshoe-shaped area, bermed
101 and ringed with stone" (USACE, 1995). The ASR Supplement placed the Burial Pit as near the
102 old landfill and provided location coordinates. An extensive search of the area was completed
103 during the SI and no evidence of the Burial Pit was found. Workers at the Nature Center, where
104 the Burial Pit was reported as being located, could not confirm the existence of the Burial Pit.
105 There have been no reports of MEC or munitions debris from this pit or in the area. Because the
106 pit could not be located, no MC samples were collected. Because of the uncertainty in the

107 location or even existence (ASR described as ‘potential’) of the Burial Pit, the Burial Pit is
108 recommended for NDAI for both MEC and MC.

109 *Chemical Training Area*

110 No MEC or munitions debris has been reported at the Chemical Training Area. The Chemical
111 Training Area is located within a housing development. The Inventory Project Report (INPR)
112 (USACE, 1994) indicated that a gas chamber was located in this area. A recent telephone
113 interview (Appendix L) indicated that “chemicals” may have been buried at the “sledding hill”
114 located north of the AOC. However, Mr. Cliff Walkey of ODEQ stated that the “sledding hill” is
115 a former asbestos disposal site used for building debris from the demolition of former Camp
116 Abbot. Mr. Walkey also stated that to his knowledge no MEC or munitions debris has been
117 identified at this site.

118 No MC samples were collected from the Chemical Training Area, because the area is currently
119 residential housing and the area has been developed and utilized, and any chemical agents that
120 may have been released would be in very small quantities associated with CAIS sets. Based on
121 no MEC having been identified associated with this AOC and the low exposure potential from
122 CAIS sets, the Chemical Training Area, is recommended for NDAI with respect to both MEC
123 and MC.

124 *Removal Action*

125 There is no indication from the SI that a removal action is warranted at Camp Abbot.

126 Due to the uncertainty in the location of the Burial Pit between the location in the ASR
127 Supplement (near landfill) and the location in the ASR (east of the ordnance area), it is
128 recommended that additional reconnaissance for the Burial Pit be completed in the vicinity of the
129 ordnance area in the northern part of Camp Abbot.

130 **1.0 Introduction**

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

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

141 **1.1 Project Authorization**

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

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

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

159 **1.2 Site Name and Location**

160 Camp Abbot, property number F10OR0041, is located approximately 15 miles south of Bend,
161 Oregon, in Deschutes County (Figure 1-1). Camp Abbot is included in the MMRP Inventory in
162 the *Defense Environmental Programs Annual Report to Congress Fiscal Year 2006* (DoD, 2006)
163 and in the *Archive Search Report (ASR) Supplement* (USACE, 2004b). The Camp Abbot project

164 number used to identify ranges is F10OR004102. Identified ranges and other areas of concern
 165 (AOCs) are as follows:

Range Name	Range Identifier	Approximate Area (acres)	UTM Coordinates (meters) ¹
Burial Pit	F10OR004102M01	48	N 4860332.50; E 624695.52
Anti-Tank Range	F10OR004102R01	354	N 4859041.99; E 623348.74
Chemical Training Area	F10OR004102R02	27	N 4858969.21; E 625900.23
Demolition Area	F10OR004102R03	96	N 4863508.32; E 623628.20
Grenade Courts	F10OR004102R04	50	N 4858051.24; E 623361.36
Mortar Range	F10OR004102R05	1421	N 4861875.88; E 624050.99
Range Complex No. 1	F10OR004102R06	3527	N 4859541.80; E 621252.77
Rifle Range	F10OR004102R06-SR01	684	N 4859031.66; E 624135.93
Rifle/Machine Gun Range	F10OR004102R06-SR02	754	N 4858527.00; E 621947.53
Landscape Range	F10OR004102R06-SR03	19	N 4859354.99; E 623965.34
Transition Range	F10OR004102R06-SR04	591	N 4858698.24; E 622099.91
Anti-Aircraft Range	F10OR004102R06-SR05	1022	N 4858316.58; E 621364.30
Field Target and Submachine Gun Range	F10OR004102R06-SR06	2766	N 4859936.70; E 620986.42

166 UTM – Universal Transverse Mercator

167 ¹ UTM Zone 10, North American Datum 1983.

168 1.3 Purpose, Scope, and Objectives of the Site Inspection

169 The primary objective of the MMRP SI is to determine whether a FUDS project warrants further
 170 response action under CERCLA or not. The SI collects the minimum amount of information
 171 necessary to make this determination, as well as it (i) determines the potential need for a removal
 172 action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking System
 173 (HRS) scoring by Environmental Protection Agency (EPA); and (iii) collects data, as
 174 appropriate, to characterize the release for effective and rapid initiation of the Remedial
 175 Investigation and Feasibility Study (RI/FS). An additional objective of the MMRP SI is to

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

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

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

- 187 • There is no indication of MEC;
- 188 and
- 189 • MC contamination does not exceed screening levels determined from Technical
190 Project Planning (TPP).

191
192 **Is an RI/FS warranted?** An RI/FS may be recommended if:

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

200
201 **Is a removal action warranted?** A removal action may be needed if:

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

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

216 **1.4 *Munitions Response Site Prioritization Protocol***

217 Draft MRSPP scoring sheets for the munitions response sites (MRSs) identified in this SI Report
218 are included in Appendix K. The MRSPP scoring will be updated on an annual basis to
219 incorporate new information.

220 2.0 *Property Description and History*

221 The setting, history, and use of Camp Abbot are described in the following sections. Unless
222 referenced otherwise, this information is taken from the ASR (USACE, 1995).

223 2.1 *Historical Military Use*

224 Camp Abbot (Figure 2-1) was used primarily as an Engineer Replacement Training Center
225 (ERTC) during World War II. Construction of the camp was completed in May 1943, and it
226 operated for approximately 14 months, until June 1944. In that time, a total of 90,000 engineer
227 soldiers were trained (up to 10,000 men at a time). Camp trainees received instruction in
228 military construction and engineering. General and specialist training programs, in periods
229 ranging from 5 to 17 weeks, included instruction in heavy equipment operation, fire-fighting,
230 carpentry, demolition, tank operation and maintenance, bridge construction, infiltration,
231 mapmaking, pipeline construction, depot storage, specialized mechanics, aerial photography,
232 water and sewage systems, camouflage, mine detection, and bomb disarmament. The 17-week
233 general training program, a modification of earlier strategies involving shorter training periods
234 and greater emphasis on specialist training, at the Army's three ERTCs went into effect in
235 August 1943. Figure 2-1 shows the layout of Camp Abbot based on an historical site map
236 contained in the Inventory Project Report (USACE, 1994). Figure 2-2 shows the current site
237 layout overlain on the most recent available aerial photograph from 2003. Section 1.2 lists the
238 Camp Abbot ranges and subranges.

239 The Camp Abbot program included three distinct phases:

- 240 • Six weeks of basic military training, including rifle marksmanship, use of hand grenades
241 and anti-tank grenades, and defense against chemical, air, and mechanized attack;
- 242 • Eight weeks of technical training in demolitions, etc., preparing trainees for duty either as
243 general engineers or as specialists;
- 244 • A 3-week, field maneuver spent under field and combat conditions, including such team
245 training tasks as mine laying, demolitions, and building of bridges, roads, and obstacles.

246 A letter dated 25 September 1946 states that Camp Abbot was “dedudded” in November 1944,
247 and that “A recent inspection of Camp Abbot was made by the Chemical Officer of the 6th U.S.
248 Army to determine whether poisonous gases were present on the area. The inspection showed
249 that the land was free of any such contamination.”

250 A War Department letter of 30 October 1946 stated that Camp Abbot “is hereby declared safe for
251 return to private use.” A letter dated 18 November 1947, relinquishing the Army's permits for
252 use of Forest Service land, states “the lands have been examined and have been cleared of all
253 explosives or explosive objects reasonably possible to detect by visual inspection.”

254 **2.2 Munitions Information**

255 Table 2-1 includes a list of munitions and the associated MC reportedly used at Camp Abbot.
256 Use of munitions at ERTCs was very limited due to short supply of munitions because of the
257 war. For example, although the .50-caliber machine gun was issued to Camp Abbot, its use was
258 limited due to short supply of ammunition and much of the machine gun training used the .30-
259 caliber weapon. Also, the use of anti-tank rockets was limited to one rocket for every 50 men
260 (Coll et al., 1958, p 264).

261 **2.3 Ownership History**

262 Camp Abbot was constructed in May 1943. In November 1947, the Army relinquished permits
263 of use of Forest Service land west of the Deschutes River. Land east of the river was used for
264 cattle grazing until approximately 1968, when a group of developers began Sunriver Resort. The
265 resort now occupies approximately 3,300 acres east of the Deschutes River. The land east of the
266 river is owned by a private corporation (Sunriver Limited Partnership) and private citizens.
267 Figures 2-3A through 2-3F show the current property ownership. The property owners are
268 identified by an index number rather than a name on the figures. The property owners' names
269 are available on request from the USACE Seattle District office.

270 **2.4 Physical Setting**

271 **2.4.1 Topography and Vegetation**

272 The landscape of the former camp varies from flat areas with low grass and few shrubs in the
273 valley of the Deschutes River, to rugged hills, buttes, and cliffs with heavy shrubs and trees west
274 of the river. Figure 2-4 shows the FUDS boundary overlain on available topographic maps.

275 **2.4.2 Land Use**

276 Current and expected future land use within the area of former Camp Abbot includes residential,
277 recreational, and multiple Forest Service land uses.

278 East of the Deschutes River, much of the former Camp Abbot is now the resort and residential
279 community of Sunriver. The privately owned area includes houses, condominiums, an airport,
280 golf courses, bike paths, and a nature center. The portion of the former Camp Abbot west of the
281 Deschutes River is under the control of the Forest Service and is virtually undeveloped. Figure
282 2-2 shows the FUDS boundary overlain on aerial photographs taken in 2003. The aerial
283 photographs illustrate the diverse use of the land.

284 **2.4.3 Nearby Population**

285 The community of Sunriver has a population of approximately 534 (U.S. Census Bureau
286 estimate). The city of Bend, Oregon, 15 miles north of Camp Abbot, has a population of 62,937.
287 Deschutes County has a total population of approximately 141,382 (averaging 44.2 people per
288 square mile) (U.S. Census Bureau, 2000). Several hundred residences and numerous farms are

289 located within a 2-mile radius of the site. Three schools are located approximately 2 miles
290 southwest of the site. The estimated population (U.S. Census, 2000) within a 2-mile radius of
291 the Camp Abbot FUDS property boundary is 4,122 (Figure 2-5). The population density is 42.6
292 persons per square mile (within a 2-mile radius). The estimated numbers of housing units and
293 households within a 2-mile radius are 5,460 and 1,798, respectively.

294 *2.4.4 Climate*

295 Camp Abbot is situated east of the Cascade Range, which strongly influences the area's climate.
296 As air moves east over the Cascades, it descends and becomes drier. The annual average rainfall
297 at Bend, Oregon is less than 12 inches, with average monthly precipitation ranging from a low of
298 0.49 inch in September to a high of 1.78 inches in December. The monthly average mean
299 temperature ranges from 31.2 degrees Fahrenheit (°F) in December and January to 63.5°F in July.

300 *2.4.5 Area Water Supply*

301 The community of Sunriver uses groundwater from deep water supply wells for the community
302 water supply. Residents outside of Sunriver use private groundwater wells. The water
303 department of the City of Bend, located 15 miles downstream of Camp Abbot, uses surface water
304 (Deschutes River) as its primary water source.

305 *2.4.6 Geologic and Hydrogeologic Setting*

306 The site is located along the Deschutes River in the High Lava Plains physiographic province of
307 Oregon, a few miles east of the Cascade Range.

308 *2.4.6.1 Geology*

309 The Cascade Range is a north-south trending zone of volcanic eruptive centers, including the
310 large stratovolcanoes North, Middle, and South Sister, and Mount Jefferson, which all exceed an
311 elevation of 10,000 feet (ft) above sea level. Broad lava plateaus are interrupted by faults and
312 fault-bounded grabens.

313 The surficial geology of the site includes Pliocene, Pleistocene, and Holocene basaltic andesite
314 and basalt flows that are often fractured and highly permeable. Deposits of alluvial and/or
315 glacial outwash silt, sand, and gravel are present along the Deschutes River. Soils at the site are
316 generally very thin to absent, with surface outcrops of volcanic rocks.

317 *2.4.6.2 Hydrogeology*

318 Groundwater is present in the fractured and highly permeable Pliocene, Pleistocene, and
319 Holocene basaltic andesite and basalt flows. Precipitation readily infiltrates the permeable lava
320 flows, particularly in the Cascade Range where both precipitation and permeability are high.

321 Groundwater flow is generally toward the Deschutes Basin and Deschutes River, where fine-
322 grained sedimentary and older volcanic units tend to divert groundwater flow to the surface, as
323 evidenced by numerous springs feeding creeks and rivers. Perched water near the ground

324 surface is likely to be encountered due to low permeability silts and clays. These perched water
325 layers likely flow to the Deschutes River or small ponds within the Sunriver community.

326 Domestic water wells are typically less than 100 ft deep, and the depth to groundwater is a few
327 tens of feet, as evidenced by the domestic well used to obtain a background water sample. That
328 well had a total depth of 56 ft, with groundwater at 30 ft. Wells used by the Sunriver community
329 are deeper and may extend to as much as 600 ft below ground surface (bgs).

330 *2.4.7 Sensitive Environments*

331 Camp Abbot contains sensitive environments. The Deschutes River is designated as a Federal
332 Wild and Scenic River and several miles of sensitive wetlands occur along the river. Portions or
333 all of Camp Abbot qualify as Important Ecological Places (IEP) or Sensitive Environments as
334 defined by USACE (2006) or EPA (1997). Table 2-2 provides the checklist used for determining
335 the IEP status. A determination has been made by Shaw for SI evaluation purposes to consider
336 the whole FUDS to qualify as IEP or Sensitive Environments because there is a stream running
337 through the middle of the site and AOCs that contains wetlands. Sensitive environments are
338 present in Range Complex No. 1, the Anti-Tank Range, Mortar Range, Grenade Court, and
339 Burial Pit AOCs. No sensitive environments are present at the Demolition Area and Chemical
340 Training Area.

341 *2.5 Previous Investigations for MC and MEC*

342 Multiple investigations regarding MC/MEC have been performed at Camp Abbot.

343 *2.5.1 Archives Search Report*

344 The USACE completed an ASR in 1995. The ASR confirmed past DoD ownership of Camp
345 Abbot and compiled available information with emphasis on types, quantities, and areas of
346 ordnance use and disposal. Members of the USACE performed a limited inspection of the site,
347 “focusing specifically on areas of past recoveries” (USACE, 1995). The site visit team
348 concluded that “there exists the possibility of OEW [ordnance and explosive waste]
349 contamination of the site...” and that “no indications of CWM [chemical warfare materials]
350 contamination were found” (USACE, 1995).

351 *2.5.2 ASR Supplement*

352 The USACE completed an ASR Supplement in 2004, which identified Range Complex No. 1,
353 Mortar Range, Demolition Area, Anti-Tank Range, Grenade Courts, Burial Pit, and Chemical
354 Training Area as AOCs. A risk assessment was completed on the explosives safety hazard
355 related to munitions. The risk assessment did not address the environmental hazards associated
356 with munitions constituents. The Risk Assessment Code (RAC) score was assigned to each
357 AOC. Possible scores range from high (1) to low (5). All AOCs received a score of 1 (high risk)
358 except for Range Complex No. 1, which received a score of 5.

359 **2.5.3 Other Investigations**

360 In 2005, a *Preliminary Assessment/Site Inspection Report (PA/SI)* for Camp Abbot was
361 completed for the EPA by Weston (2005). The scope of the PA/SI largely parallels the scope of
362 the 2006 SI. Samples were collected from soil, sediment, surface water, and groundwater at
363 several AOCs. To the extent possible, this SI uses data previously collected for the PA/SI. The
364 data collected during the PA/SI is discussed in Section 5, along with the data collected during the
365 SI field activities. Note that the data collected from the landfill area was for HTRW and not MC
366 evaluation. The landfill samples were analyzed for metals, semivolatile organic compounds, and
367 pesticides/polychlorinated biphenyls. Only metals and nitrogen-based explosives are chemicals
368 of concern for the Camp Abbot MMRP SI.

369 One groundwater sample was collected during the PA/SI from municipal Well #2, as designated
370 by Sunriver Water LLC. The well is located approximately 0.75 mile east of the Machine Gun
371 Range and approximately 0.4 mile southeast of the landfill and is upgradient of all AOCs.
372 Review of the well log data shows that the well was screened between 254 ft and 266 ft bgs. The
373 PA/SI groundwater sample was analyzed for perchlorate and nitrogen-based explosives. There
374 were no detected compounds (Weston, 2005).

375 Analytical reporting limits used in the PA/SI report were generally higher than those used in this
376 Camp Abbot SI. In particular, reporting limits used in the PA/SI for soil explosive compound
377 analysis using EPA Method 8330 were approximately 10 times higher than those used in the
378 Camp Abbot SI. Analysis for metals in the PA/SI also generally had somewhat higher reporting
379 limits than those used in this Camp Abbot SI report. Section 5 evaluates the impact, if any, that
380 higher detection limits for the PA/SI data has on the Camp Abbot SI results.

381 **2.6 Other Land Uses that May Have Contributed to Contamination**

382 A large portion of Camp Abbot is within the Deschutes National Forest, which has uncontrolled
383 access. Areas within the Sunriver community include an airport and commercial buildings that
384 may have contributed to HTRW contamination in surface soil. Agricultural uses may have
385 included the use of fertilizers and pesticides containing nitrate-based compounds and heavy
386 metals, which may also occur as MC.

387 **2.7 Past Regulatory Activities**

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

389 **2.8 Previous MEC Finds**

390 Previous MEC finds at Camp Abbot include:

- 391 • At the Anti-Tank Range, a 2.36-inch anti-tank rocket was found.
- 392 • At the Mortar Range, 60 and 81 millimeter (mm) mortar duds were found.

- 393 • At an unknown site, an historical brochure published by Sunriver states that a group of
394 youths found bazooka rockets, bullets, hand grenades, and barbed wire that were used
395 in the engineers' bivouac training.
- 396 • In the area of the Grenade Court, a grenade spoon was found during the ASR site visit.
- 397 • An artillery round and a bazooka round were found west of the Sunriver Resort
398 (across the Deschutes River). In addition, spent mortar and rocket rounds have been
399 found northwest of the Sunriver airstrip.
- 400 These finds are further noted in Section 4.0.

401 3.0 Site Inspection Tasks

402 The SI tasks conducted at the FUDS involved compiling and reviewing historical reports and
403 information that were then used in the TPP process. Following the TPP meeting, the *Site-*
404 *Specific Work Plan* (SSWP) was prepared to define the SI field activities necessary to collect the
405 information needed to address the data gaps and data quality objectives (DQOs). Field work was
406 conducted at the site in September 2006.

407 3.1 Technical Project Planning

408 TPP involved compiling and reviewing historical reports and information to identify data gaps
409 and develop a path forward. The TPP Meeting for the Camp Abbot was conducted on April 4,
410 2006 at the Sunriver Resort, located at Sunriver, Oregon. This meeting included representatives
411 from USACE – Omaha Design Center, the USACE Hazardous, Toxic, and Radioactive Waste
412 Center of Expertise, and the USACE Seattle District; Shaw; Oregon Department of
413 Environmental Quality (ODEQ); Sunriver Owners Association; and Sunriver Resort.

414 In the TPP Meeting, historical information was discussed and historical aerial photographs were
415 reviewed. The stakeholders agreed that soil, surface water, and groundwater warrant inspection
416 to evaluate the potential presence of MEC and MC. The results of the TPP meeting were
417 documented in the *TPP Memorandum* (Shaw, 2006b), which was issued final on July 26, 2006
418 after incorporating comments from the stakeholders. The proposed technical approach was
419 defined in the SSWP (Shaw, 2006c), which was issued final on September 15, 2006 after
420 incorporating comments from the stakeholders.

421 The SI approach groups ranges and other areas into historical use, types of MEC, MC expected,
422 and environmental conditions. This grouping was documented in the *TPP Memorandum*. The
423 AOC groupings identified within Camp Abbot were (Figure 3-1):

- 424 • Range Complex No. 1 contains all small arms ranges;
- 425 • Explosive Munitions Ranges includes the Anti-Tank Range, the Demolition Area, and
426 the Mortar Range;
- 427 • Grenade Courts includes all grenade training areas;
- 428 • Burial Pit is a potential munitions disposal area, and
- 429 • Chemical Training Area is where chemical weapons familiarization was conducted.

430 A more complete discussion of the TPP meeting is contained in Appendix B.

431 Following the TPP meeting with institutional stakeholders on April 4, 2006, a second TPP/public
432 information meeting was held at Sunriver Resort. The meeting presented to interested public an
433 overview of the proposed work at Camp Abbot. Discussed were the overall project purpose,
434 contact information, preliminary sampling areas, and rights of entry. Questions were answered

435 following the meeting. An additional public information meeting was held on July 19, 2006 to
436 brief the public on the upcoming sampling that was to be completed in September.

437 As discussed during the TPP meeting and subsequent telephone calls, the following project
438 objectives and DQOs were developed.

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

441 DQO #1 – At AOCs where MEC has not been reported in the past (Range Complex No. 1 and
442 the Live Hand Grenade Court), trained UXO personnel will conduct a visual search of the AOCs
443 aided by a handheld magnetometer or metal detector, searching for evidence of the presence of
444 MEC (e.g., craters and ground scars indicative of ordnance burial/ordnance disposal [OB/OD]
445 activities, MEC on the surface, munitions debris indicative of OB/OD activities, and soil
446 discoloration indicative of explosives). The visual search will consist of a meandering path
447 survey along trails and in accessible areas. The magnetometer will aid the UXO personnel in
448 locating MEC or munitions debris on the ground surface. The magnetometer or metal detector
449 will identify subsurface magnetic or metal anomalies. However, no attempt will be made to
450 identify any subsurface anomalies. Typically, only a handheld magnetometer is used to identify
451 MEC; however, the FUDS is underlain by basaltic rock that has high iron content. A backup
452 metal detector (White's Eagle Metal Detector – which is based on electromagnetic geophysical
453 methods) may be used if excessive signal noise is encountered from the basaltic rocks.

454 The following decision rules will apply for AOCs where no MEC has been previously reported:

- 455 • If no evidence of MEC is found, the AOCs will be recommended for NDAI relative to
456 MEC.
- 457 • If evidence of MEC is confirmed, the AOCs will be recommended for additional
458 investigation.
- 459 • If there is indication of an imminent MEC hazard, the site may be recommended for a
460 removal action.

461 DQO #2 – At AOCs where MEC has been reported in the past (Anti-Tank Range, Demolition
462 Area, and Mortar Range), the following decision rules will apply:

- 463 • The presence of MEC is confirmed on the basis of past finds, and these areas will be
464 recommended for additional investigation.
- 465 • If, in the course of reconnaissance for sample targets and/or UXO avoidance, there is
466 indication of an imminent MEC hazard, the site may be recommended for a removal
467 action.

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

470 DQO #3 – Soil, sediment, surface water, and groundwater samples will be collected and
471 analyzed. Analytical results will be compared to screening values for human health screening
472 risk assessment and a screening level ecological risk assessment, and to background values for
473 naturally occurring substances. The following decision rules will apply if there is a complete
474 human health or ecological pathway:

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

483 **3.2 Additional Records Research**

484 **3.2.1 Coordination with State Historic Preservation Office**

485 The State Historic Preservation Office (SHPO) for Oregon is located within the Parks and
486 Recreation Department. After a search of the SHPO's archaeological database, a SHPO
487 representative identified several reported archaeological/cultural sites within the project AOCs.
488 Furthermore, the SHPO representative indicated that this area includes several features typically
489 associated with archaeological resources. In order to protect these sites and any previously
490 unidentified sites from damage or inadvertent intrusion, Shaw contracted with a local
491 archaeologist to accompany the field teams to ensure known sites were avoided and previously
492 unidentified sites were noted for the SHPO. The archeologist prepared and submitted a field
493 report (Appendix C). The archeologist's report noted that known sites were successfully avoided
494 during sampling activities, and one previously unknown site was identified with appropriate
495 photos and GPS locations, and forwarded to the SHPO. The known and recently identified
496 archeological sites that were avoided were located west of the Deschutes River in Range
497 Complex No. 1, Anti-Tank Range, and Mortar Range AOCs.

498 **3.2.2 Coordination Regarding Natural Resources**

499 The Oregon Department of Fish and Wildlife (ODFW) was contacted to identify any potentially
500 impacted threatened or endangered species in the area. The ODFW indicated there was no
501 impact to threatened or endangered wildlife species in the area (ODFW, 2006). The U.S. Fish
502 and Wildlife Service website was reviewed for threatened or endangered species. Species are
503 identified in the *Final TPP Memorandum* (Shaw, 2006b). The Oregon Department of
504 Agriculture coordinates inquiries into threatened or endangered plant species for the State of
505 Oregon. The Department indicated it has no jurisdictional authority for the Forest Service
506 property within the FUDS and did not provide any information pertinent to endangered plants for
507 the Camp Abbot area. The U.S. Forest Service has responsibility over its lands. The Forest

508 Service communicated verbally that they did not have any concerns over impacts to their lands.
509 Species lists are included in Appendix C.

510 **3.2.3 Historical Aerial Photographs**

511 The historical aerial photographs of Camp Abbot were reviewed and interpreted prior to field
512 mobilization to aid in site reconnaissance and to refine proposed sampling point locations. Four
513 aerial photographs dating from 1957 were obtained from the United States Geological Survey and
514 reviewed. There were no significant observations made from these photographs.

515 **3.2.4 Environmental Database Search**

516 A search of available environmental records was conducted by Environmental Data Resources,
517 Inc. (EDR, 2005a and b). The government records search met the requirements of ASTM
518 Standard Practice for Environmental Site Assessments. The search results indicated that Camp
519 Abbot does appear on mapped sites in known federal, state, or local databases (Appendix L).
520 Within a 1-mile radius of the Camp Abbot site the following were identified:

- 521 • Facility Index System – 8 sites,
- 522 • Environmental Cleanup Site Information System – 5 sites,
- 523 • Oregon Underground Injection Control System Database – 2 sites,
- 524 • Leaky Underground Storage Tank List – 1 site,
- 525 • Underground Storage Tanks – 2 sites,
- 526 • Above Ground Storage Tanks – 12 sites,
- 527 • Oregon HAZMAT Spill database – 2 sites, and
- 528 • Oregon Hazardous Substance Information Survey – 22 sites.

529 Additional information on the databases searched and the results for surrounding properties is
530 included in the EDR reports found in Appendix L.

531 **3.2.5 Rights of Entry**

532 Prior to mobilizing to the site, the Project Manager for the USACE Seattle District office
533 obtained the Right of Entry from the property owners where the SI field activities were
534 performed.

535 **3.3 Field Work**

536 SI field activities, conducted between September 22 and September 28, 2006, included site
537 reconnaissance and collection of surface soil, sediment, surface water, and groundwater samples.
538 The following conditions were recorded in the field log book (Appendix D) and/or by digital
539 photographs (Appendix E):

- 540 • Presence or absence of evidence of MEC,
- 541 • Changes, if any, in sample location because of field constraints,
- 542 • Vegetative cover, and

- 543 • Presence or absence of water for sediment and surface water samples, and other
544 conditions encountered that impacted sample collection.

545 **3.4 *Lab Analysis and Data Quality Review***

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

548 One-hundred percent of the analytical data have been reviewed based on EPA Contract
549 Laboratory Program (CLP) *National Functional Guidelines for Organic Data Review*, October
550 1999 and EPA CLP *National Functional Guidelines for Inorganic Data Review*, October 2004.
551 Automated Data Review software (version 8.1) was used to assist in the data validation process
552 for all areas with the exception of initial calibration blanks, continuing calibration blanks,
553 interference check standards, serial dilutions, internal standards, instrument tuning standards, and
554 second-column confirmation. Data were evaluated against specific criteria to verify the
555 achievement of all precision, accuracy, representativeness, completeness, comparability, and
556 sensitivity goals established to meet the project DQOs.

557 The overall quality of the data collected is discussed in the Analytical Data QA/QC Report
558 (Appendix G). Results of the analyses, as discussed in this evaluation, suggest that
559 representative samples were collected and analyzed, and the results are indicative of the media
560 analyzed, with the exception of the few anomalies noted in the report.

561 No data was “R” qualified as unusable. Overall, these data reflect expected site conditions and
562 they are fully usable for their intended purpose.

563 **3.5 *Variances from the SSWP***

564 A surface water sample was scheduled to be collected from the Mortar Range (Location
565 013A013, sample number NWO-013-2001). The location was the same as where a sediment
566 sample was collected by Weston during the PA/SI (Weston, 2005). However, the site was dry
567 and surface water was not available for sampling.

568 Samples NWO-013-0005 (surface soil) and NWO-013-1002 (sediment) were scheduled to be
569 analyzed for lead only. However, during the visual reconnaissance, a depression possibly caused
570 by explosives was identified. This soil sample was collected from within the depression and the
571 sediment sample was collected from a drainage approximately 0.2 mile downslope of the
572 depression. The analytical suite for these two samples was expanded to metals and explosives
573 including nitroglycerin and pentaerythritol tetranitrate (PETN).

574 **3.6 *Third TPP Meeting***

575 A third TPP meeting was held on April 18, 2007 to present the SI findings to stakeholders and
576 reach consensus regarding conclusions. The only attendee was a representative of the ODEQ,
577 Mr. Cliff Walkey. Comments received included:

578 • References to 'Camp Adair' appeared at several places in the report. These should be
579 replaced with 'Camp Abbot.'

580 • Add a recommendation that additional reconnaissance to locate the Burial Pit AOC be
581 completed in the vicinity of the ordinance area, located near the northern FUDS
582 boundary. This SI only investigated the vicinity of the landfill.

583 Mr. Wakley is also familiar with the 'sledding hill' located near the Chemical Training Area. He
584 stated that this site is also known as the 'Amphitheater' and is a former asbestos disposal site.
585 Building debris from the demolition of former Camp Abbot was disposed to this site. To his
586 knowledge, no MEC or munitions debris have ever been identified here. The former disposal
587 area is inspected annually by the property owners (Sunriver Owners Association), with the last
588 inspection being completed in October 2006.

589 *4.0 Munitions and Explosives of Concern*

590 A reconnaissance for potential MEC was completed at specific AOCs. A visual observation of
591 site conditions was performed prior to collection of samples, and a hand-held all-metal detector
592 was used to aid in discovering unseen items obscured by shallow soil or vegetative cover.

593 *4.1 Field Observations*

594 The reconnaissance team located each planned sampling location and documented conditions
595 with respect to vegetative cover, soil conditions, unexpected debris or material, presence or
596 absence of water, and any other conditions that could potentially impact the collection of
597 samples. Particular attention was paid to munitions debris, potential indications of
598 contamination such as vegetative stress, and other features of interest (e.g., building foundations,
599 floor slabs, drain tiles, etc.). Additionally, the reconnaissance team recorded the path walked
600 within the AOC using a hand-held Global Positioning System (GPS) unit. Digital photographs
601 were taken to document significant features. Representative photographs of reconnaissance
602 activities and observations are included as Appendix E. A table of GPS coordinates is included
603 in Appendix H.

604 The approach used for MEC evaluations/investigations at Camp Abbot was that if MEC or
605 munitions debris had been previously reported at an AOC, no visual reconnaissance would be
606 completed. MEC has been previously identified at the Explosive Munitions Ranges, but not at
607 Range Complex No. 1 or the Live Grenade Court.

608 During the SI field activities a visual search was completed to locate the reported Burial Pit
609 (USACE, 1995). The route walked was also recorded using a GPS unit.

610 The field activities included a visual reconnaissance along four routes in Range Complex No. 1
611 (Routes 1 through 4) and in the vicinity of the reported Live Grenade Court located north of the
612 Grenade Court AOC (Figure 4-1) to evaluate the presence or absence of MEC. The visual
613 reconnaissance was supplemented with a Fisher 1266-X electromagnetic all-metal detector. The
614 electromagnetic all-metal detector was used to avoid high iron-content rock interference that
615 occurs with the ferrous metal magnetometer. The SSWP identified a White's Eagle Metal
616 Detector as a possible instrument, but the unit was not available from the vendor. The
617 instrument used (Fisher 1266-X metal locator) provided equivalent metallic object detection
618 capability as the White's instrument. The path walked during the visual reconnaissance was
619 recorded using a hand-held GPS unit.

620 *4.1.1 Range Complex No. 1*

621 The field activities conducted at the Range Complex No. 1 included a visual reconnaissance to
622 evaluate the presence or absence of MEC, and collection of surface soil, sediment, and
623 groundwater samples. Four visual reconnaissance routes of Range Complex No. 1 were

624 completed to identify whether there was evidence of military activity inconsistent both with use
625 as a small arms range and with the CSM. The reconnaissance routes are shown on Figure 4-1
626 and are identified as Routes 1, 2, 3, and 4. The route locations were selected to provide a
627 representative evaluation of the terrain and environment of the subranges within Range Complex
628 No. 1 and to look in areas that may have a higher likelihood of having other than small arms
629 munitions used (e.g. reconnaissance Route No. 2 completed the Field Target and Submachine
630 Gun Subrange). All routes were approximately 4,200 ft in length and covered a swath
631 approximately 3 ft wide (swing of the all-metal detector).

632 The CSM for Range Complex No. 1 is for small arms ranges, with all munitions used being of
633 .50-caliber or less. Numerous spent bullets and casings were identified along reconnaissance
634 Route 2, which appeared to indicate that maneuvers occurred in the area. Bullet holes were
635 noted in tree stumps, and multiple finds of concentrations of bullets and casings were found. No
636 MEC or munitions debris was identified. Along Route 2, two large depressions were identified.
637 One appeared to be a crater (possibly caused by explosives), with multiple small subsurface
638 anomalies. The crater was located on a slope and generally circular, approximately 10 ft in
639 diameter, and 2 ft deep. Photographs 1 and 2 (Appendix E) show the crater. A second smaller
640 depression, approximately 6 ft in diameter, was identified approximately 0.2 miles west and
641 upslope or the larger depression. The second depression was supported by rocks on the
642 downslope side and may have been a constructed observation post.

643 *4.1.2 Explosive Munitions Ranges (Anti-Tank Range, Demolition Area, and Mortar Range)*

644 The field activities at the Explosive Munitions Ranges included a visual observation aided by an
645 all-metal detector for MEC avoidance during sampling. No reconnaissance was completed to
646 evaluate the presence or absence of MEC, because MEC has been confirmed previously at this
647 AOC. However, MEC avoidance was conducted using an electromagnetic all-metal detector
648 when walking from the vehicle to the sampling location. These MEC avoidance paths are shown
649 on Figure 4-1.

650 *4.1.3 Grenade Courts*

651 The ASR Supplement identified the Grenade Court AOC as a small area (50 acres) located
652 between the Spring and Deschutes Rivers. A map included in the ASR (Appendix D-1)
653 indicated a practice grenade court at the same location indicated in the ASR Supplement, and a
654 live grenade court located further north near the confluence of the Spring and Deschutes Rivers.
655 A visual reconnaissance of the suspected live grenade court was completed, aided by a hand-held
656 all-metal detector. The objective of the reconnaissance was to identify the location of the
657 suspected live grenade court and to determine whether any MEC or munitions debris was present
658 in the live grenade court area. The reconnaissance route paths are shown on Figure 4-1 (Route
659 5). The route location was based on the location suggested by historical maps provided in the
660 ASR (see also Figure 2-1). Because of the amount of vegetation in the area, a meandering path

661 was followed to cover the area of the suspected live grenade court. The location of the suspected
662 live grenade court was not found and no MEC or munitions debris, other than bullets, was
663 identified in the live grenade court area. The field team did identify a small camp site (shredded
664 tent, sleeping bags, aluminum bowl with brush, cassette tape), suspected to have been used by
665 recreationists. A small area with several subsurface anomalies was identified with the hand-held
666 all-metal detector that appeared to be associated with recreational use.

667 **4.1.4 Burial Pit**

668 A visual reconnaissance (Figure 4-1, Route 6) was conducted in the suspected vicinity of the
669 Burial Pit, with the objective of finding the pit for sampling. The ASR and ASR Supplement had
670 identified the Burial Pit as “horseshoe in shape, bermed, and ringed with stone.” The ASR
671 placed the pit as east of the ordnance area and the ASR Supplement placed it at the former
672 landfill. The two documents provided conflicting location coordinates for the pit. The ASR
673 placed the pit near the northern FUDS boundary along the Deschutes River. One coordinate set
674 provided in the ASR Supplement placed the location nearly 70 miles south of Camp Abbot. The
675 second coordinate set provided in the ASR Supplement placed the Burial Pit location very near
676 the landfill in a lake.

677 The visual reconnaissance failed to find the location of the Burial Pit. Personnel at the Nature
678 Center did not know of the reported pit or any feature that is “horseshoe in shape, bermed, and
679 ringed with stone.”

680 **4.1.5 Chemical Training Area**

681 No visual reconnaissance was completed in the vicinity of the Chemical Training Area. At the
682 TPP, the stakeholders agreed that additional investigation was not warranted based on the
683 location of the Chemical Training Area relative to the cantonment area, the development that has
684 occurred at the area, and the type of activities that may have occurred there. It is understood that
685 these activities were limited to training using Chemical Agent Identification Sets (CAIS) in a
686 building or tent. Neither conventional explosive MEC nor chemical agents were expected to be
687 present at this site. Additional information on this AOC is provided in Section 5.7.

688 **4.2 MEC Risk Assessment**

689 The following sections present a qualitative assessment of the risk associated with MEC at each
690 inspected AOC. This assessment is based on historical documentation and limited visual
691 inspection conducted during the SI. This is provided to convey relative risk on a scale from low
692 to high and is not intended to be a thorough risk assessment as required by CERCLA.

693 **4.2.1 Range Complex No. 1**

694 Four magnetometer assisted visual reconnaissance were completed within Range Complex No.
695 1. No MEC or munitions debris (other than expended small arms munitions) was identified.
696 One suspected explosion crater was identified and a second smaller depression was identified

697 that may have been an observation post along Route 2. Photographs of the suspected crater are
698 provided in Appendix E (photographs 1 and 2). Historically, no MEC (other than expended
699 small arms munitions) has been reported within Range Complex No. 1. The first crater may
700 have been an explosive detonation site used to simulate field conditions. The only known
701 potential use of explosives at the small arms ranges would have been explosive detonations used
702 to simulate field conditions during practice.

703 The current land use is primarily open field east of the river and forested areas west of the river.
704 However, there are residences along the southeastern boundary of Range Complex No. 1. Based
705 on the reported use of this range for small arms training only and no evidence of other uses, other
706 than the two craters, the MEC risk at Range Complex No. 1 is considered to be low.

707 *4.2.2 Explosive Munitions Ranges*

708 Types of explosive munitions used within the Explosive Munitions Ranges included: 2.36-inch
709 anti-tank high explosive and practice rockets, rifle grenades, explosives, dynamite, detonators,
710 and 60 mm and 81 mm high explosive and practice mortar rounds. Based on reports (Coll et al.,
711 1958) the availability of munitions for training by the ETRCs was limited, and the density of
712 MEC or munitions debris would be expected to be low. Shaw completed limited all-metal
713 detector assisted reconnaissance at soil and sediment sampling locations within the Explosive
714 Munitions Ranges. No MEC or munitions debris was located. Historically, MEC and munitions
715 debris have been found associated with the Anti-Tank Range and Mortar Range (60 mm and 81
716 mm mortar rounds) (USACE, 1995). No MEC or munitions debris were reported during the
717 PA/SI (Weston, 2005) at the Demolition Area. However, MEC is considered potentially present
718 because of the adjacent Mortar Range.

719 Current land use for the Explosive Munitions Ranges is primarily National Forest land.
720 However, the reported firing positions for the Mortar Range and Anti-tank Range are within the
721 Sunriver development and numerous residences are present east of the Deschutes River. Public
722 access to the Explosive Munitions Ranges is unrestricted. The types of MEC that may be present
723 are potentially dangerous because of sensitive fuzes or high explosive content. Potential
724 receptors include forest workers and recreational users. Based on the current use of the
725 Explosive Munitions Ranges and the historical occurrence of MEC and munitions debris, the
726 overall MEC risk is considered to be moderate for the Anti-Tank and Mortar Ranges and the
727 Demolition Area.

728 *4.2.3 Grenade Courts*

729 Munitions used at the grenade courts included the Mk II hand grenade, fragmentation; the M21
730 practice grenade; AN-M8 smoke grenade; AN-M14, incendiary grenade; and the M15 smoke
731 grenade. Shaw completed a visual reconnaissance of the live grenade court area. The location of
732 the live grenade court was not confirmed, and no MEC or munitions debris associated with a
733 grenade court were identified. Historically, no MEC or munitions debris have been found at the

734 live grenade court area. However, the ASR reported that a grenade spoon had been found in the
735 vicinity of the practice grenade court during the ASR site visit (USACE, 1995).

736 The grenade court is a natural area that is between Spring River on the west and the Deschutes
737 River on the east. The land is vegetated with tall grass and pine trees. Access to the land is
738 unrestricted and open to the public. The types of MEC that may be present are potentially
739 dangerous because of sensitive fuzes or high explosive content. Potential receptors include
740 forest workers and recreational users. Based on the limited investigation that has been
741 conducted, the overall MEC risk is considered to be moderate.

742 *4.2.4 Burial Pit*

743 Munitions that may have been disposed at the Burial Pit included small arms, anti-tank rockets,
744 mortar rounds, practice and live grenades, explosives, and chemical identification kits. Shaw
745 conducted a visual reconnaissance of the area and could not locate the Burial Pit. No evidence of
746 MEC or munitions debris was found during the SI, and there have been no historical reports of
747 MEC or munitions debris.

748 The Burial Pit was reported as located within a natural area with tall grasses, marsh areas, and
749 pine and alder trees (USACE, 1995). This area is controlled by the local Nature Center. There
750 are no noticeable remnants of the Burial Pit, and Nature Center staff is unaware of its existence.
751 Access to the land is unrestricted and open to the public; however, the public are required to stay
752 on trails. Based on the current use of the area, absence of MEC or munitions debris, uncertainty
753 of the location, and even whether the site was actually used as a munitions burial pit, the overall
754 MEC risk is considered to be low.

755 *4.2.5 Chemical Training Area*

756 Shaw did not conduct any field work at the Chemical Training Area, as the area is located
757 entirely within a housing development and all remnants of the AOC or evidence of prior use by
758 Camp Abbot personnel is gone. No MEC or munitions debris has been reported at this area. The
759 likely munitions used at this AOC included CAIS.

760 Access to the land is unrestricted and open to the public. Based on the current use of this AOC
761 and no occurrence of MEC or munitions debris, the overall MEC risk is considered to be low.

762 *5.0 Munitions Constituents Sampling and Analysis*

763 The results from sampling and analysis for MC are described in this section. Data collected from
764 both this SI and the PA/SI (Weston, 2005) are used in the evaluation of MC impacts to media.
765 As appropriate, results are compared to site-specific background values to determine if there is a
766 release. If a release is confirmed, analytical results are compared to screening values for human
767 health risk assessment and, if appropriate, for ecological risk assessment. Results are considered
768 in terms of groundwater, surface water, terrestrial, and air pathways for each AOC. Tables 5-1
769 and 5-2 provide a summary of samples and analyses completed during the SI and the PA/SI,
770 respectively.

771 *5.1 General Setting*

772 The general setting for Camp Abbot was provided in Section 2.0.

773 Figure 5-1 shows groundwater wells in the vicinity of Camp Abbot in relation to distance from
774 the AOCs. Available well records indicate that water wells are numerous in the community of
775 Three Rivers directly south and mostly upgradient of the site. There are also water wells within
776 the FUDS boundary in developed areas within and near Sunriver. Figure 5-2 shows regional
777 surface water features in the vicinity of Camp Abbot in relation to distance from the AOCs.
778 Figure 5-3 shows the location of sensitive receptors such as schools in the vicinity of Camp
779 Abbot in relation to distance from the AOCs.

780 *5.2 Screening Values*

781 The following subsections present details regarding the development of screening values for this
782 SI. Project specific screening values are presented on Tables 5-3 through 5-11.

783 *5.2.1 Determination of Background Concentrations*

784 Ten background soil samples were collected from the Camp Abbot area and analyzed for metals.
785 Background sample locations are shown on Figure 5-4. The selection of the soil background
786 locations was aided by Visual Sampling Plan (VSP) (PNNL, 2005). VSP is a computer software
787 program that allows for an independent sampling location selection across a designated area.
788 The area provided to the VSP software was all areas within the FUDS boundary not included in a
789 known AOC. After VSP identified potential sampling locations, the locations were adjusted by
790 hand to place the background sample location on a property for which the USACE has a signed
791 ROE. Background surface water and sediment sampling locations were collected from a location
792 at the upstream Camp Abbot FUDS boundary. The background groundwater sampling location
793 was from an existing well interpreted to be upgradient or cross gradient of the FUDS where no
794 Camp Abbot activities were conducted. Note that groundwater flow is assumed to be towards
795 the Deschutes River. The well log for the background well is provided in Appendix L.

796 The background soil sample analytical results were used to calculate background metal soil
797 concentrations using published EPA Guidance (1989, 1992, 1994, 1995, and 2006). The
798 background concentrations are either a 95th upper tolerance limit (UTL) for normally and
799 lognormally distributed analytes or the 95th percentile for nonparametric distributed analytes.
800 The background soil sample analytical results are provided in Appendix G. Table 5-A lists the
801 soil, groundwater, surface water, and sediment background concentrations used in this report. A
802 summary of the soil background calculations is presented in Appendix L.

803 One sediment, one surface water, and one groundwater background samples were collected from
804 the Camp Abbot vicinity (Figure 5-4). The analytical results are presented in Appendix G.

805 The method for comparing sediment and groundwater results to background was not defined in
806 the TPP process. For purposes of comparison in this SI, the background concentrations for
807 sediments and groundwater are taken to be the background sample value. The approach for
808 determining if a release has occurred is consistent with the EPA's Hazard Ranking System (40
809 CFR Part 300: Appendix A): "The minimum standard to establish an observed release by
810 chemical analysis is analytical evidence of a hazardous substance in the media significantly
811 above the background level." Table 2-3, "Observed Release Criteria for Chemical Analysis" in
812 the above referenced regulation has the following criteria:

- 813 1. If the sample measurement is less than or equal to the sample quantitation limit, no
814 observed release is established.
- 815 2. If the sample measurement is greater than or equal to the sample quantitation limit,
816 then an observed release is established as follows:
 - 817 • If the background concentration is not detected (or is less than the detection limit),
818 an observed release is established when the sample measurement equals or exceeds
819 the sample quantitation limit.
 - 820 • If the background concentration equals or exceeds the detection limit, an observed
821 release is established when the sample measurement is three times or more above
822 the background concentration.

823 In the discussions below, these criteria are used to determine whether a release of MC has
824 occurred in sediment and groundwater, regardless of whether the analyte is considered a
825 hazardous substance. However, these criteria are not applied for soils because a statistically
826 based determination of background has been established, and an exceedance of the 95th UTL or
827 95th percentile, depending on the individual analyte, is used to establish a release of MC.

828 *5.2.2 Human Health*

829 Human health screening values for groundwater, surface water, sediment, and soil analytical
830 results were established using the following reference sources:

- 831 • EPA Region 9 Preliminary Remediation Goals for Tap Water, Residential Soil.
- 832 • Federal Drinking Water Criteria Maximum Contaminant Levels (groundwater and
833 surface water).

834 In cases where screening values were listed from both sources, the lower value is used for
835 screening, except where the screening value is a Secondary Maximum Contaminant Level.
836 Secondary Maximum Contaminant Levels are based on aesthetic criteria (taste, odor, color) and
837 not on health based criteria and are not enforceable.

838 Analytical detection limits for explosive compounds analyzed for in the PA/SI were higher than
839 the detection limits used in this site inspection. However, all PA/SI detection limits were below
840 the human health screening values.

841 **5.2.3 Ecological Screening**

842 According to the *Screening-Level Ecological Risk Assessment (SLERA) Guidance for FUDS*
843 *MMRP Site Inspections* (USACE, 2006), only sites that are considered to be IEP or are to be
844 managed for ecological purposes, require a SLERA. As shown in Table 2-2, the site does meet
845 some of the 33 criteria for designation as an IEP. Shaw developed a SLERA (Appendix L) using
846 ecological screening values obtained from ODEQ (2001) and other appropriate sources as
847 described in the *TPP Memorandum* included as Appendix B in this SI Report.

848 Some analytical detection limits (0.2 milligrams per kilogram [mg/kg]) for explosive compounds
849 in the PA/SI sediment samples were above the ecological screening values. The screening
850 values exceeded were for RDX (0.13 mg/kg), HMX (0.047 mg/kg), 1,3,5-TNB (0.024 mg/kg),
851 and 1,3-DNB (0.067 mg/kg).

852 **5.3 Range Complex No. 1**

853 **5.3.1 General History and Field Findings**

854 The ranges within Range Complex No. 1 were used by the Army between 1943 and 1944.
855 Weapons used at these ranges were limited to general small arms. At some ranges, firing would
856 have taken place from fixed positions or within a restricted area up to a fixed limit of advance.
857 Small arms fire may have been directed toward targets in front of man-made backstop berms.

858 At the Anti-Aircraft Range and the Field Target and Sub-Machine Gun Range, small arms fire
859 would tend to be dispersed over a wider area as a result of the variety of target positions and/or
860 firing positions.

861 General small arms (up to .50-caliber) may have been used at these ranges. However, although
862 ERTCs were issued the .50-caliber machine gun, the use of this weapon was limited due to a
863 limited supply of ammunition, and much machine gun training used the .30-caliber weapon (Coll
864 et al., 1958, p. 264). Based on the potential use of .50-caliber ammunition, tracer rounds
865 containing perchlorate may have been used. Additionally, Range Complex No. 1 may have been
866 potentially used for field maneuvers using explosive rounds although no evidence of this has
867 been found.

868 The current land use is primarily open field east of the river and forested areas west of the river.
869 However, there are residences along the southeastern boundary of Range Complex No. 1. Range

870 Complex No.1 contains ecologically sensitive areas, including wetland areas and the Deschutes
871 River. Range Complex No.1 also contains culturally sensitive areas that were avoided during
872 sampling.

873 *5.3.2 Sampling and Analysis*

874 Sample details are provided in Tables 5-1 and 5-2, and analytical detections are listed in Tables
875 5-3, 5-4, and 5-5. Field records are provided in Appendix D and representative photographs of
876 sampling activities are included as Appendix E. Figure 5-5 shows the SI and PA/SI sampling
877 locations and indicates if an exceedance of background concentrations and human health and/or
878 ecological screening values has occurred. Complete analytical data are presented in Appendix F
879 and the Analytical Data QA/QC Report is included as Appendix G.

880 *5.3.3 Groundwater Pathway*

881 One groundwater sample was collected from Range Complex No. 1. Results were compared to
882 the results from the background groundwater sample. The background groundwater sample
883 results are provided on Table 5-A and in Appendix G. The location of the groundwater sample is
884 shown on Figure 5-5. During the TPP process groundwater sampling was proposed from a well
885 located within the Anti-Tank Range. The well was part of the Sunriver Water LLC which
886 supplies water to the Sunriver community. The USACE was unable to obtain an ROE to sample
887 this well. During the finalization of the SSWP (Shaw, 2006c), Shaw was unable to locate any
888 wells that would sample the groundwater in this area. An alternate well was selected within
889 Range Complex No. 1 that samples groundwater from the Anti-Aircraft, Transition, and Field
890 Target and Sub-Machine Gun Subranges within Range Complex No. 1. Groundwater flow
891 direction is assumed to be towards the Deschutes River valley.

892 The sample was collected using the pump installed in the well. The well is a domestic water
893 source for the homeowner. The well log shows that the well depth is 56 ft and the static water
894 level at time of installation was 30 ft bgs (Appendix L). Neither the well depth nor the water
895 level could be measured at the time of sampling because of the installed sanitary well seal. The
896 sample was collected from a hose bib at the house. Samples were analyzed for metals,
897 explosives, and perchlorate. This analyte list was selected based on use of Range Complex No. 1
898 for small arms firing, including the use of potential perchlorate-containing tracer rounds, and the
899 potential use of Range Complex No. 1 for field maneuvers using explosive rounds. Analytical
900 result detections, background concentrations, and human health screening values are shown on
901 Table 5-3. The potential receptor is the homeowner.

902 *5.3.3.1 Comparison to Background Data*

903 Lead, magnesium, and molybdenum were detected at concentrations above the background
904 values. Lead was not detected in the background sample, but it was detected in the well sample
905 at an estimated concentration of 0.44 micrograms per liter ($\mu\text{g/L}$), which is between the method
906 detection limit (MDL) ($0.18 \mu\text{g/L}$) and the practical quantitation limit (PQL) ($2 \mu\text{g/L}$). The

907 magnesium detection (3,140 µg/L) was 1.5 times the background value (2,100 µg/L) and is not
908 considered a significant exceedance (greater than 3 times background). Molybdenum was not
909 detected in the background sample, but it was detected in the well sample at an estimated
910 concentration of 0.72 µg/L, which is between the MDL (0.12 µg/L) and the PQL (5 µg/L).
911 Explosive compounds and perchlorate were not detected in the groundwater sample.

912 The magnesium detection was 1.5 times the background value and is not considered a significant
913 (greater than three time background) exceedance. Because lead and molybdenum were not
914 detected in the background sample but were in the source area sample the detections are
915 considered significant.

916 *5.3.3.2 Comparison to Human Health Screening Values*

917 The groundwater sample analytical result was compared to the human health screening values if
918 the concentrations significantly exceeded (greater than three times background) the background
919 concentration. Lead and molybdenum concentrations were below the human health screening
920 values.

921 *5.3.4 Surface Water/Sediment Pathway*

922 No surface water samples were collected at Range Complex No. 1. The surface water conditions
923 for Camp Abbot are evaluated by a sample collected downstream from the Mortar Range and the
924 results are discussed under the explosives munitions ranges. In accordance with the SSWP, two
925 sediment samples were collected at Range Complex No. 1 (samples NWO-013-1001 and NWO-
926 013-1002). The samples were collected from the bottom of intermittent stream drainages. The
927 locations are shown on Figure 5-5. Sediment sample NWO-013-1001 was analyzed for lead
928 only. Sediment sample NWO-013-1002 was analyzed for select metals and explosives,
929 including nitroglycerin and PETN. This sample was originally scheduled for analysis for lead
930 only; however, during visual reconnaissance, an explosion crater was identified upslope from
931 this sample location, and it was decided that the additional analyses were warranted to evaluate
932 site conditions. The sediment samples were collected as dry samples. The analytical results,
933 background concentrations, and human health and ecological screening values are shown on
934 Table 5-4.

935 The select metals list was developed from metals related to either munitions firing (e.g., mercury
936 in fuzes, magnesium in incendiary devices, barium in explosives) or components of bullets,
937 projectiles, or metal casings (i.e., chromium, copper, iron, lead, magnesium, molybdenum,
938 nickel, and zinc). In addition, the metals aluminum and cadmium were also included as they
939 may be used in evaluation of site soil concentrations to background.

940 Three sediment samples collected during the PA/SI (Weston, 2005) within Range Complex No.
941 1 are also included in the evaluation and are discussed below. Note that the samples collected
942 during the PA/SI were analyzed for the 21 metal target analyte list (TAL). Analytical detections,

943 background soil concentrations, and human health and ecological screening values are shown on
944 Table 5-4.

945 Potential receptors are forest workers, recreational users, and wildlife. For the screening risk
946 assessment, it was conservatively assumed that exposures to sediments would be similar to those
947 of soil.

948 *5.3.4.1 Comparison to Background*

949 Sediment sample results were compared to the detected concentration from the single
950 background sediment sample. The background sediment sample results are provided in
951 Appendix G. In sample NWO-103-1001 lead was detected at a concentration equal to the single
952 sample background concentration of 3.7 mg/kg. The following samples had background
953 concentration exceedances.

- 954 • In sample NWO-013-1002 background concentrations were exceeded for barium (162
955 mg/kg vs. 111 mg/kg), iron (20,300 mg/kg vs. 14,100), lead (3.9 mg/kg vs. 3.7
956 mg/kg), magnesium (2,680 mg/kg vs. 1,850 mg/kg), manganese (463 mg/kg vs. 175
957 mg/kg), mercury (0.016 mg/kg vs. not detected at 0.0082 mg/kg), molybdenum (0.44
958 mg/kg vs. not detected at 0.28 mg/kg), and zinc (36.8 mg/kg vs. 29.3).

959 All exceedances were less than three times the background concentration and thus do not
960 represent a release.

961 Three sediment samples were collected from Range Complex No. 1 during the PA/SI. The
962 following summarizes the detections that were above background.

- 963 • In sample SD-MR001 from the Machine Gun Range in Range Complex No. 1
964 background concentrations were exceeded for iron (17,900 mg/kg vs. 14,100 mg/kg),
965 lead (352 mg/kg vs. 3.7 mg/kg), magnesium (2,900 mg/kg vs. 1,850 mg/kg),
966 manganese (213 mg/kg vs. 175 mg/kg), and mercury (0.07 mg/kg vs. not detected).
- 967 • In sample SD-RR001 from the Rifle Range in Range Complex No. 1 background
968 concentrations were exceeded for copper (27.4 mg/kg vs. 25.8 mg/kg), iron (18,100
969 mg/kg vs. 14,100 mg/kg), magnesium (6,900 mg/kg vs. 1,850 mg/kg), manganese
970 (197 mg/kg vs. 175 mg/kg), mercury (non-detect at 0.21 mg/kg vs. non-detect at
971 0.0082 mg/kg), and zinc (52.2 mg/kg vs. 29.3 mg/kg).
- 972 • In sample SD-RR02 from the Transition Range in Range Complex No. 1 background
973 concentrations were exceeded for magnesium (1,890 mg/kg vs. 1,850 mg/kg), mercury
974 (non-detect at 0.14 mg/kg vs. non-detect at 0.0082 mg/kg), and zinc (36.5 mg/kg vs.
975 29.3 mg/kg).

976 The lead result (352 mg/kg) for PA/SI sample SD-MR001 exceeded the lead background
977 concentration of 3.7 mg/kg by nearly a factor of 100. This is considered a significant
978 exceedance. Magnesium exceeded the site background concentration by a factor of 3.6.
979 Mercury in PA/SI samples was not detected; however, the detections limits for two samples were
980 greater than three times the background concentration. This is considered a significant

981 exceedance. All other exceedances were less than three times the background value and are not
982 considered significant.

983 The detected lead concentration in PA/SI sample SD-MR001 was 352 mg/kg (Weston, 2005).
984 The PA/SI evaluated this detection and concluded “The reported lead concentration at the
985 machine gun range PPE (editor’s note: probable point of entry) (352 mg/kg) is not in line with
986 concentrations reported from localized source area samples (maximum value reported: 24
987 mg/kg). As a result, the lead concentration at the PPE is considered to be an outlier, which is not
988 associated with the machine gun range and therefore not attributable to the FUDS.”

989 *5.3.4.2 Comparison to Human Health Screening Values*

990 The analytical results were compared to the human health screening values if they exceeded
991 background concentrations. All detected concentrations that were greater than three times the
992 background values (lead at 352 mg/kg) were below the human health screening value of 400
993 mg/kg. Magnesium also significantly exceeded the background concentration. However, there
994 is no human health screening value for magnesium. Non-detect results (detection limit) for
995 mercury from the PA/SI that were greater than three times the respective background value were
996 below the human health screening value of 23 mg/kg. No human health impacts were noted in
997 sediments at Range Complex No. 1.

998 *5.3.4.3 Comparison to Ecological Screening Values*

999 The analytical results were compared to the ecological screening value if they significantly
1000 exceeded the site background concentration (three times the background value). Lead,
1001 magnesium, and mercury significantly exceeded the background concentration. However,
1002 magnesium does not have an ecological screening value. Based on the ecological screening
1003 values lead (352 mg/kg in sample SD-MR001) significantly exceeded the background
1004 concentration (3.7 mg/kg) and ecological screening value (35 mg/kg) and adverse ecological
1005 impacts may occur. As discussed above, the PA/SI (Weston, 2005) concluded that the elevated
1006 lead result in the sediment sample from the machine gun range is likely an outlier and not
1007 attributable to the Camp Abbot FUDS, as the concentration is well above source area soil sample
1008 concentrations.

1009 One non-detect result (detection limit) for mercury from the PA/SI (SD-RR001, 0.21 mg/kg)
1010 greater than three times the background value was equal to the ecological screening value (0.2
1011 mg/kg). Therefore, only lead is considered as exceeding the ecological screening criteria.

1012 *5.3.5 Terrestrial Pathway*

1013 The potential routes of human exposure to the surface soil include incidental ingestion, dermal
1014 contact, or inhalation of soil particulates during intrusive work. Current exposure scenarios
1015 would primarily involve forest workers, residents, and recreational users. Workers and residents
1016 would be potentially exposed to surface and subsurface soil during intrusive activities such as

1017 digging. Future land use is expected to remain as discussed in Section 5.3.1 above. Therefore,
1018 potential future exposures to soil would be similar to current exposures.

1019 Soil sampling at Range Complex No. 1 was completed as planned in accordance with the SSWP
1020 with the collection of four surface soil samples (plus one field duplicate) from Range Complex
1021 No. 1. All samples were composite samples, collected at or near the locations and coordinates
1022 specified in the Final SSWP. All samples were analyzed for lead only, except sample NWO-
1023 013-0005, which was analyzed for select metals and explosives, including nitroglycerin and
1024 PETN. This sample was originally scheduled for analysis for lead only; however, during visual
1025 reconnaissance, a detonation crater was identified. It was decided that the additional analyses
1026 were warranted to evaluate site conditions.

1027 The select metals list was developed from metals related to either munitions firing (i.e., mercury
1028 in fuzes, magnesium in incendiary devices, barium in explosives) or components of bullets,
1029 projectiles, or metal casings (i.e., chromium, cobalt, copper, iron, lead, manganese, molybdenum,
1030 nickel, and zinc). In addition, the metals aluminum and cadmium were also included as they
1031 may be used in evaluation of site soil concentrations to background.

1032 Each composite surface soil sample was collected from between 0 to 6 inches in depth and
1033 consisted of seven surface samples collected in a wheel pattern (2-ft diameter). Samples were
1034 sieved by the laboratory prior to analysis for lead.

1035 Nine soil samples collected during the PA/SI (Weston, 2005) are also included in the evaluation
1036 and are discussed below. Note that the samples collected during the PA/SI were analyzed for the
1037 TAL metals. Analytical detections, background soil concentrations, and human health and
1038 ecological screening values are shown on Table 5-5.

1039 *5.3.5.1 Comparison to Background Data*

1040 Analytical results were compared to the background concentrations. Lead results in all four SI
1041 soil samples (NWO-13-0001, 4.3 mg/kg; NWO-013-0003, 4.6 mg/kg; NWO-013-0004, 4.6
1042 mg/kg; and NWO-013-0005, 7.7 mg/kg) plus the field duplicate (NWO-013-0002, 4.3 mg/kg)
1043 exceeded the background concentration for lead (4.2 mg/kg).

1044 Sample NWO-013-0005, collected from a detonation crater was analyzed for a larger list of
1045 metals and explosives. All metals results from sample NWO-013-0005 were less than the Camp
1046 Abbot background concentrations except, as noted above, lead exceeded the background
1047 concentration. There were no detections of explosive compounds.

1048 Nine soil samples were collected from Range Complex No. 1 during the PA/SI. Seven of the
1049 nine samples had exceedances of site background concentrations as follows:

- 1050 • In sample SS-RR001 background concentrations were exceeded for copper (26.8 vs.
1051 23.7), mercury (0.07 mg/kg vs. 0.022 mg/kg), and zinc (54.9 mg/kg vs. 43.5 mg/kg);

- 1052 • In samples SS-RR002, SS-RR004 and SS-005 the background concentration for mercury
1053 (0.022 mg/kg) was exceeded at concentrations of 0.1 mg/kg, 0.07 mg/kg, and 0.11
1054 mg/kg);
- 1055 • In sample SS-RR006 background concentrations were exceeded for copper (24 mg/kg vs.
1056 23.7 mg/kg), mercury (0.1 mg/kg vs. 0.022 mg/kg), and zinc (45.8 mg/kg vs. 43.5
1057 mg/kg);
- 1058 • In sample SS-MR001 background concentrations were exceeded for lead (4.8 mg/kg vs.
1059 4.2 mg/kg) and mercury (0.96 mg/kg vs. 0.022 mg/kg);
- 1060 • In sample SS-MR002 background concentrations were exceeded for lead (6.3 mg/kg vs.
1061 4.2 mg/kg), mercury (0.06 mg/kg vs. 0.022 mg/kg), and zinc (72.8 mg/kg vs. 43.5
1062 mg/kg); and
- 1063 • In sample SS-MR003 background concentrations were exceeded for copper (27.2 mg/kg
1064 vs. 23.7 mg/kg), lead (24 mg/kg vs. 4.2 mg/kg), and zinc (65.7 mg/kg vs. 43.5 mg/kg).

1065 All background exceedances were near their background concentration (Table 5-5). Exceptions
1066 to this are for lead in PA/SI sample SS-MR003 and mercury in sample SS-MR0001. Sample SS-
1067 MR003 was collected from the near the firing point of the Machine Gun Range; the lead
1068 concentration was 24 mg/kg, exceeding the background concentration of 4.2 mg/kg. Mercury
1069 was detected in PA/SI sample SS-MR001 at a concentration of 0.96 mg/kg.

1070 Mercury was not detected in two PA/SI samples. The detection limit for mercury in the PA/SI
1071 samples SS-RR003 and SS-MR003 were 0.15 mg/kg and 0.13 mg/kg, which are above the
1072 background concentration of 0.022 mg/kg. Mercury in these two samples is considered to be
1073 above the background concentrations.

1074 Metals that exceeded background values were copper, lead, mercury, and zinc.

1075 *5.3.5.2 Comparison to Human Health Screening Values*

1076 The analytical results from Range Complex No. 1 were compared to the human health screening
1077 values for soil if they exceeded the background concentration. All background exceedances
1078 were well below the human health screening criteria.

1079 *5.3.5.3 Comparison to Ecological Screening Values*

1080 Analytical results were compared to the ecological screening values if they also exceeded
1081 background concentrations. Lead in one sample from the Machine Gun Range exceeded the
1082 background concentration (4.2 mg/kg) and the ecological screening value of 16 mg/kg. Mercury
1083 in samples SS-RR005 and SS-MR001 exceeded the background concentration of 0.022 mg/kg
1084 and the ecological screening value of 0.1 mg/kg. The zinc concentration in PA/SI samples SS-
1085 RR001, SS-MR002, and SS-MR003 exceeded the background (43.5 mg/kg) and ecological
1086 screening value (50 mg/kg). These concentrations for lead, mercury, and zinc indicate that
1087 adverse ecological impacts may occur. In addition, the presence of lead bullets in soil indicates
1088 potential terrestrial bird toxicity as certain bird species intentionally ingest grit to aid their
1089 digestion.

1090 The detection limit in PA/SI samples SS-RR003 (0.15 mg/kg) and SS-MR003 (0.13 mg/kg) were
1091 also above the ecological screening level (0.1 mg/kg) for mercury.

1092 *5.3.6 Air Pathway*

1093 By agreement at the TPP meeting, air is not considered to be a significant pathway as inhalation
1094 of MC in vapor form is not a pathway of concern for non-volatile MC under normal
1095 environmental conditions. The potential inhalation of soil particles is included in the
1096 development of health-based screening values for soil.

1097 *5.4 Explosive Munitions Ranges (Anti-Tank Range, Demolition Area, Mortar* 1098 *Range)*

1099 *5.4.1 General History and Field Findings*

1100 The Explosive Munitions Ranges were used by the Army between 1943 and 1944. However, the
1101 period of use for the Demolition Area may have been more limited. Three-week team training
1102 exercises were not begun at Camp Abbot until December 1943 (Coll et al., 1958, pp. 265-266).
1103 A Camp Abbot newspaper article dated 12 February 1944 refers to a “new assault and
1104 demolitions course.” The article states that the new course “incorporates many problems of
1105 actual warfare, including barbed wire entanglements and machine gun fire.” Steps in the course
1106 included:

- 1107 • Use of a tank, directing simulated fire (using set charges to give the appearance of shells
1108 fired from the tank’s guns) at enemy machine gun nests and pill boxes,
- 1109 • A demolitions squad using Bangalore torpedoes to clear barbed wire entanglements,
- 1110 • A flame-thrower crew “running the distance and taking full advantage of cover and shell
1111 holes, to burn what remains of the ‘enemy’ from its positions,” and
- 1112 • The demolitions squad “setting charges which complete destruction of the fortifications.”

1113 The ASR Supplement provided an estimated boundary of the Mortar Range, based on reported
1114 finds of 60 mm and 81 mm mortars, assuming firing directed to the west from a position east of
1115 the river shown as a “tactical area” on historic maps.

1116 The location of the Demolition Area shown on maps in the ASR Supplement and the location of
1117 the reported pill box reported in the same report and in the ASR do not agree. The reported
1118 location of the pill box is approximately 0.4 miles east southeast of the Demolition Area
1119 location. The pill box, along with demolition craters, was also reported in the PA/SI (Weston,
1120 2005) but was shown as being located approximately 0.2 miles southwest of the Demolition Area
1121 as shown in the ASR Supplement. Based on this, the location of the Demolition Area shown in
1122 the ASR Supplement is suspect and the demolition area is likely located overlapping the
1123 northwest corner of the Mortar Range.

1124 The current land use is open field and residences east of the river and forested areas west of the
1125 river. The Anti-Tank Range and Mortar Range contain ecologically sensitive areas, including

1126 wetland areas and the Deschutes River. The Anti-Tank Range and Mortar Range also contain
1127 culturally sensitive areas that were avoided during sampling.

1128 *5.4.2 Sampling and Analysis*

1129 Sample details are provided in Tables 5-1 and 5-2, and analytical detections are listed in Tables
1130 5-6, 5-7, 5-8, and 5-9. Field records are provided in Appendix D and representative photographs
1131 of sampling activities are included as Appendix E. Figures 5-6 and 5-7 show the SI and PA/SI
1132 sampling locations and indicate if an exceedance of background concentrations and human
1133 health and/or ecological screening values has occurred. Complete analytical data are presented
1134 in Appendix F and the Analytical Data QA/QC Report is included as Appendix G.

1135 *5.4.3 Groundwater Pathway*

1136 No groundwater samples were proposed or collected within the Explosive Munitions Ranges. A
1137 sample from a spring was scheduled to be collected from the Mortar Range to assess
1138 groundwater conditions at the point of discharge. However, the spring was dry at the time of
1139 field work in September 2006.

1140 *5.4.4 Surface Water/Sediment Pathway*

1141 Two surface water samples were scheduled to be collected from the Explosive Munitions
1142 Ranges. One surface water sample (NWO-013-2001) was to be collected from the same location
1143 as a sediment sample (SD-DP001) collected during the PA/SI (Weston, 2005). The sample was
1144 to be analyzed for total and dissolved metals. However, at the time of sampling there was no
1145 water at the site; therefore, the sample was not collected.

1146 One surface water sample (NWO-013-2003) was collected from a point along the Deschutes
1147 River downstream of the Mortar Range. The objective of this sample was to evaluate the
1148 impacts of the Mortar Range and other upstream AOCs on the overall water quality of the
1149 Deschutes River. The sample was analyzed for total and dissolved metals, explosives, and
1150 perchlorate.

1151 A sediment sample (NWO-013-1003 and field duplicate NWO-013-1005) was collected from the
1152 same location as the surface water sample (NWO-013-2003). The sample was analyzed for
1153 metals and explosives, including nitroglycerin and PETN. No sediment sample was planned or
1154 collected from the Anti-Tank Range.

1155 One PA/SI sediment sample was collected from a location downslope from the Demolition Area
1156 and within the Mortar Range. The sample was analyzed for TAL metals and nitrogen-based
1157 explosive compounds.

1158 Analytical results, background concentrations, and human health and ecological screening values
1159 are shown on Tables 5-6, 5-7, and 5-8. Potential receptors are recreational users and wildlife.
1160 The city of Bend, located approximately 15 miles downstream, obtains its drinking water supply

1161 from the Deschutes River. For the screening risk assessment, it was conservatively assumed that
1162 exposures to sediments would be similar to those of soil.

1163 *5.4.4.1 Comparison to Background*

1164 Both filtered (dissolved) and unfiltered (total) metals were analyzed in the surface water samples.
1165 Each was compared to respective background sample concentrations collected at a location
1166 upstream of Camp Abbot. For the dissolved sample (NWO-013-2003) the single sample
1167 background concentrations were exceeded for iron (95.5 µg/L vs. 71.9 µg/L), magnesium (2,180
1168 µg/L vs. 2,020 µg/L, and manganese (7.3 µg/L vs. 4.3 µg/L). All were less than a factor of 2
1169 above the background concentrations.

1170 The total metal sample (NWO-013-2003) detections exceeded the single sample background
1171 concentrations for iron (56.7 µg/L vs. not detected at 5.5 µg/L), manganese (6.5 µg/L vs. 1.1
1172 µg/L), molybdenum (0.5 µg/L vs. 0.47 µg/L), and nickel (0.38 µg/L vs. 0.37 µg/L). Iron and
1173 manganese significantly exceeded (greater than three times background) their respective
1174 background concentrations, although at relatively low levels. Iron was not detected in the
1175 unfiltered background sample, but was detected in the filtered background sample at a
1176 concentration of 71.9 µg/L, which is above the concentration detected in the unfiltered sample
1177 NWO-013-2003. Similarly, manganese was detected at a higher concentration in the filtered
1178 background sample than in the unfiltered one. This is likely a result of normal variability in
1179 surface water concentrations for pristine streams. The other background exceedances were very
1180 near the unfiltered background concentrations.

1181 The SI sediment sample collected from the Deschutes River (sample NWO-013-1003 and field
1182 duplicate sample NWO-013-1005) exceeded the single sample background concentration for
1183 iron, magnesium, and zinc. The detected concentration for sample NWO-013-1003 and
1184 respective background concentrations were: iron (16,500 mg/kg vs. 14,100 mg/kg), magnesium
1185 (2,860 mg/kg vs. 1,850 mg/kg), and zinc (39.8 mg/kg vs. 29.3 mg/kg). These results exceeded
1186 the background concentration by a factor of less than 1.5. The lead concentration in sample
1187 NWO-013-1003 (Figure 5-7) was equal to the background concentration.

1188 The mercury concentration in the sediment sample collected during the PA/SI (sample SD-
1189 DP001) significantly exceeded the background concentration (0.11 mg/kg vs. not detected at
1190 0.0082 mg/kg).

1191 Based on the above discussion, iron and manganese in the surface water sample and mercury in
1192 sediment represent a potential release. However, only one sample is used for comparison.

1193 No explosives were detected in either the SI surface water or sediment sample or the PA/SI
1194 sediment sample.

1195 *5.4.4.2 Comparison to Human Health Screening Values*

1196 The analytical results were compared to the human health screening values if their
1197 concentrations significantly exceeded background. All results were below the human health
1198 screening value.

1199 *5.4.4.3 Comparison to Ecological Screening Values*

1200 There were no exceedances of ecological screening values for surface water.

1201 For sediment the analytical results were compared to the ecological screening values if analytical
1202 results significantly (greater than three times) exceeded the background value. Only mercury
1203 meets this criterion. The detected mercury concentration of 0.11 mg/kg is below the ecological
1204 screening value of 0.2 mg/kg. Therefore, no ecological impacts are indicated.

1205 *5.4.5 Terrestrial Pathway*

1206 The potential routes of human exposure to the surface soil include incidental ingestion, dermal
1207 contact, or inhalation of soil particulates during intrusive work. Current exposure scenarios
1208 would primarily involve forest workers, residents, and recreational users. Workers and residents
1209 would be potentially exposed to surface and subsurface soil during intrusive activities such as
1210 digging. Future land use is expected to remain as discussed in Section 5.4.1 above. Therefore,
1211 potential future exposures to soil would be similar to current exposures.

1212 Soil sampling for the SI at the Explosive Munitions Ranges was completed as planned in
1213 accordance with the SSWP with the collection of four surface soil samples. One sample (NWO-
1214 013-0006) was collected east of the Deschutes River in the Anti-Tank Range, two samples
1215 (NWO-013-008 and NWO-013-0009) were collected from the Mortar Range, and one sample
1216 (NWO-013-0007) was collected from the Demolition Area. All samples were composite
1217 samples, collected at or near the locations and coordinates specified in the Final SSWP. All
1218 samples were analyzed for metals and explosives, including nitroglycerin and PETN, except
1219 sample NWO-013-0007 collected from the Demolition Area, which was analyzed only for
1220 nitroglycerin and PETN. Each composite surface soil sample was collected from between 0 to 6
1221 inches in depth and consisted of seven surface samples collected in a wheel pattern (2-ft
1222 diameter). Metals and nitrogen-based explosives were previously analyzed in a PA/SI sample
1223 from this location. Each composite surface soil sample was collected from between 0 to 6 inches
1224 in depth and consisted of seven surface samples collected in a wheel pattern (2-ft diameter).

1225 Three soil samples were collected at the Demolition Area during the PA/SI. Samples were
1226 analyzed for metals and nitrogen-based explosives. The PA/SI analyzed for the TAL metals.

1227 Analytical detections, background soil concentrations and human health and ecological screening
1228 values are shown on Table 5-9.

1229 **5.4.5.1 Comparison to Background Data**

1230 Analytical results were compared to background concentrations. The following summarizes
1231 background exceedances for SI and PA/SI sample results.

- 1232 • In sample NWO-013-0006 the background concentration was exceeded for lead (27.8
1233 mg/kg vs. 4.2 mg/kg) and mercury (0.027 mg/kg vs. 0.022 mg/kg);
- 1234 • In sample NWO-013-0008 the background concentration was exceeded for iron
1235 (23,500 mg/kg vs. 21,300 mg/kg);
- 1236 • In sample NWO-013-0009 the background concentration was exceeded for barium
1237 (198 mg/kg vs. 176 mg/kg), chromium (22.3 mg/kg vs. 19.2 mg/kg), iron (28,800
1238 mg/kg vs. 21,300 mg/kg), lead (4.3 mg/kg vs. 4.2 mg/kg), and mercury (0.027 mg/kg
1239 vs. 0.022 mg/kg). In PA/SI sample SS-DP001 the background concentration was
1240 exceeded for barium (191 mg/kg vs. 176 mg/kg), and iron (23,400 mg/kg vs. 21,300
1241 mg/kg);
- 1242 • In sample SS-DP003 the background concentration was exceeded for barium (262
1243 mg/kg vs. 176 mg/kg), cobalt (13.9 mg/kg vs. 13 mg/kg), and zinc (48.1 mg/kg vs.
1244 43.5 mg/kg).

1245 Metals exceeding background concentrations were barium, chromium, iron, lead, mercury, and
1246 zinc. There were no explosives detections in any sample.

1247 **5.4.5.2 Comparison to Human Health Screening Values**

1248 The analytical results from the Explosive Munitions Ranges were compared to the human health
1249 screening values for soil if they exceeded the background concentration. Only iron in SI samples
1250 NWO-013-0008 and NWO-013-0009 and in PA/SI sample SS-DP001 exceeded both the
1251 background soil concentration and the human health screening value.

1252 **5.4.5.3 Comparison to Ecological Screening Values**

1253 Analytical results were compared to the ecological screening values if they also exceeded
1254 background concentrations. The following summarizes the analytical results that exceeded both
1255 site background values and the ecological screening values.

- 1256 • In sample NWO-013-0006 lead (27.8 mg/kg) exceeded the ecological screening value
1257 of 16 mg/kg;
- 1258 • In sample NWO-013-0008 iron (23,500 mg/kg) exceeded the ecological screening
1259 value of 200 mg/kg;
- 1260 • In sample NWO-013-0009 the ecological screening values were exceeded for barium
1261 (198 mg/kg vs. 85 mg/kg), chromium (22.3 mg/kg vs. 0.4 mg/kg), and iron (28,800
1262 mg/kg vs. 200 mg/kg);
- 1263 • In PA/SI sample SS-DP001 the ecological screening values were exceeded for barium
1264 (191 mg/kg vs. 85 mg/kg) and iron (23,400 mg/kg vs. 200 mg/kg); and
- 1265 • In PA/SI sample SS-DP003 barium (262 mg/kg) exceeded the ecological screening
1266 value of 85 mg/kg).

1267 A SLERA was completed (Appendix L) that evaluated the exceedances.

1268 Iron and manganese are only a concern for adverse effects on soil microbial processes.
1269 Typically, protection of soil microbes is not selected as an assessment endpoint in ecological risk
1270 assessments; therefore, iron and manganese are not considered to be a concern at the site.

1271 The SLERA concludes that only lead in sample NWO-013-0006, barium and chromium in
1272 sample NWO-013-0009, and barium in PA/SI samples SS-DP001 and SS-DP003 were above
1273 ecological screening values that may result in adverse ecological effects.

1274 *5.4.6 Air Pathway*

1275 By agreement at the TPP meeting, air is not considered to be a significant pathway as inhalation
1276 of MC in vapor form is not a pathway of concern for non-volatile MC under normal
1277 environmental conditions. The potential inhalation of soil particles is included in the
1278 development of health-based screening values for soil.

1279 *5.5 Grenade Courts*

1280 *5.5.1 General History and Field Findings*

1281 The Grenade Courts were used by the Army between 1943 and 1944 and were used for training
1282 in the use of live (explosive) and/or training hand grenades. Grenades were thrown from
1283 individual throwing bays constructed from sandbags or concrete, or from a trench and were
1284 thrown toward targets in an impact area approximately 25 yards from the throwing line. A safety
1285 zone of approximately 600 ft would have been established around the court.

1286 The location of the grenade courts is within a natural area located between the Spring and
1287 Deschutes Rivers. There are no residences within the area. The Grenade Courts AOC contains
1288 ecologically sensitive areas, including wetland areas and the Deschutes River.

1289 *5.5.2 Sampling and Analysis*

1290 The TPP Memo and SSWP identified that one sediment and two soil samples would be collected
1291 from the live grenade court if the visual reconnaissance found evidence of the live grenade court.
1292 No evidence was found (see Section 4.1.3 above) and therefore no samples were collected during
1293 the SI. No groundwater or surface water sampling within the Grenade Court AOC were
1294 proposed in the TPP Memo and SSWP.

1295 One sediment sample and three soil samples were collected from the practice grenade court
1296 during the PA/SI. Sample details are provided in Table 5-2, and analytical detections are listed
1297 in Tables 5-10 and 5-11. Field records are provided in Appendix D and representative
1298 photographs of sampling activities are included as Appendix E. Figure 5-8 shows the PA/SI
1299 sampling locations and indicates if an exceedance of background concentrations and human
1300 health and/or ecological screening values has occurred.

1301 *5.5.3 Groundwater Pathway*

1302 No groundwater samples were proposed or collected within the Grenade Court.

1303 **5.5.4 Surface Water/Sediment Pathway**

1304 No surface water samples were collected during the PA/SI at the Grenade Court.

1305 One sediment sample (SD-GC001) was collected during the PA/SI from the grenade court
1306 probable point of entry to the river. The sample was analyzed for TAL metals and nitrogen-
1307 based explosives.

1308 Detected analytical results, background concentrations, and human health and ecological
1309 screening values are shown on Tables 5-10. Potential receptors are recreational users and
1310 wildlife. The city of Bend, located approximately 15 miles downstream, obtains its drinking
1311 water supply from the Deschutes River. For the screening risk assessment, it was conservatively
1312 assumed that exposures to sediments would be similar to those of soil.

1313 **5.5.4.1 Comparison to Background**

1314 The PA/SI sediment sample (SD-GC001) exceeded the single sample background concentrations
1315 for copper (27.5 mg/kg vs. 25.8 mg/kg), iron (15,500 mg/kg vs. 14,100 mg/kg), magnesium
1316 (1,900 mg/kg vs. 1,850 mg/kg), and nickel (34.4 mg/kg vs. 31.4 mg/kg). These results exceeded
1317 the background concentration by a factor of less than 1.1. Based on these results, a significant
1318 release to the sediment has not occurred.

1319 As indicated in Section 2.5.3, reporting limits used in the PA/SI were generally higher than those
1320 used in this Camp Abbot SI. Evaluation of the PA/SI reporting limits for non-detect metals of
1321 concern indicates that all PA/SI detection limits were below the background concentration for
1322 sediments except mercury. The PA/SI detection limit and SI background concentration for
1323 mercury was 0.19 mg/kg vs. non-detect at 0.0082 mg/kg). This detection limit was above the
1324 respective background concentration at greater than three times the background value, and will
1325 be carried forward in the evaluation of human health and ecological risk.

1326 **5.5.4.2 Comparison to Human Health Screening Values**

1327 No detected sediment analytical results significantly exceeded the single background sample
1328 concentrations. Non-detect result (detection limit) for mercury from the PA/SI was greater than
1329 three times the respective background value but was below the human health screening value of
1330 23 mg/kg. No human health impacts were noted in sediments at the Grenade Courts.

1331 **5.5.4.3 Comparison to Ecological Screening Values**

1332 No detected sediment analytical results significantly exceeded the single background sample
1333 concentrations. Therefore, there are no exceedances of the ecological screening criteria.

1334 Non-detect results (detection limit) for mercury (0.19 mg/kg) were below the ecological
1335 screening value in sediment (0.2 mg/kg). Therefore, no ecological impacts are indicated for the
1336 Grenade Court.

1337 **5.5.5 Terrestrial Pathway**

1338 The potential routes of human exposure to the surface soil include incidental ingestion, dermal
1339 contact, or inhalation of soil particulates during intrusive work. Current exposure scenarios
1340 would primarily involve forest workers and recreational users. Workers would be potentially
1341 exposed to surface and subsurface soil during intrusive activities such as digging. Future land
1342 use is expected to remain as discussed in Section 5.5.1 above. Therefore, potential future
1343 exposures to soil would be similar to current exposures.

1344 No soil sampling was conducted at the Grenade Court during the SI. However, three soil
1345 samples (SS-GC001, SS-GC002, and SS-GC003) were collected during the PA/SI. The samples
1346 were analyzed for TAL metals and nitrogen-based explosives. Analytical detections,
1347 background soil concentrations and human health and ecological screening values are shown on
1348 Table 5-11.

1349 **5.5.5.1 Comparison to Background Data**

1350 Analytical results were compared to background concentrations. For the PA/SI sample results,
1351 no detected concentrations exceeded soil background concentrations.

1352 As indicated in Section 2.5.3, reporting limits used in the PA/SI were generally higher than those
1353 used in this Camp Abbot SI. Evaluation of the PA/SI reporting limits for non-detect metals of
1354 concern indicates that all PA/SI detection limits were below the background concentration for
1355 sediments except mercury. The PA/SI detection limits for the three samples were SS-GC001
1356 (0.11 mg/kg), SS-GC-002 (0.10 mg/kg), and SS-GC-003 (0.11 mg/kg) and SI background
1357 concentration for mercury was 0.022 mg/kg. These detection limits were above the respective
1358 background concentration and will be carried forward in the evaluation of human health and
1359 ecological risk.

1360 **5.5.5.2 Comparison to Human Health Screening Values**

1361 The analytical results from the grenade courts were compared to the human health screening
1362 values for soil if they exceeded the background concentration. The detection limits for the three
1363 PA/SI grenade court samples for mercury, SS-GC001 (0.11 mg/kg), SS-GC-002 (0.10 mg/kg),
1364 and SS-GC-003 (0.11 mg/kg), were below the human health screening value of 23 mg/kg. Based
1365 on that criterion, there were no exceedances of human health screening values.

1366 **5.5.5.3 Comparison to Ecological Screening Values**

1367 Analytical results were compared to the ecological screening values if they also exceeded
1368 background concentrations. The detection limits for the three PA/SI grenade court samples for
1369 mercury, SS-GC001 (0.11 mg/kg), SS-GC-002 (0.10 mg/kg), and SS-GC-003 (0.11 mg/kg),
1370 were equal to the ecological screening value of 0.1 mg/kg. Based on that criterion, there were no
1371 exceedances of ecological screening values.

1372 **5.6 Burial Pit**

1373 **5.6.1 General History and Field Findings**

1374 The Burial Pit was identified in the ASR as occurring east of the Deschutes River and east of the
1375 ordnance area, and described as follows: “The potential pit was horseshoe-shaped area, bermed
1376 and ringed with stone” (USACE, 1995). The ASR Supplement placed the Burial Pit as near the
1377 old landfill and provided location coordinates. An air photo review conducted for the ASR
1378 (USACE, 1995) found evidence that the landfill had expanded eastward between 1951 and 1968,
1379 indicating continued use of the landfill by others following closure of Camp Abbot. An
1380 extensive search of the landfill area was completed during the SI and no evidence of the Burial
1381 Pit was found. Workers at the Nature Center, where the Burial Pit was reported as being located,
1382 could not confirm the existence of the Burial Pit. There have been no reports of MEC or
1383 munitions debris from this pit or in the area. Because the pit could not be located, no MC
1384 samples were collected.

1385 The area of the suspected burial pit is within a grassy area with some timber and is located within
1386 the Sunriver Nature Area. The area of the burial pit AOC contains ecologically sensitive areas
1387 including wetland areas.

1388 **5.6.2 Sampling and Analysis**

1389 The SSWP identified that one sediment, one surface soil, and one subsurface soil samples would
1390 be collected from the Burial Pit if the pit could be located. A visual reconnaissance completed
1391 during the SI did not identify the location of the Burial Pit (see Section 4.1.4 above), and
1392 therefore no samples were collected during the SI.

1393 No samples were collected from the Burial Pit itself during the PA/SI. However, soil samples
1394 were collected from the location of the former landfill. The PA/SI landfill samples were
1395 analyzed for metals, semivolatile organic compounds, and pesticides/polychlorinated biphenyls.
1396 The PA/SI analytical results indicated that there were no detections of semivolatile organic
1397 compounds or pesticides/polychlorinated biphenyls. The PA/SI concluded that there were no
1398 metal detections that were at significant concentrations (greater than three times background).

1399 **5.7 Chemical Training Area**

1400 **5.7.1 General History and Field Findings**

1401 The area was used by the Army between 1943 and 1944. The Inventory Project Report (INPR)
1402 (USACE, 1994) indicated that a gas chamber was located in this area. Soldiers were trained in
1403 the proper use of gas masks. Training likely included exposure to tear gas. There is evidence
1404 that chemical agents other than tear gas were used on a limited basis at Camp Abbot, but not
1405 necessarily at the gas chamber.

1406 A camp newspaper article (USACE, 1995, Appendix G-3) refers to a 34-hour specialist course
1407 taught for 30 officers and noncommissioned officers. The program was intended to train “unit

1408 gas defense personnel...in order to fit them for instructors' posts as well as combat jobs." The
1409 training program included "repair of gas masks, protective measures against all types of chemical
1410 warfare agents, offensive use of gas, first aid measures, knowledge and identity of gasses,
1411 fighting incendiaries, handling violent mobs with gas, and night reconnaissance of gassed areas."
1412 The program consisted of largely practical field work. The article went on to say that the
1413 "program will include actual use of mustard and other vesicant gases." There is no indication
1414 that chemical training of this type was part of the general program for enlisted personnel.

1415 Because of the location of this area, which was adjacent to the cantonment area and in close
1416 proximity to the post hospital, it is unlikely that any conventional weapons or chemical agents
1417 were used here, with the possible exception of CAIS (K941/K942 and K955), which contained
1418 several 4-ounce glass bottles variously containing 50 cubic centimeters of charcoal saturated
1419 with agent gas or small quantities of solid agents, and intended for indoor use. The use of
1420 conventional weapons and chemical agents was likely carried out in another area of Camp Abbot
1421 away from the cantonment area.

1422 The Chemical Training Area AOC has been developed for residential housing. There are no
1423 remnants of the former training area. This AOC does not contain any ecological sensitive areas.

1424 *5.7.2 Sampling*

1425 No sampling was planned at the Chemical Training Area because any chemical agents that may
1426 have been released would be in very small quantities associated with CAIS, and if released the
1427 agents would not be expected to persist in the environment.

1428 **6.0 Summary and Conclusions**

1429 The conclusions of the SI are presented in this section. Recommendations for further action are
 1430 presented in Section 7.0 and Appendix K.

1431 Camp Abbot is included in the MMRP Inventory in the *Defense Environmental Programs*
 1432 *Annual Report to Congress Fiscal Year 2006* (DoD, 2006) and in the *ASR Supplement* (USACE,
 1433 2004b), with seven identified ranges and other AOCs as follows:

Range Name	Range ID	Approximate area (acres)	UTM Coordinates (meters)
Burial Pit	F10OR004102M01	48	N 4860332.50; E 624695.52
Anti-Tank Range	F10OR004102R01	354	N 4859041.99; E 623348.74
Chemical Training Area	F10OR004102R02	27	N 4858969.21; E 625900.23
Demolition Area	F10OR004102R03	96	N 4863508.32; E 623628.20
Grenade Courts	F10OR004102R04	50	N 4858051.24; E 623361.36
Mortar Range	F10OR004102R05	1421	N 4861875.88; E 624050.99
Range Complex No. 1	F10OR004102R06	3527	N 4859541.80; E 621252.77
Rifle Range	F10OR004102R06-SR01	684	N 4859031.66; E 624135.93
Rifle/Machine Gun Range	F10OR004102R06-SR02	754	N 4858527.00; E 621947.53
Landscape Range	F10OR004102R06-SR03	19	N 4859354.99; E 623965.34
Transition Range	F10OR004102R06-SR04	591	N 4858698.24; E 622099.91
Anti-Aircraft Range	F10OR004102R06-SR05	1022	N 4858316.58; E 621364.30
Field Target and Submachine Gun Range	F10OR004102R06-SR05	2766	N 4859936.70; E 620986.42

1434 **6.1 Range Complex No. 1**

1435 No MEC or munitions debris, other than expended bullets and casings were encountered or have
 1436 been reported at Range Complex No. 1. Based on the reported use of this range for small arms
 1437 training only and no evidence of other uses, the MEC risk at Range Complex No. 1 is considered
 1438 to be low.

1439 During the SI and PA/SI (Weston, 2005) field work, 1 groundwater, 5 sediment, and 13 soil
1440 samples were collected from Range Complex No. 1. Analyses completed are summarized on
1441 Tables 5-1 and 5-2. Analytical results were compared to site background concentrations. If the
1442 analytical results exceeded the background concentration, the results were then compared to EPA
1443 Region 9 PRGs for human health risk screening and ecological risk screening values developed
1444 during the TPP process. The exceedances and subsequent evaluation are summarized below.

1445 *6.1.1 Groundwater Pathway*

1446 There were no significant exceedances of Camp Abbot groundwater background concentrations
1447 and human health risk screening values for metals. There were no detections of explosive
1448 compounds. There does not appear to be an impact to groundwater at Range Complex No. 1.

1449 *6.1.2 Surface Water/Sediment Pathway*

1450 No surface water samples were collected during the SI field work. There were no analytical
1451 results that significantly exceeded background concentrations and also exceeded human health
1452 screening values. Analytical results from the sediment samples indicate lead in one PA/SI
1453 sediment sample significantly exceeded the Camp Abbot sediment background concentration and
1454 also the ecological screening values.

1455 However, the PA/SI report (Weston, 2005) discounts one very high lead result in sample SD-
1456 MR001 was 352 mg/kg. The PA/SI evaluated this detection and concluded “The reported lead
1457 concentration at the machine gun range PPE (editor’s note: probable point of entry) (352 mg/kg)
1458 is not in line with concentrations reported from localized source area samples (maximum value
1459 reported: 24 mg/kg). As a result, the lead concentration at the PPE is considered to be an outlier
1460 which is not associated with the machine gun range and therefore not attributable to the FUDS.”

1461 *6.1.3 Terrestrial Pathway*

1462 All analytical results were below the human health screening value. Analytical results from soil
1463 samples collected during the SI and PA/SI (Weston, 2005) indicate that lead, mercury, and zinc
1464 concentrations exceeded both the respective Camp Abbot background concentrations and the
1465 ecological screening values. This result indicates that adverse ecological impacts may occur. In
1466 addition, the presence of lead bullets in soil indicates potential terrestrial bird toxicity from
1467 ingestion of grit for digestive purposes.

1468 *6.2 Explosive Munitions Ranges*

1469 No MEC or munitions debris was located during SI field work. Historically MEC and munitions
1470 debris have been found associated with the Anti-Tank Range and Mortar Range (60 mm and 81
1471 mm mortar rounds). No MEC or munitions debris were reported during the PA/SI (Weston,
1472 2005) at the Demolition Area. However MEC is considered potentially present because of the
1473 adjacent and overlapping Mortar Range. Note that the sampling locations from the Demolition
1474 Area discussed in this SI report are just outside the AOC boundary shown in the ASR

1475 Supplement. Based on the current use of the Explosive Munitions Ranges and the historical
1476 occurrence of MEC and munitions debris, the overall MEC risk is considered to be moderate.

1477 During the SI and PA/SI (Weston, 2005) field work, one surface water, two sediment, and seven
1478 soil samples were collected from the Explosive Munitions Ranges. No groundwater samples
1479 were collected. Analyses completed are summarized on Tables 5-1 and 5-2. Analytical results
1480 were compared to site background concentrations. If the analytical results exceeded the
1481 background concentration, the results were then compared to EPA Region 9 PRGs for human
1482 health risk screening values and ecological risk screening values developed during the TPP
1483 process. The exceedances and subsequent evaluation are summarized below.

1484 **6.2.1 Groundwater Pathway**

1485 No groundwater samples were proposed or collected within the Explosive Munitions Ranges. A
1486 spring sample was scheduled to be collected from the Mortar Range to assess groundwater
1487 conditions at the point of discharge. However, the spring was dry at the time of field work in
1488 September 2006.

1489 **6.2.2 Surface Water/Sediment Pathway**

1490 One surface water sample was collected during the SI along the Deschutes River downstream of
1491 the Mortar Range. All analytical results for the surface water sample were below the background
1492 value and ecological and human health screening values.

1493 Two sediment samples were collected. One sediment sample was collocated with the surface
1494 water sample and one sample was collected during the PA/SI within the Mortar Range. All
1495 analytical results for the sediment samples were below the background values and ecological and
1496 human health screening values. There were no explosive compounds detected.

1497 **6.2.3 Terrestrial Pathway**

1498 The analytical results from the Explosive Munitions Ranges indicate that iron in SI and PA/SI
1499 samples exceeded both the background soil concentration and the human health screening value.
1500 However, iron is a common rock forming mineral and not a hazardous substance. The bedrock
1501 at Camp Abbot is basaltic, which has high iron content. These elevated iron concentrations may
1502 reflect natural variation in the soils. There were no explosive compounds detected.

1503 Analytical results from soil samples collected during the SI and PA/SI indicate that barium,
1504 chromium, and lead exceeded both the Camp Abbot background concentrations and the
1505 ecological screening values. These exceedances indicate that adverse ecological impacts may
1506 occur. In addition, the presence of lead bullets in soil indicates potential terrestrial bird toxicity
1507 from ingestion of grit for digestive purposes.

1508 **6.3 Grenade Courts**

1509 No MEC or munitions debris was located during SI field work. Historically no MEC or
1510 munitions debris have been found at the live grenade court area. However, the ASR reported

1511 that a grenade spoon had been found in the vicinity of the practice grenade court during the ASR
1512 site visit (USACE, 1995). Based on the types of MEC that may be present and the limited
1513 investigation that has been conducted, the overall MEC risk is considered to be moderate.

1514 One sediment sample and three soil samples were collected during the PA/SI (Weston, 2005).
1515 Analytical results were compared to site background concentrations. If the analytical results
1516 exceeded the background concentration, the results were then compared to EPA Region 9 PRGs
1517 for human health risk screening values and ecological risk screening values developed during the
1518 TPP process. The exceedances and subsequent evaluation are summarized below.

1519 *6.3.1 Groundwater Pathway*

1520 No groundwater samples were proposed or collected within the Grenade Courts area. The
1521 Grenade Courts are located in a peninsula between the Spring and Deschutes Rivers. There is no
1522 groundwater use in the grenade court area. All near-surface groundwater is in direct connection
1523 with the surface water in the rivers.

1524 *6.3.2 Surface Water/Sediment Pathway*

1525 No surface water samples were collected from the Grenade Court area. One sediment sample
1526 was collected during the PA/SI (Weston, 2005). There were no detected concentrations of
1527 metals in sediment that significantly exceeded the background concentrations. Therefore, no
1528 human health or ecological screening was completed on detected concentrations.

1529 *6.3.3 Terrestrial Pathway*

1530 Analytical results from soil samples collected during the PA/SI were all below ecological and
1531 human health screening values and no adverse impacts are indicated.

1532 *6.4 Burial Pit*

1533 The Burial Pit was identified in the ASR as occurring east of the Deschutes River and east of the
1534 ordnance area, and described as follows: “The potential pit was horseshoe-shaped area, bermed
1535 and ringed with stone” (USACE, 1995). The ASR Supplement placed the Burial Pit as near the
1536 old landfill and provided location coordinates. An extensive search of the landfill area was
1537 completed during the SI and no evidence of the Burial Pit was found. Workers at the Nature
1538 Center, where the Burial Pit was reported as being located, could not confirm the existence of the
1539 Burial Pit. There have been no reports of MEC or munitions debris from this pit or in the area.
1540 Because the pit could not be located, no MC samples were collected. No evidence of MEC or
1541 munitions debris was found and there have been no historical reports. Based on the current use
1542 of the area, absence of MEC or munitions debris, uncertainty of the location, and even whether
1543 the site was actually used as a munitions burial pit, the overall MEC risk is considered to be low.

1544 No sampling was completed at the Burial Pit during the SI because the location could not be
1545 verified or found. Sampling of the landfill in the vicinity of where the Burial Pit is reported as
1546 being located was completed during the PA/SI (Weston, 2005). The PA/SI analytical results

1547 indicated that there were no detections of semivolatile organic compounds or
1548 pesticides/polychlorinated biphenyls. The PA/SI concluded that there were no metal detections
1549 that were at significant concentrations (greater than three times background).

1550 No MC assessments of the groundwater, surface water/sediment, or terrestrial pathways were
1551 completed.

1552 *6.5 Chemical Training Area*

1553 No field work was completed during the SI or PA/SI (Weston, 2005) at the Chemical Training
1554 Area. All evidence of area is gone. No MEC or munitions debris have been reported at this area.
1555 Information obtained, following completion of field work, during a telephone interview with a
1556 Sunriver resident indicates that a hill located north of the Chemical Training Area may contain
1557 buried items. The person interviewed (Appendix L) indicated that a former longtime Sunriver
1558 resident (now deceased) relayed that the ‘sledding hill’ located in Sunriver was “there for a
1559 reason” and “all kinds of stuff was buried there.”

1560 Discussion with Mr. Cliff Walkey of ODEQ during the third TPP meeting indicated that the
1561 “sledding hill” (also known as the “Amphitheater”) is a former asbestos disposal area. The
1562 asbestos debris at the disposal area was from the demolition of the former Camp Abbot
1563 buildings. He stated that annual inspections are completed by the property owners (Sunriver
1564 Owners Association). To his knowledge, no MEC or munitions debris has been identified at this
1565 disposal area.

1566 The likely munitions used at these AOCs included riot control (tear gas) and CAIS including
1567 K955, K941/K942. The Chemical Training Area is located within a housing development.
1568 Based on the current use of this AOC and no occurrence of MEC or munitions debris, the overall
1569 MEC risk is considered to be low.

1570 No sampling was planned at the Chemical Training Area because any chemical agents that may
1571 have been released would be in very small quantities associated with CAIS.

1572 **7.0 Recommendations**

1573 Results of the SI provide the basis for conclusions and/or recommendations for further actions at
1574 each of the AOCs.

1575 **7.1 Range Complex No. 1**

1576 Based on historical evidence and results from the SI field activities, the MEC risks are low and
1577 Range Complex No. 1 is recommended for NDAI with respect to MEC.

1578 Ecological screening of analytical results from soil samples indicate that lead, mercury, and zinc
1579 results from soil samples, that also exceeded background concentrations, indicate that adverse
1580 ecological impacts may occur. An elevated lead detection from a sediment sample collected
1581 during that PA/SI exceeded the ecological screening value. However, the PA/SI determined that
1582 the elevated lead result was an outlier and was not due to activities occurring at the FUDS.

1583 There are no human health impacts indicated.

1584 Following consultation with ODEQ, a recommendation of NDAI with respect to MC is made.
1585 Although, ecological screening values were exceeded and a potential for ecological impact is
1586 present, the risk is not considered to be sufficient to warrant an RI/FS.

1587 **7.2 Explosive Munitions Range**

1588 Based on historical evidence and results of the SI field activities, there is evidence of MEC,
1589 munitions debris, and use of explosives occurring within the Anti-Tank Range, the Mortar
1590 Range, and the Demolition Area. Based the historical occurrence of MEC, the Anti-Tank Range,
1591 the Mortar Range, and the Demolition Area are recommended for RI/FS.

1592 Iron was detected at concentrations above the background and human health screening value in
1593 soil samples from the Demolition Area and the Mortar Range. Iron is a common rock forming
1594 mineral and the bedrock at Camp Abbot is basaltic, which has high iron content. These elevated
1595 iron concentrations may reflect natural variation in the soils. Additionally, iron is not a
1596 CERCLA hazardous substance and therefore a recommendation based on iron alone cannot be
1597 used to recommend RI/FS.

1598 The Camp Abbot background concentrations and ecological screening values were exceeded for
1599 barium, chromium, and lead in soil samples. The exceedances indicate that adverse ecological
1600 impacts may occur in soil. Following consultation with ODEQ, a recommendation of NDAI
1601 with respect to MC is made. Although, ecological screening values were exceeded and a
1602 potential for ecological impact is present, the risk is not considered to be sufficient to warrant an
1603 RI/FS.

1604 **7.3 Grenade Courts**

1605 Historically, no MEC or munitions debris, other than a grenade spoon and expended lead bullets,
1606 have been found at the Grenade Courts. Based on the types of MEC that may be present and the
1607 limited investigation that has been conducted, the overall MEC risk is considered to be moderate
1608 and the Grenade Courts area is recommended for RI/FS.

1609 All analytical results for MC were below human health screening values. The ecological
1610 screening value was exceeded for nickel in a sediment sample, which may indicate adverse
1611 ecological impacts in sediments. However, the detected concentration may reflect the natural
1612 variation of nickel in sediment. Following consultation with ODEQ, a recommendation of
1613 NDAI with respect to MC is made. Although, ecological screening values were exceeded and a
1614 potential for ecological impact is present, the risk is not considered to be sufficient to warrant an
1615 RI/FS.

1616 **7.4 Burial Pit**

1617 The Burial Pit was identified in the ASR as occurring east of the Deschutes River and east of the
1618 ordnance area, and described as follows: “The potential pit was horseshoe-shaped area, bermed
1619 and ringed with stone” (USACE, 1995). The ASR Supplement placed the Burial Pit as near the
1620 old landfill and provided location coordinates. An extensive search of the area was completed
1621 during the SI and no evidence of the Burial Pit was found. Workers at the Nature Center, where
1622 the Burial Pit was reported as being located, could not confirm the existence of the Burial Pit.
1623 There have been no reports of MEC or munitions debris from this pit or in the area. Because the
1624 pit could not be located, no MC samples were collected. Because of the uncertainty in the
1625 location or even existence (ASR described as ‘potential’) of the Burial Pit, the Burial Pit is
1626 recommended for NDAI for both MEC and MC.

1627 **7.5 Chemical Training Area**

1628 No MEC or munitions debris has been reported at the Chemical Training Area. The Chemical
1629 Training Area is located within a housing development. The INPR (USACE, 1994) indicated
1630 that a gas chamber was located in this area. A recent telephone interview (Appendix L)
1631 indicated that “chemicals” may have been buried at the ‘sledding hill’ located north of the AOC.
1632 However, Mr. Cliff Walkey of ODEQ stated that the “sledding hill” is a former asbestos disposal
1633 site used for building debris from the demolition of former Camp Abbot. Mr. Walkey also stated
1634 that to his knowledge no MEC or munitions debris has been identified at this site. No MC
1635 samples were collected from the Chemical Training Area, because the area is currently
1636 residential housing and the area has been developed and utilized, and any chemical agents that
1637 may have been released would be in very small quantities associated with CAIS sets. Based on
1638 no MEC having been identified associated with this AOC and the low exposure potential from
1639 CAIS sets, the Chemical Training Area is recommended for NDAI.

1640 **7.6 Removal Actions**

1641 Section 1.3 identified as one of the decision rules evaluation of whether a removal action is
1642 warranted. A removal action would be warranted if a high MEC hazard or an elevated MC risk
1643 were identified. There is no indication that a high MEC risk is present at Camp Abbot. No MEC
1644 was identified during the SI or ASR field activities and no reports of MEC have been made since
1645 1988 (USACE, 1993).

1646 Based on SI sampling results, no elevated MC risk has been identified. Only limited
1647 exceedances of human health or ecological screening criteria were noted. Based on the above
1648 discussion, a removal action at Camp Abbot is not warranted.

1649 **7.7 Munitions Response Sites**

1650 Results of the SI field activities provide the basis for identifying munitions response areas
1651 (MRAs) and/or MRSs and for scoring each MRS using the MRSP. An MRA is any area on a
1652 defense site that is known or suspected to contain MEC or MC. The MRA may contain one or
1653 more MRS.

1654 Based on the use and physical distribution of the ranges at Camp Abbot, seven separate MRSs
1655 are identified (Figure 7-1):

- 1656 • MRS No. 1: Consists of Range Complex No. 1,
- 1657 • MRS No. 2: Consists of the Anti Tank Range,
- 1658 • MRS No. 3: Consists of the Grenade Court,
- 1659 • MRS No. 4: Consists of the Mortar Range
- 1660 • MRS No. 5: Consists of the Demolition Area,
- 1661 • MRS No. 6: Consists of the Burial Pit,
- 1662 • MRS No. 7: Consists of the Chemical Training Area.

1663 These MRSs correspond to the ranges shown in the MMRP Inventory. There is no evidence of
1664 MEC or MC in areas outside these MRS boundaries.

1665 The live grenade court, identified from on a historical map (Figure 2-1) is within MRS No. 2
1666 Anti-Tank Range.

1667 The draft MRSP scoring packages for the MRSs are included in Appendix K.

1668 Due to the uncertainty in the location of the Burial Pit between the location in the ASR
1669 Supplement (near landfill) and the location in the ASR (east of the ordnance area), it is
1670 recommended that additional reconnaissance for the Burial Pit be completed in the vicinity of the
1671 ordnance area in the northern part of Camp Abbot.

1672 8.0 References

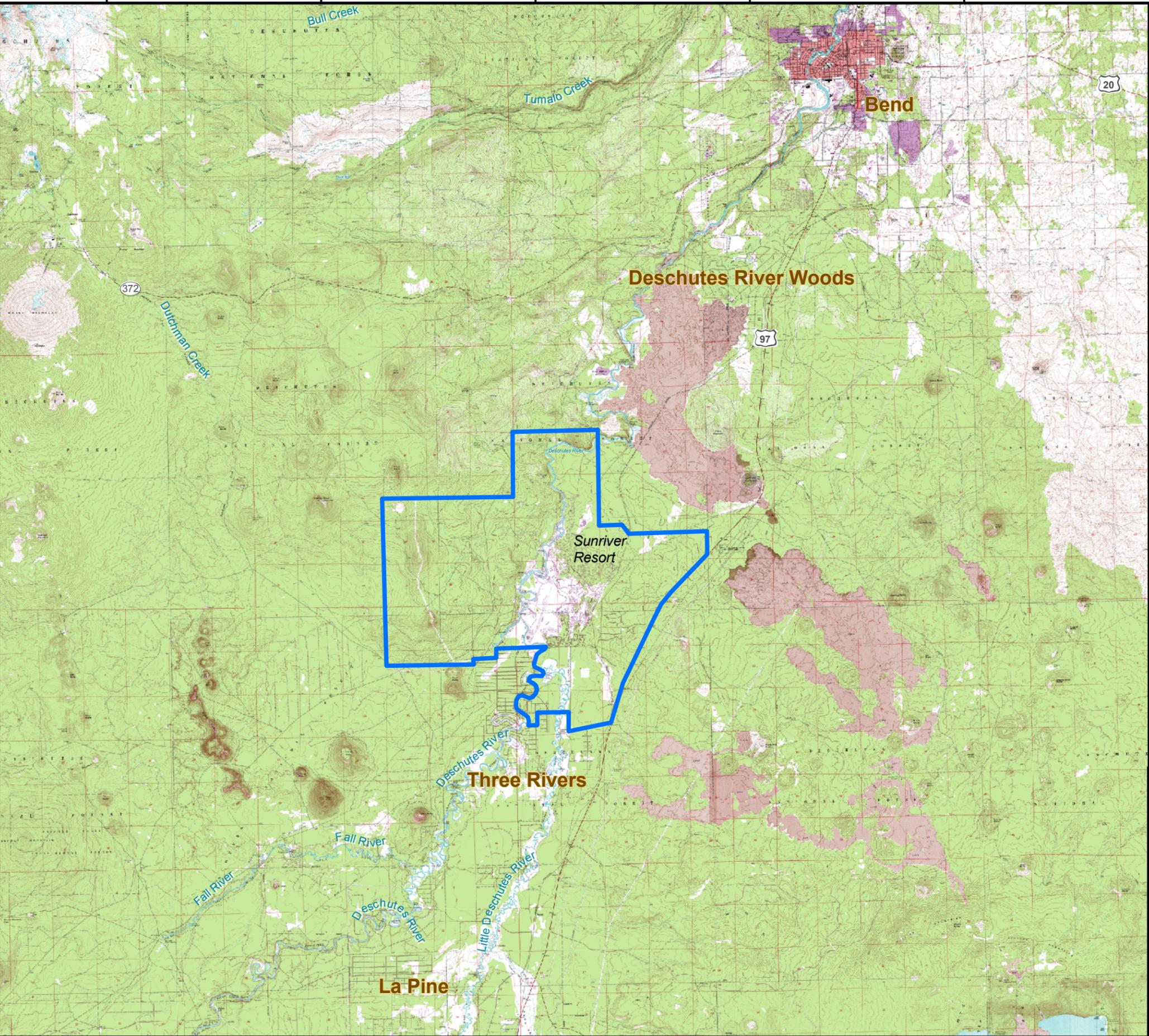
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Figures

DRAWING NUMBER CABO_034_fig1_1_site_location_S1
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OFFICE MNRVL



Legend

-  Camp Abbot FUDS Boundary

NOTES:
1) FUDS property boundary was derived from the Camp Abbot ASR Supplement.
2) Topographic map was obtained from the USDA/NRCS - National Cartography & Geospatial Center.



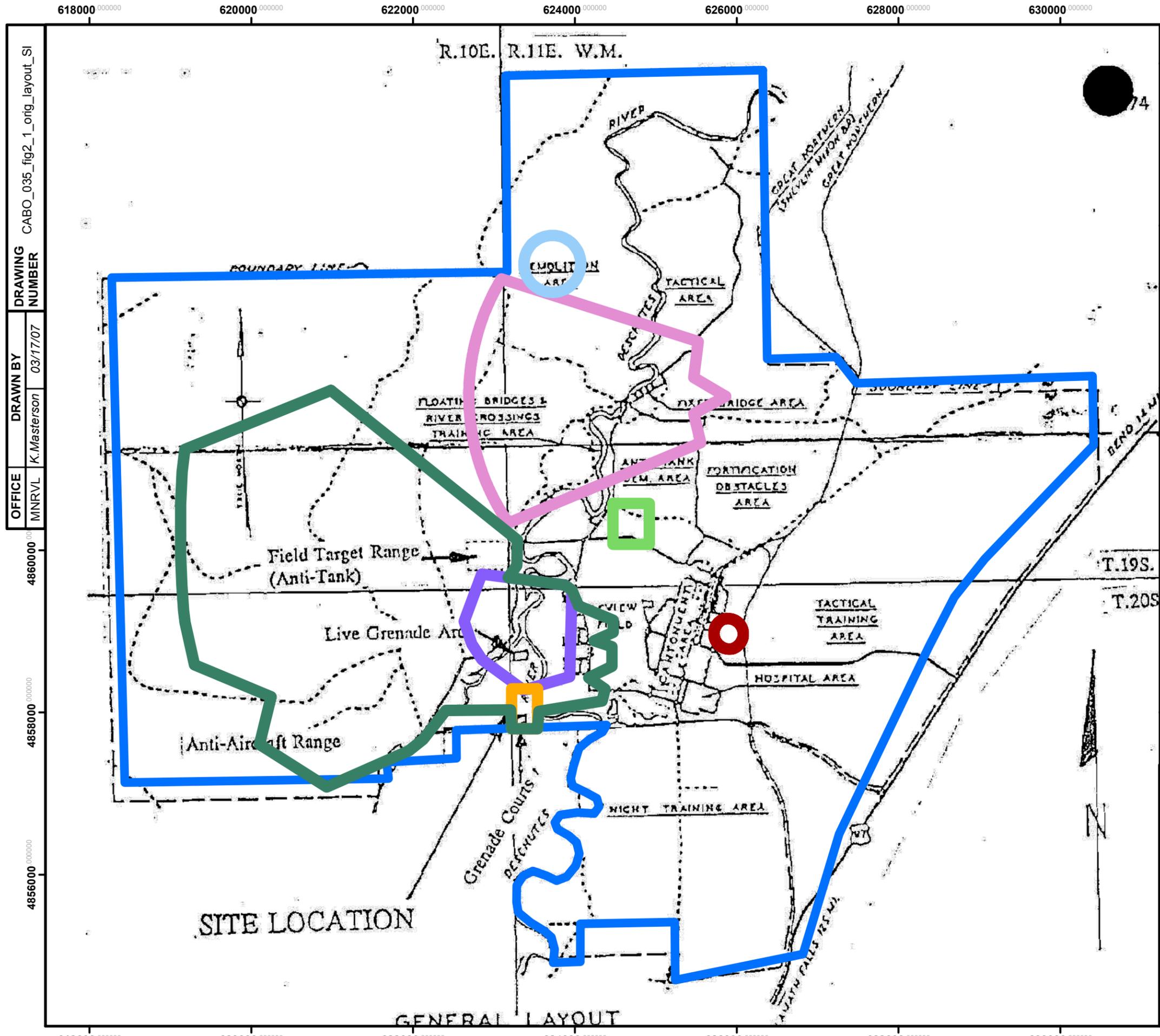
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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OMAHA DESIGN CENTER

FIGURE 1-1
SITE LOCATION
CAMP ABBOT

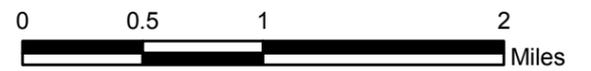




Legend

- Camp Abbot FUDS Boundary
- Anti-Tank Range AOC Boundary
- Burial Pit AOC Boundary
- Chemical Training Area AOC Boundary
- Demolition Area AOC Boundary
- Grenade Courts AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary

NOTES:
 1) The site layout drawing was obtained from the Inventory Project Report (INPR) for Camp Abbot, Oregon, 13 October 1993, Revised 6 April 1994.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

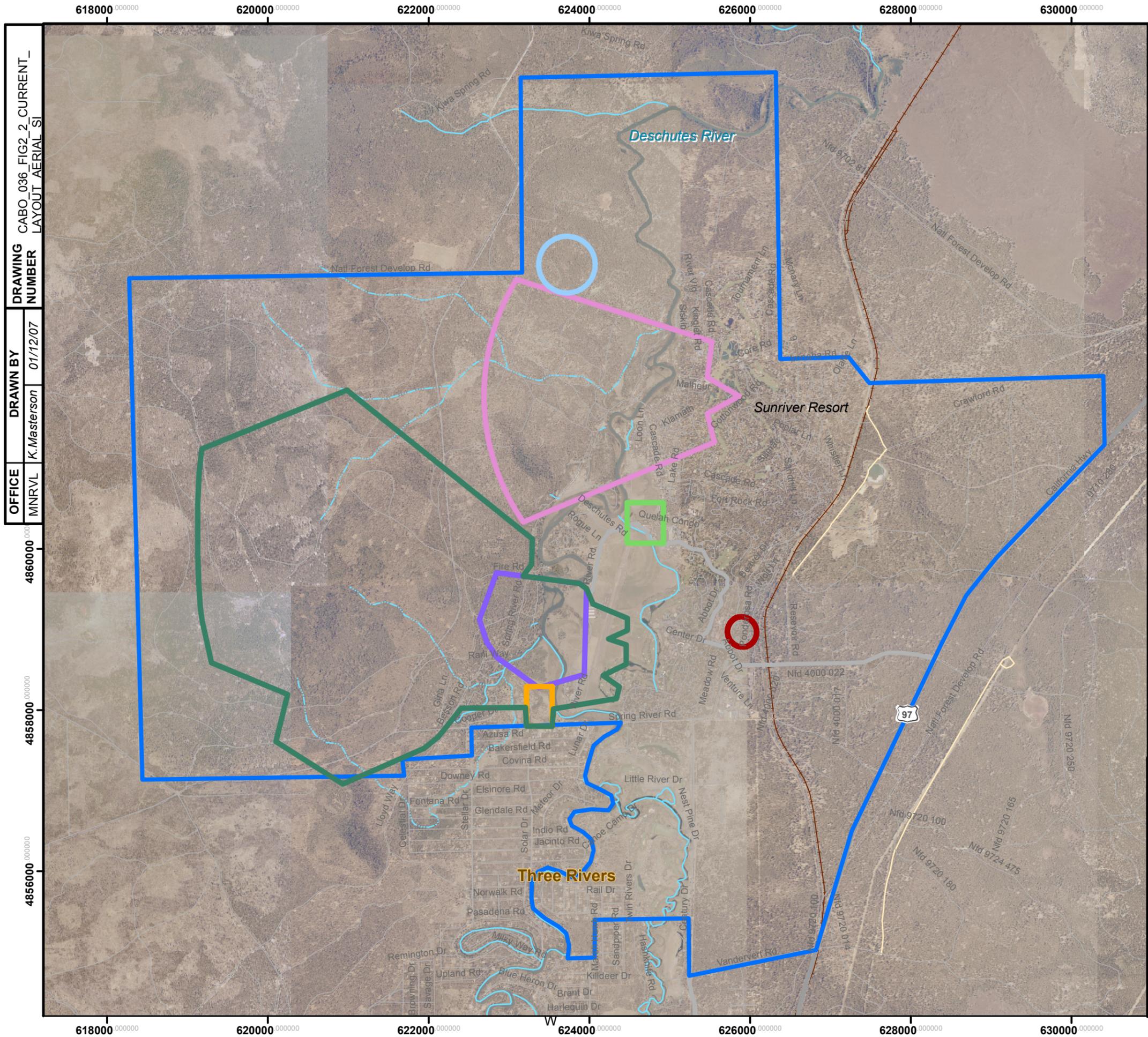


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FIGURE 2-1
ORIGINAL SITE LAYOUT
 CAMP ABBOT



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 DATE: 03/17/07
 OFFICE: MNRVL



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 MNRVL
 K.Masterson
 01/12/07

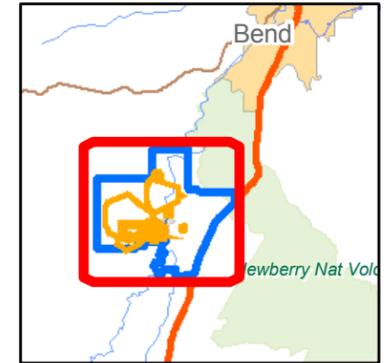
Legend

- Anti-Tank Range AOC Boundary
- Burial Pit AOC Boundary
- Chemical Training Area AOC Boundary
- Demolition Area AOC Boundary
- Grenade Courts AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary

NOTES:
 1) Aerial photo was obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-AFPO National Agricultural Inventory Project (NAIP), 2003.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

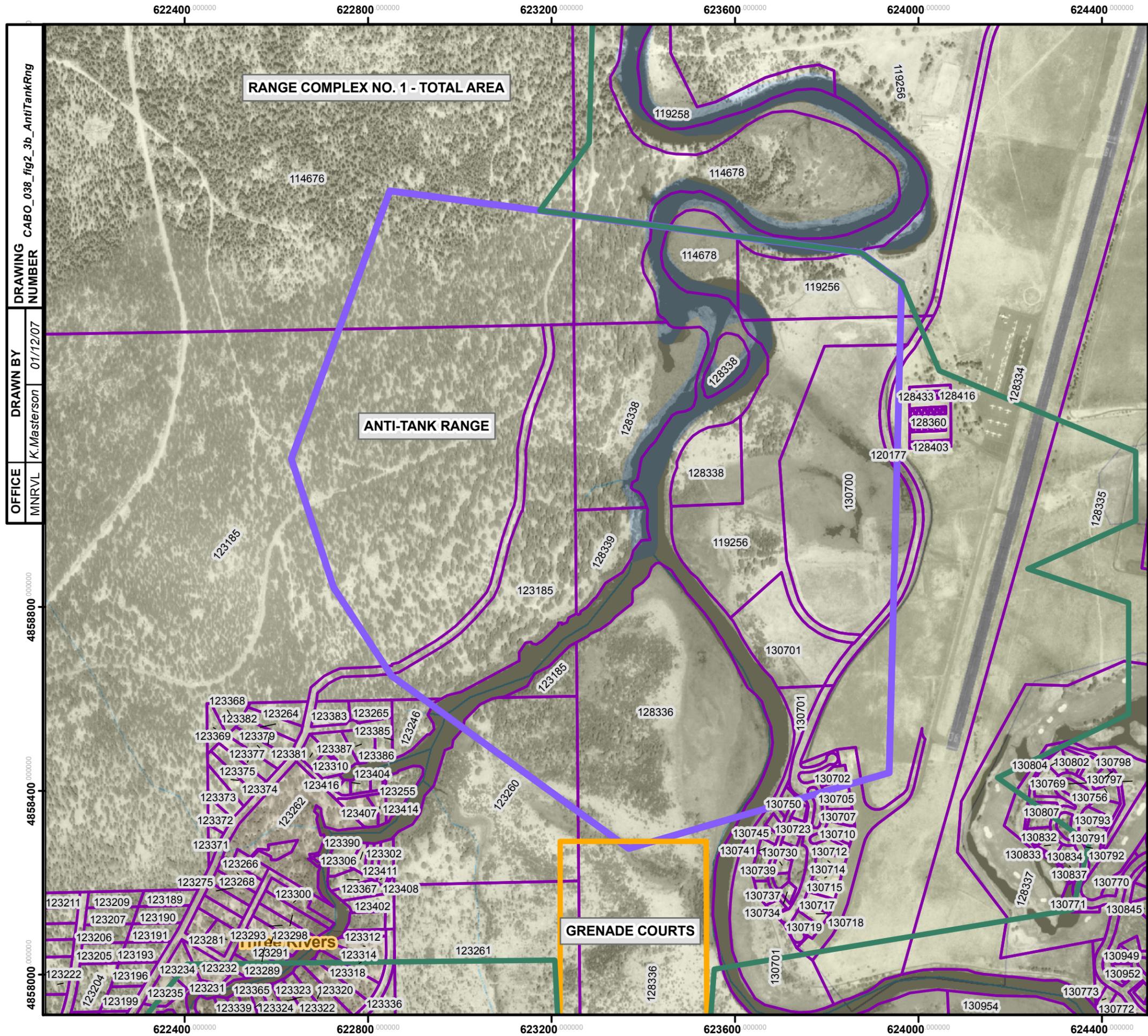


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**FIGURE 2-2
 CURRENT AERIAL PHOTOGRAPH**

CAMP ABBOT





RANGE COMPLEX NO. 1 - TOTAL AREA

ANTI-TANK RANGE

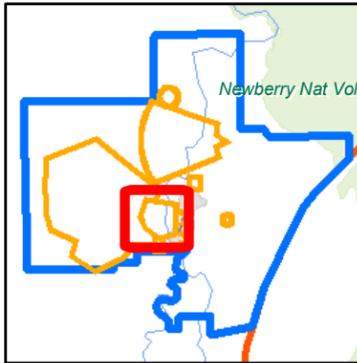
GRENADÉ COURTS

Legend

-  Anti-Tank Range AOC Boundary
-  Grenade Courts AOC Boundary
-  Range Complex No. 1 AOC Boundary
-  Taxlot Parcels

NOTES:

- 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
- 2) Taxlot parcel data were obtained from the Deschutes County GIS office.
- 3) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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FIGURE 2-3B
PARCEL OWNERSHIP
ANTI-TANK RANGE

CAMP ABBOT



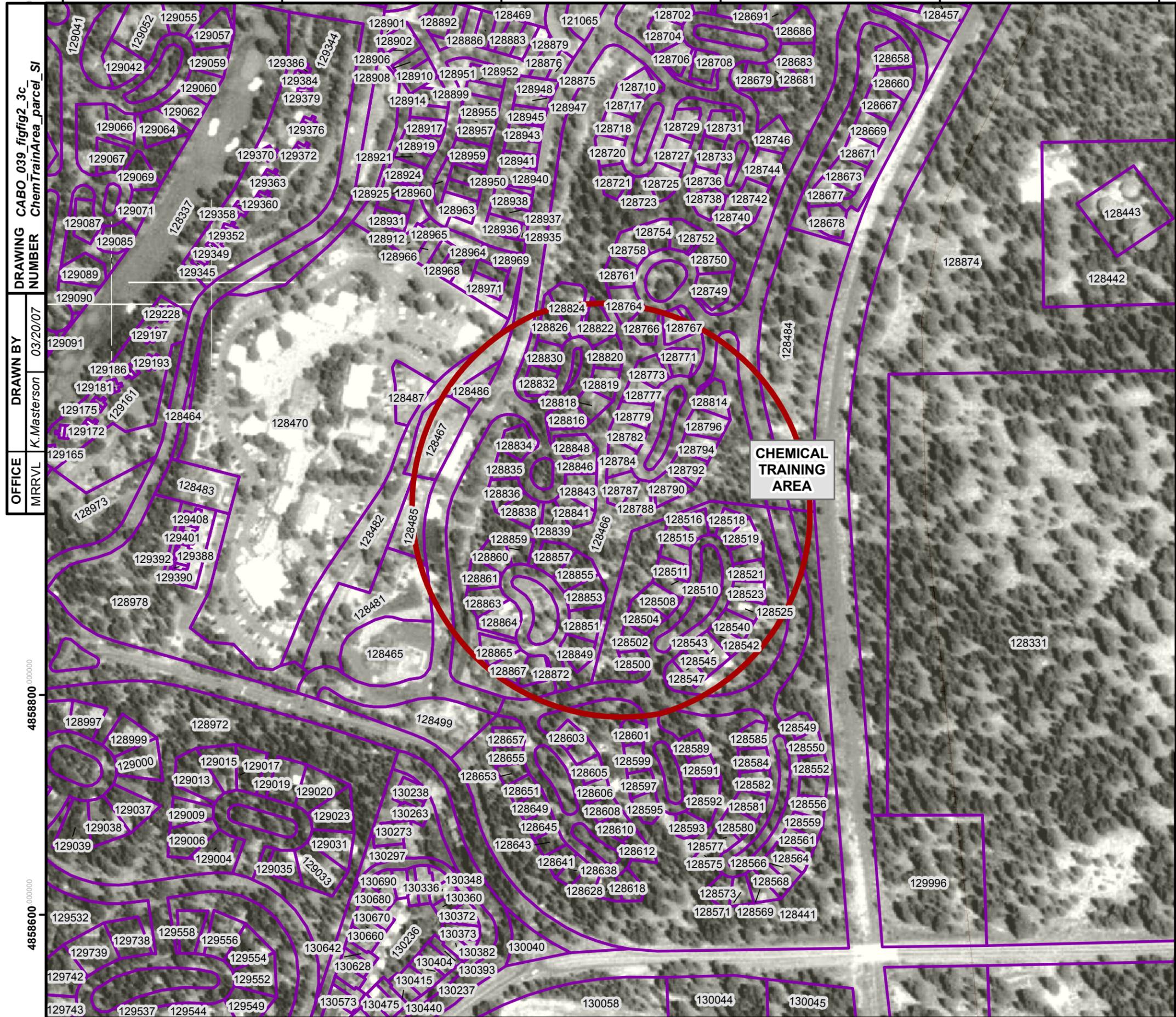
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 DRAWN BY: K. Masterson
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 DATE: 01/12/07

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 4859200
 4859600
 4860000

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622400 622800 623200 623600 624000 624400

625400 000000 625600 000000 625800 000000 626000 000000 626200 000000 626400 000000



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DRAWN BY K.Masterson 03/20/07

OFFICE MRRVL

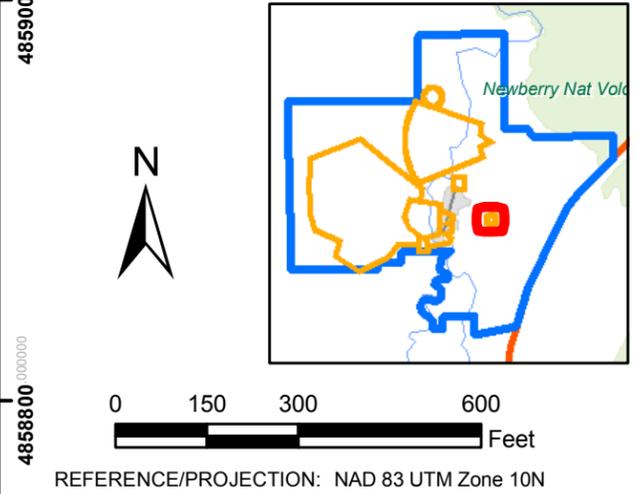
Legend

Ranges Included in the MMRP Range Inventory

- Chemical Training Area AOC Boundary
- Taxlot Parcels

NOTES:

- 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
- 2) Taxlot parcel data were obtained from the Deschutes County GIS office.
- 3) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.

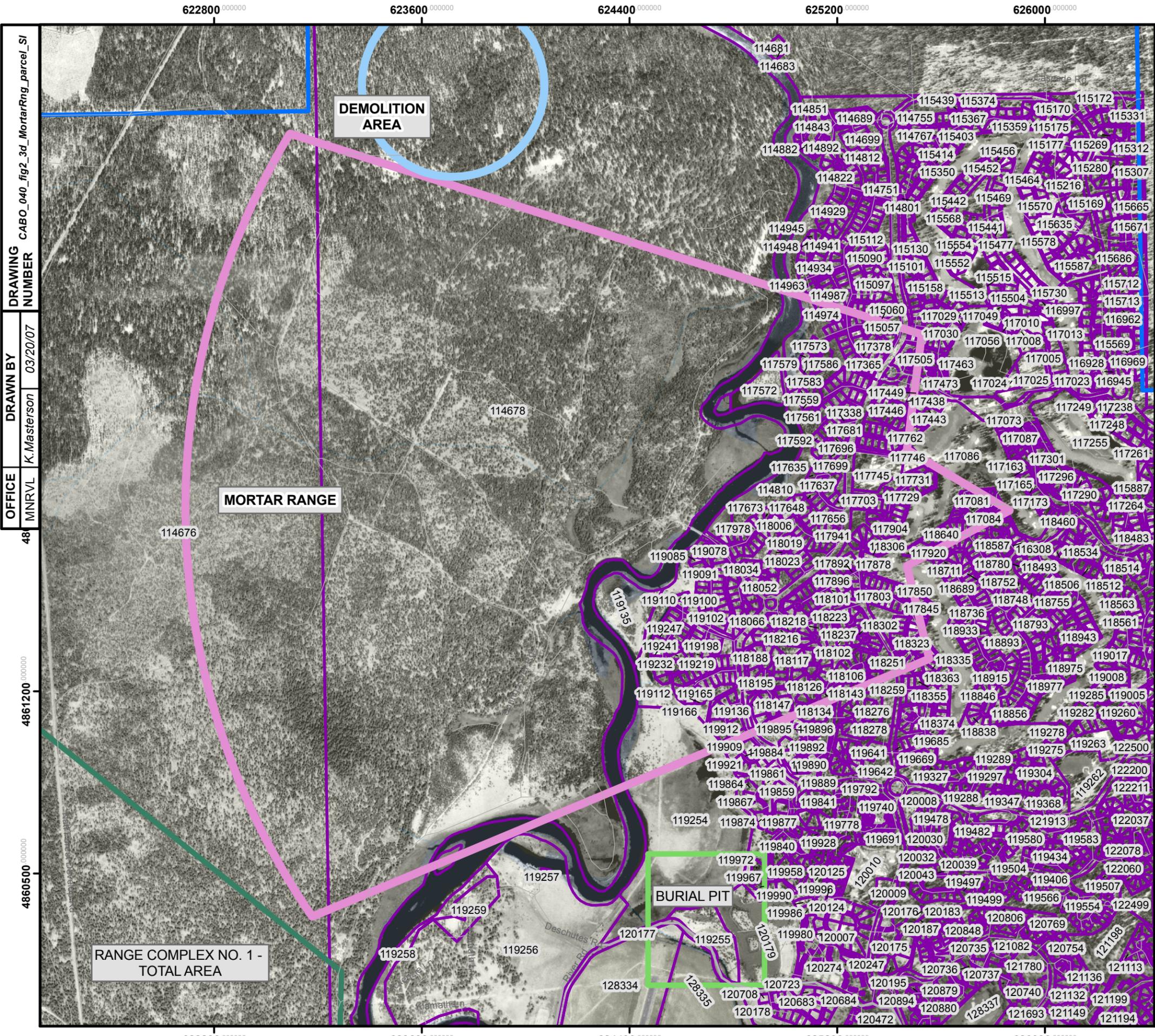


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FIGURE 2-3C
PARCEL OWNERSHIP
CHEMICAL TRAINING AREA
CAMP ABBOT

Shaw Environmental, Inc.

625400 000000 625600 000000 625800 000000 626000 000000 626200 000000 626400 000000



DRAWING NUMBER: CABO_040_fig2_3d_MortarRng_parcel_Sl
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Legend

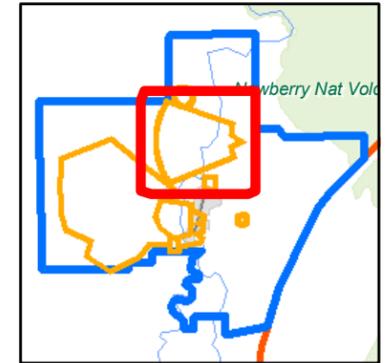
- Camp Abbot FUDS Boundary
- Burial Pit AOC Boudary
- Demolition Area AOC Boudary
- Mortar Range AOC Boudary
- Range Complex No. 1 AOC Boudary
- Taxlot Parcels

NOTES:

- 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
- 2) Taxlot parcel data were obtained from the Deschutes County GIS office.
- 3) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.



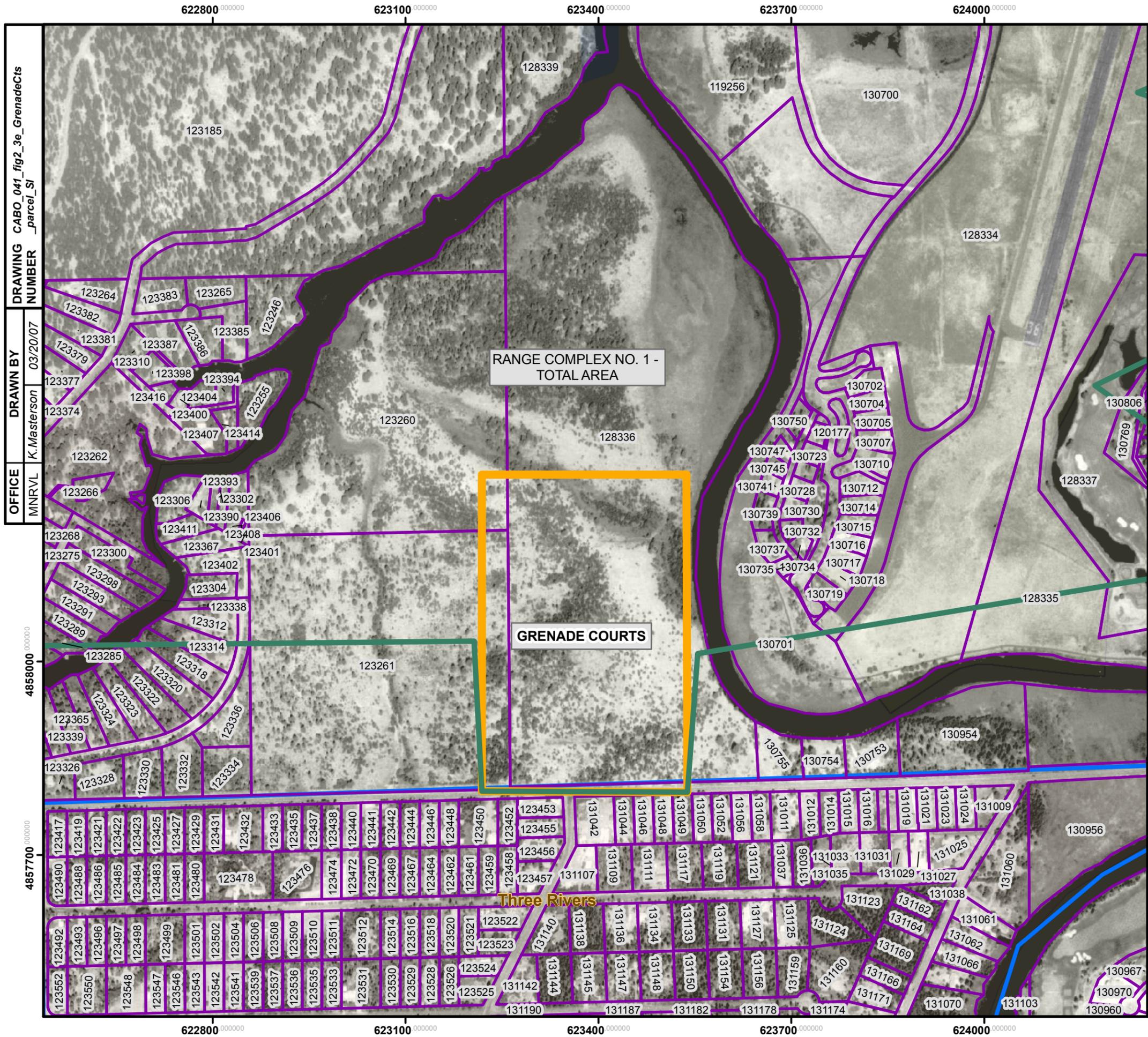
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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FIGURE 2-3D
PARCEL OWNERSHIP
DEMOLITION AREA & MORTAR RANGE
CAMP ABBOT





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Legend

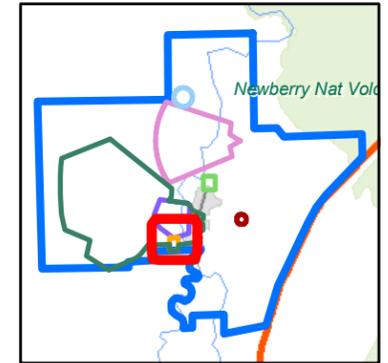
- Camp Abbot FUDS Boundary
- Grenade Courts AOC Boundary
- Range Complex No. 1 AOC Boundary
- Taxlot Parcels

NOTES:

- 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
- 2) Taxlot parcel data were obtained from the Deschutes County GIS office.
- 3) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.



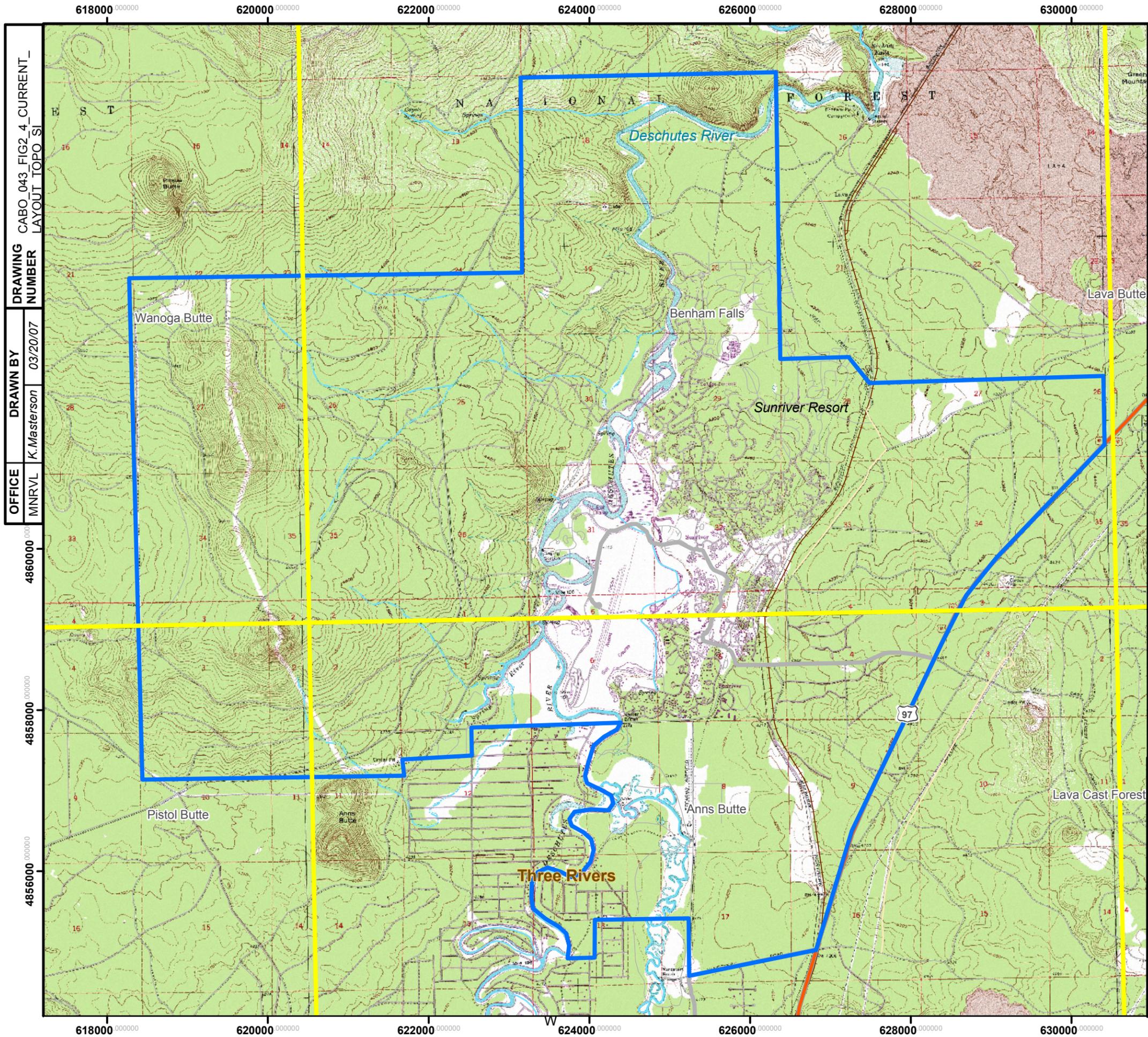
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FIGURE 2-3E
PARCEL OWNERSHIP
GRENADE COURTS
CAMP ABBOT





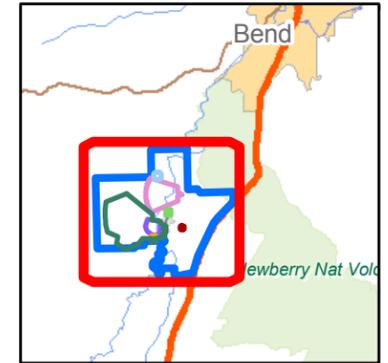
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 DRAWN BY: K.Masterson 03/20/07
 OFFICE: MNRVL

Legend

- Camp Abbot FUDS Boundary
- Quad Name
USGS Topographic Quadrangle Map Sheets

NOTES:

- 1) FUDS property boundary was derived from the Camp Abbot ASR Supplement.
- 2) USGS Topographic map was obtained from the U.S. Department of Agriculture, Service Center Agencies and is dated 2001.
- 3) USGS Topographic Quadrangles: Anns Butte, Benham Falls, Lava Butte, Lava Cast Forest, Pistol Butte, Wanoga Butte.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

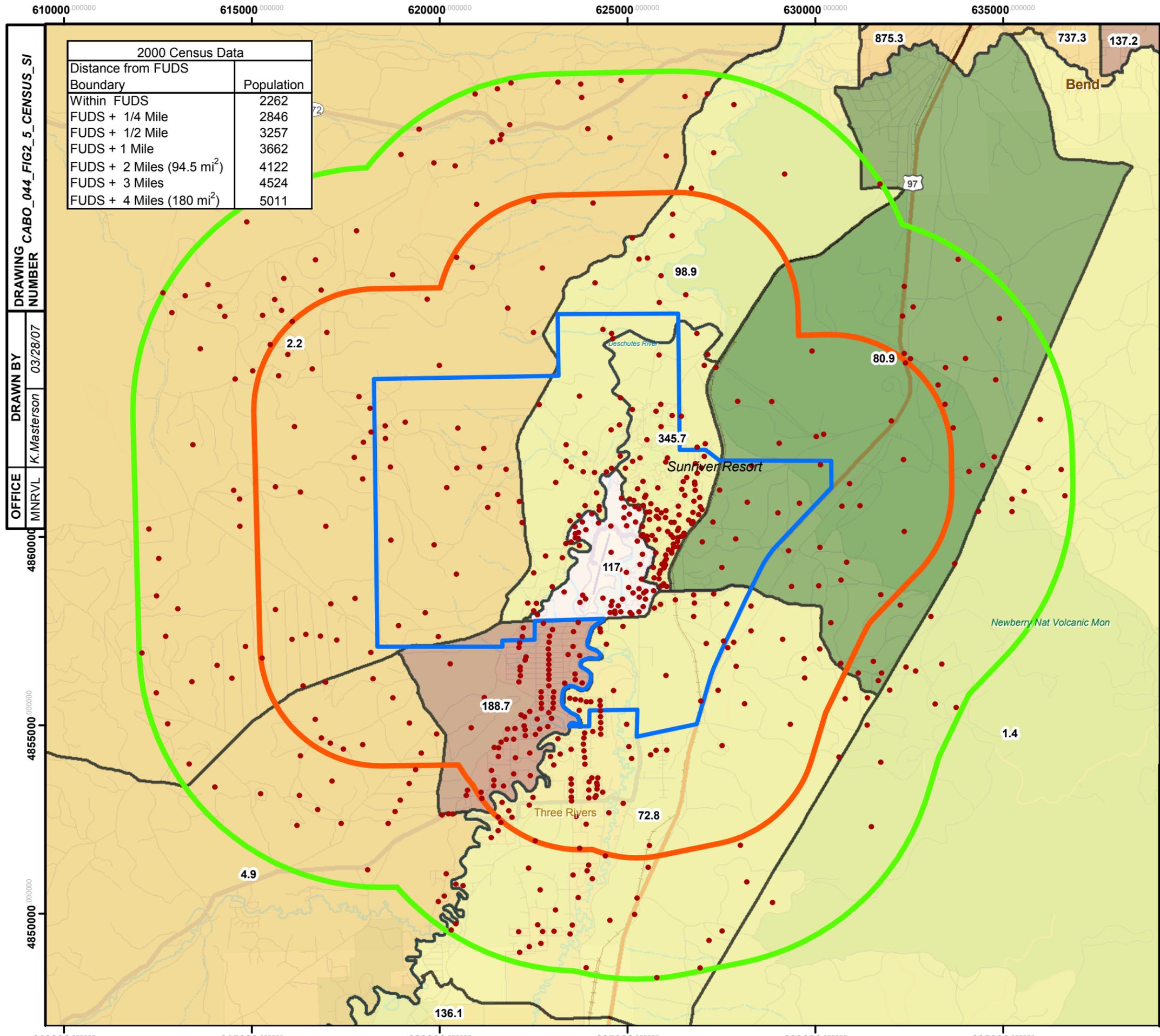


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FIGURE 2-4
CURRENT TOPOGRAPHIC MAP

CAMP ABBOT





2000 Census Data	
Distance from FUDS Boundary	Population
Within FUDS	2262
FUDS + 1/4 Mile	2846
FUDS + 1/2 Mile	3257
FUDS + 1 Mile	3662
FUDS + 2 Miles (94.5 mi ²)	4122
FUDS + 3 Miles	4524
FUDS + 4 Miles (180 mi ²)	5011

Legend

- Camp Abbot FUDS Boundary
- 2-Mile Radius from the Camp Abbot FUDS Boundary
- 4-Mile Radius from the Camp Abbot FUDS Boundary

2004 Block Group Population

- 316
- 317 - 1238
- 1239 - 1506
- 1507 - 2360
- 2361 - 3349

15.2 Number of People per Square Mile

- Census Block Centroid Unit

NOTES:

- 1) The population density for the 2-mile radius (94.5 square miles) is 27.8 persons/square mile.
- 2) The population density for the 4-mile radius (180 square miles) is 43.6 persons/square mile.

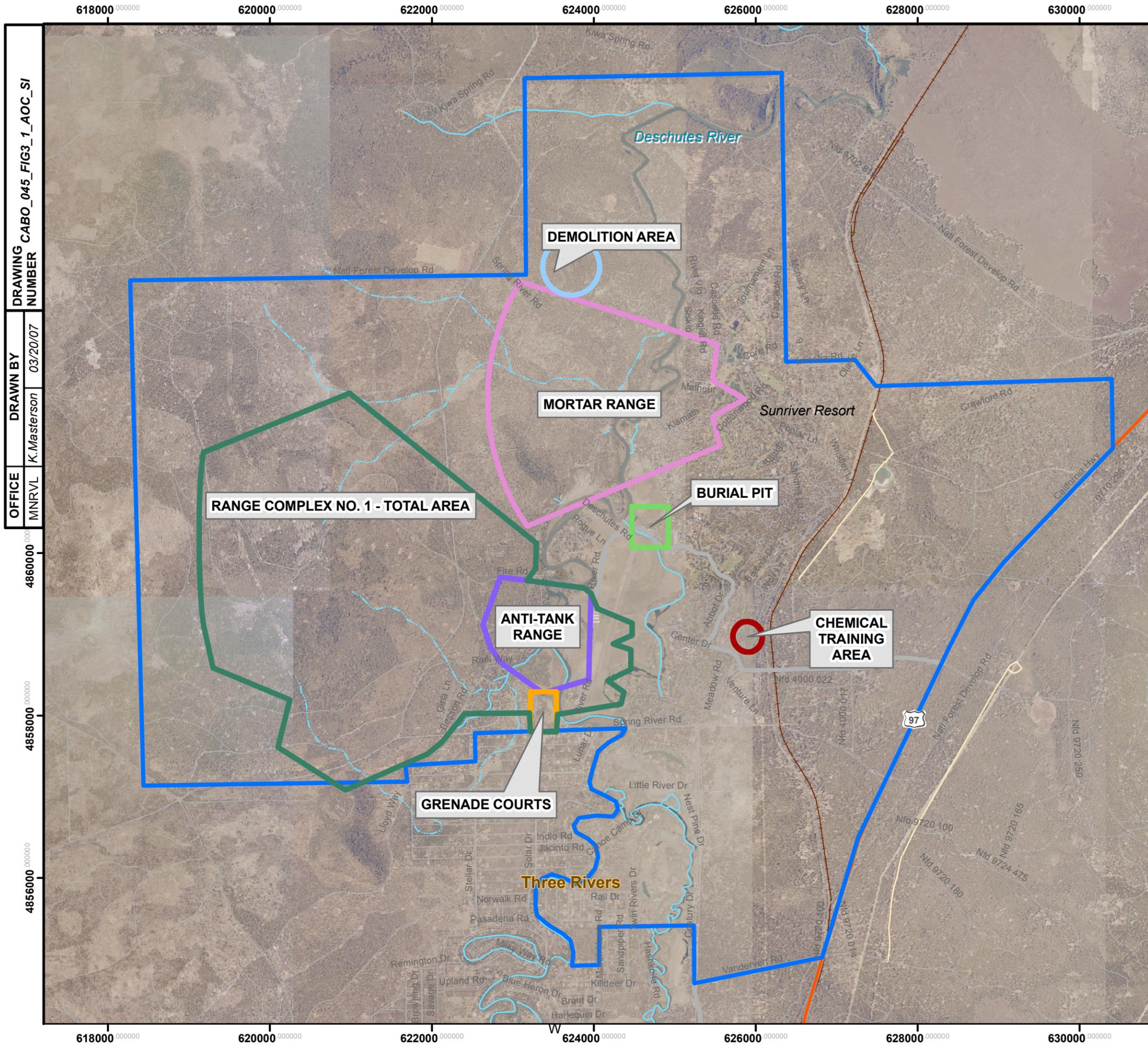
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FIGURE 2-5
CENSUS DATA
WITHIN A 2-MILE AND 4-MILE RADIUS OF
THE FUDS BOUNDARY
CAMP ABBOT

Shaw Environmental, Inc.



DRAWING NUMBER
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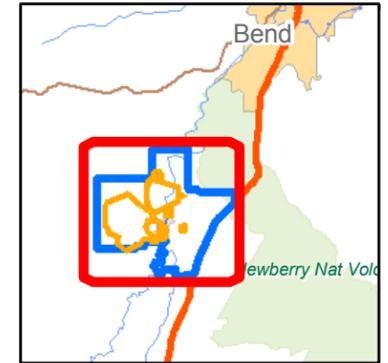
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Legend

-  Camp Abbot FUDS Boundary
-  Anti-Tank Range AOC Boundary
-  Burial Pit AOC Boundary
-  Chemical Training Area AOC Boundary
-  Demolition Area AOC Boundary
-  Grenade Courts AOC Boundary
-  Mortar Range AOC Boundary
-  Range Complex No. 1 AOC Boundary

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo was obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-AFPO National Agricultural Inventory Project (NAIP), 2003.



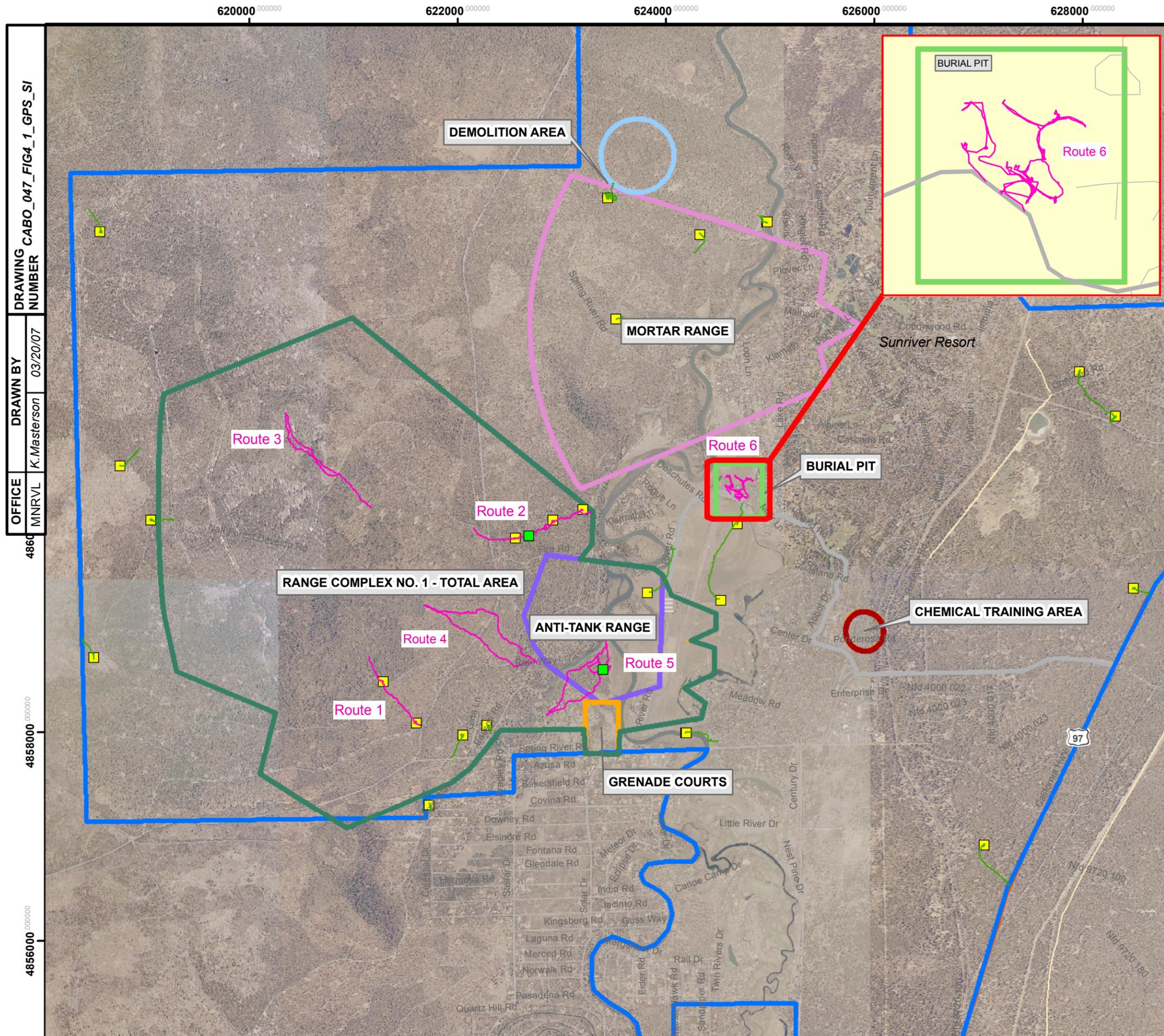
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FIGURE 3-1
AREAS OF CONCERN
 CAMP ABBOT



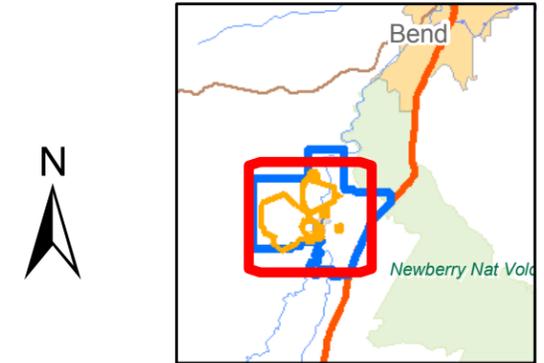


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 03/20/07
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 4858000
 4856000

Legend

- Camp Abbot Property Boundary
- Anti-Tank Range AOC Boundary
- Burial Pit AOC Boundary
- Chemical Training Area AOC Boundary
- Demolition Area AOC Boundary
- Grenade Courts AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary
- Field Sample
- Subsurface Anomaly
- Reconnaissance Path
- MEC Avoidance Path

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo was obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-AFPO National Agricultural Inventory Project (NAIP), 2003.



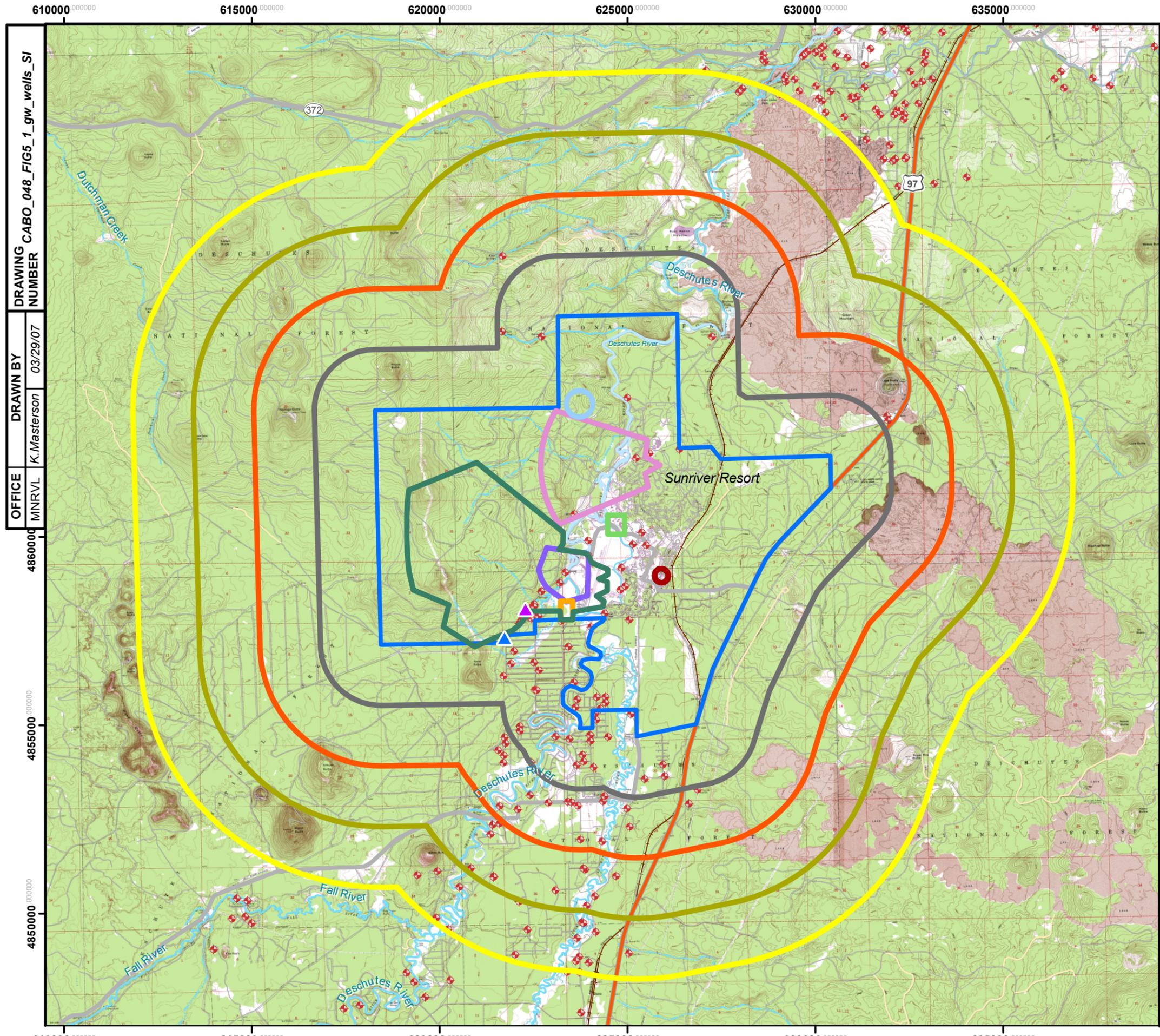
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FIGURE 4-1
VISUAL RECONNAISSANCE PATHS
 CAMP ABBOT





DRAWING CABO_048_FIG5_1_gw_wells_SI
 NUMBER
 DRAWN BY
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 03/29/07
 OFFICE
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Legend

- Camp Abbot FUDS Boundary
- Anti-Tank Range AOC Boundary
- Burial Pit AOC Boundary
- Chemical Training Area AOC Boundary
- Demolition Area AOC Boundary
- Grenade Courts AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary
- 1-Mile Radius from Camp Abbot Property Boundary
- 2-Mile Radius from Camp Abbot Property Boundary
- 3-Mile Radius from Camp Abbot Property Boundary
- 4-Mile Radius from Camp Abbot Property Boundary
- Groundwater Wells (Oregon WRD)
- Groundwater Sample Location
- Background Groundwater Sample Location

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Groundwater well data were obtained from the Oregon Water Resources Department.
 3) USGS Topographic map was obtained from the U.S. Department of Agriculture, Service Center Agencies and is dated 2001.

N

0 0.5 1 2
Miles

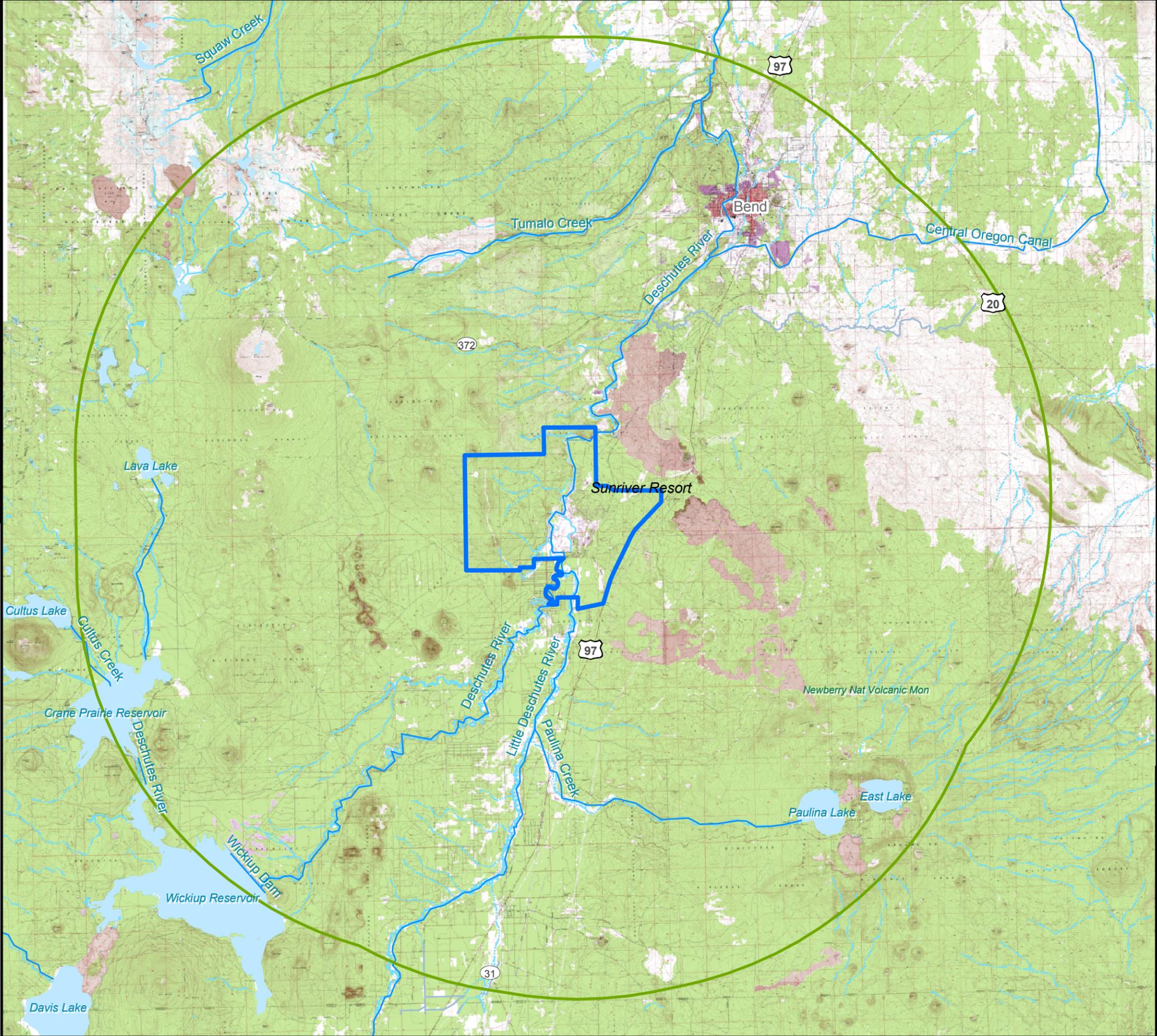
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 5-1
GROUNDWATER WELLS WITHIN
A 2-MILE AND 4-MILE RADIUS OF
THE FUDS BOUNDARY

CAMP ABBOT

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 DRAWING NUMBER: CABO_049_FIG5_2 SURFACE_DRAINAGE_SI
 DATE: 12/15/06



Legend

- Camp Abbot Property Boundary
- 15 Mile Radius from FUDS Boundary

NOTES:

- 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
- 2) USGS Topographic map was obtained from the U.S. Department of Agriculture, Service Center Agencies and is dated 2001.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

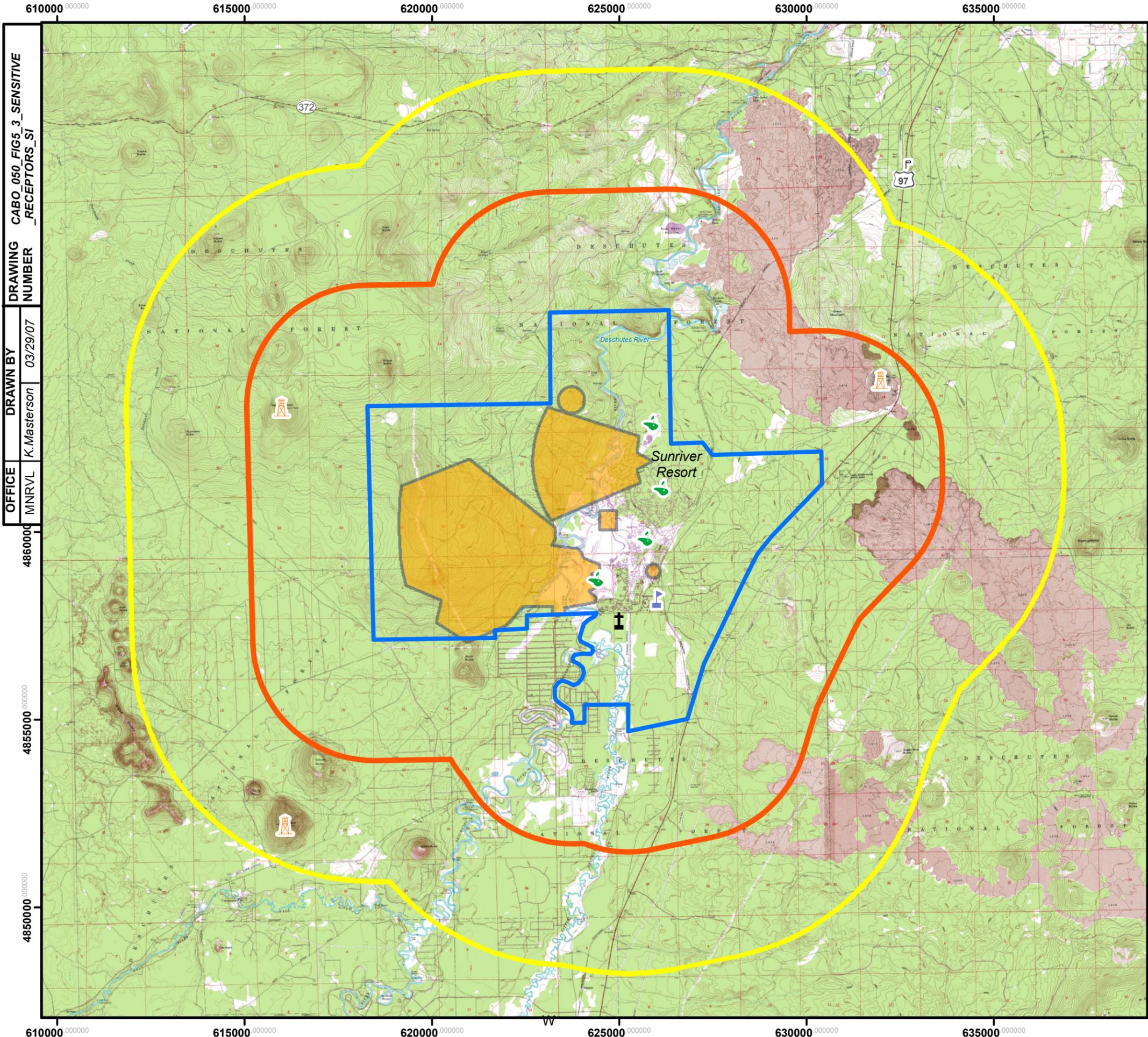


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FIGURE 5-2
REGIONAL SURFACE WATER DRAINAGE WITHIN
A 15 MILE RADIUS OF THE FUDS BOUNDARY

CAMP ABBOT





DRAWING NUMBER: CABO_050_FIG5_3_SENSITIVE_RECEPTORS_S1
 DRAWN BY: K. Masterson
 DATE: 03/29/07
 OFFICE: MNRVL
 NUMBER: 4860000

Legend

- Camp Abbot FUDS Boundary
- 2-Mile Radius from Camp Abbot FUDS Boundary
- 4-Mile Radius from Camp Abbot FUDS Boundary
- Golf Course
- Lookout Tower
- Harper Cemetery
- School

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) USGS topographic map was obtained from the U.S. Department of Agriculture, Service Center Agencies and is dated 2001.

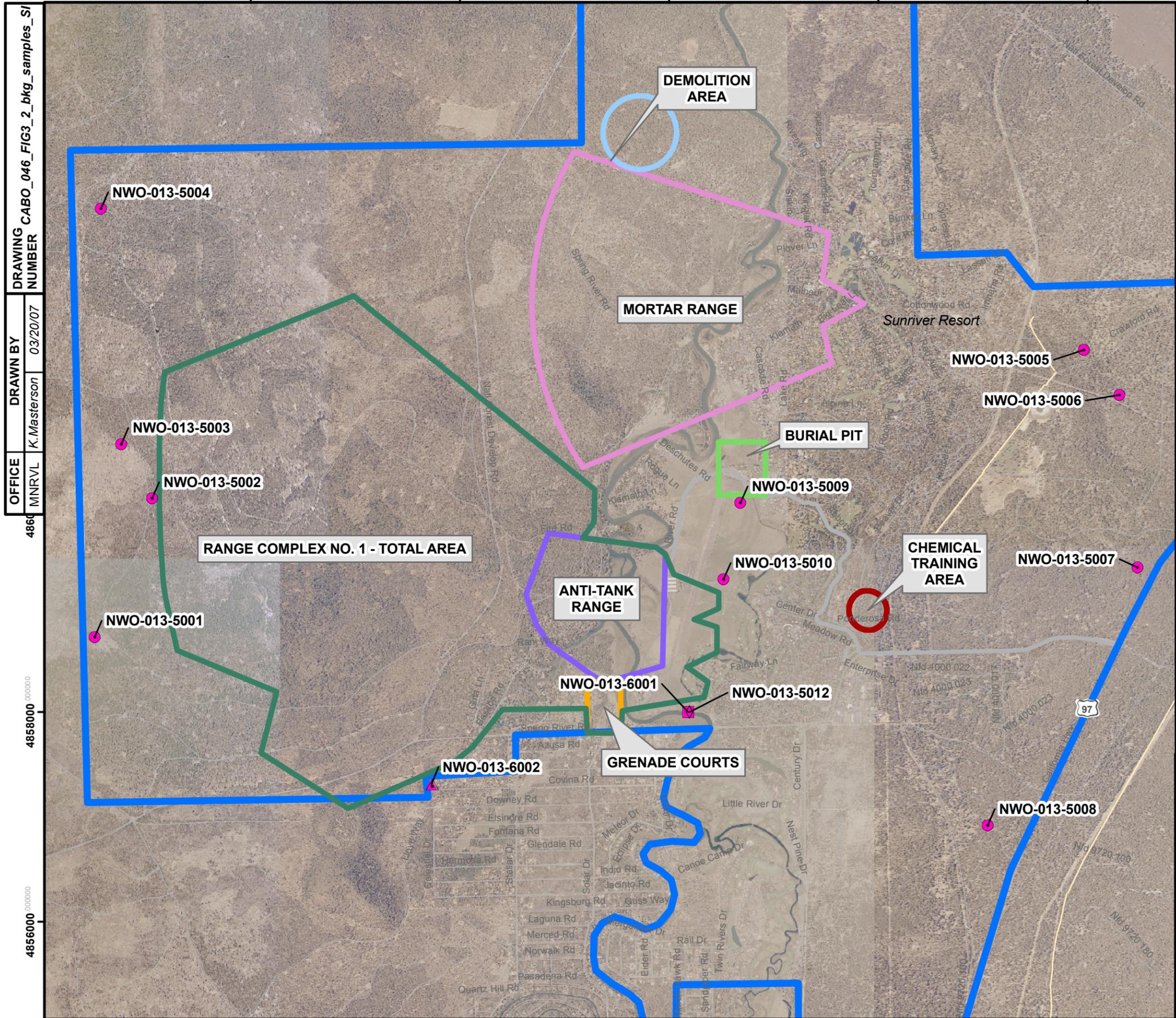
N

0 0.5 1 2 Miles

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 5-3
SENSITIVE RECEPTORS
WITHIN A 2-MILE AND 4-MILE RADIUS
OF THE FUDS BOUNDARY
 CAMP ABBOT

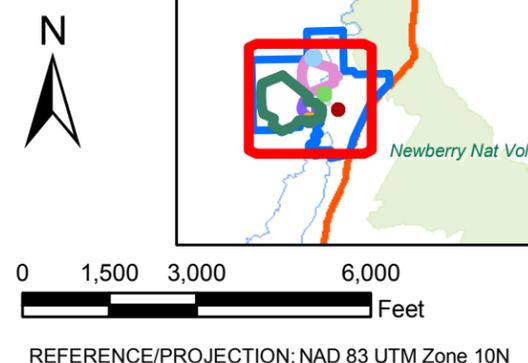


DRAWING CABO_046_FIG3_2_bkg_samples_SI
 NUMBER
 DRAWN BY
 OFFICE
 MNRVL
 K.Masterson
 03/20/07
 4860

Legend

- Camp Abbot FUDS Boundary
- Anti-Tank Range AOC Boundary
- Burial Pit AOC Boundary
- Chemical Training Area AOC Boundary
- Demolition Area AOC Boundary
- Grenade Courts AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary
- Background Soil Sample Location
- ◆ Background Sediment Sample Location
- Background Surface Water Sample Location
- ▲ Background Groundwater Sample Location

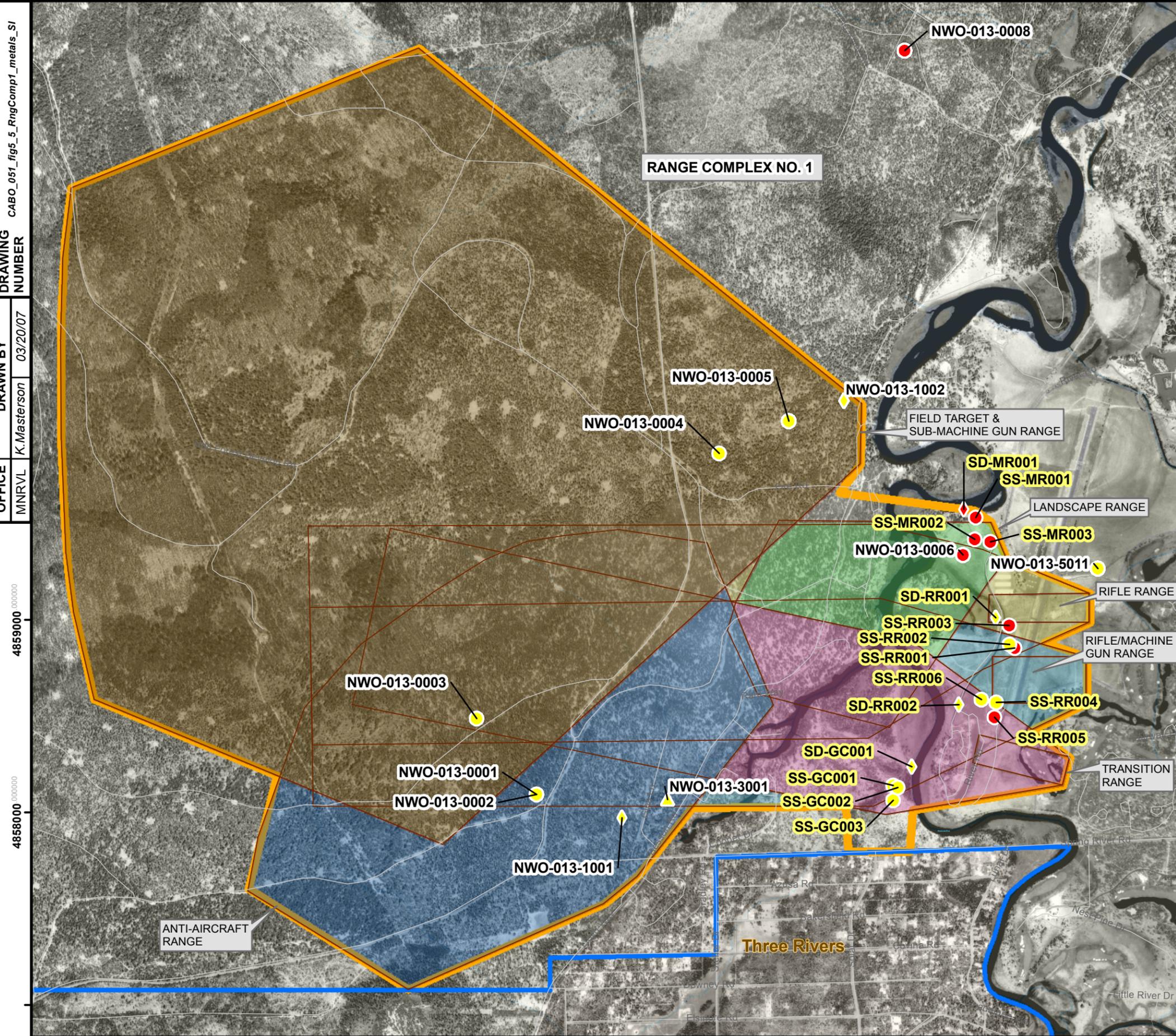
NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo was obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-AFPO National Agricultural Inventory Project (NAIP), 2003.



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FIGURE 5-4
BACKGROUND SAMPLE LOCATIONS
 CAMP ABBOT

619000 620000 621000 622000 623000 624000

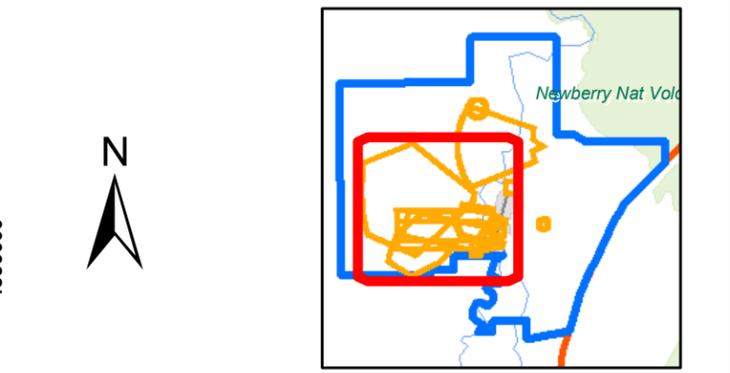


Legend

- Camp Abbot FUDS Boundary
- Range Complex No. 1
- Subrange Boundary
- Soil Samples Results Greater than Background and Greater than Eco or Human Health Screening Values
- Sediment Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Soil Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- Sediment Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- Groundwater Sample Results Less than Background

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.

SS-MR001 Yellow highlighted sample location indicates data obtained from the Camp Abbot FUDS Preliminary Assessment/Site Inspection Report, Weston (2005).



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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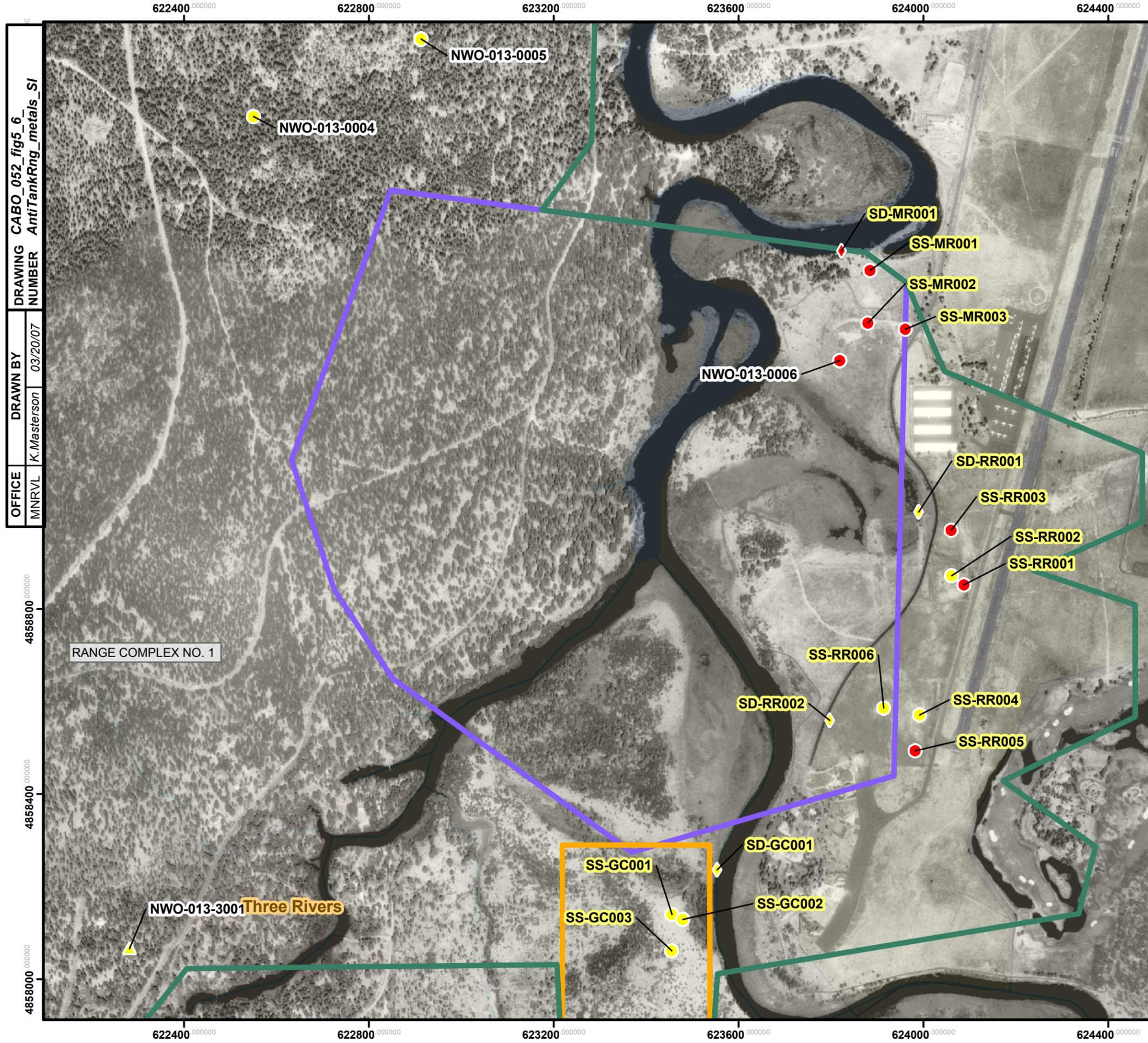
FIGURE 5-5
METALS RESULTS
RANGE COMPLEX NO. 1
 CAMP ABBOT

619000 620000 621000 622000 623000 624000

OFFICE: MNRVL
 DRAWN BY: K. Masterson
 DRAWING NUMBER: 03/20/07
 CABO_051_fig5_5_RngComp1_metals_SI

4859000
 4858000

4862000
 4861000
 4860000
 4859000



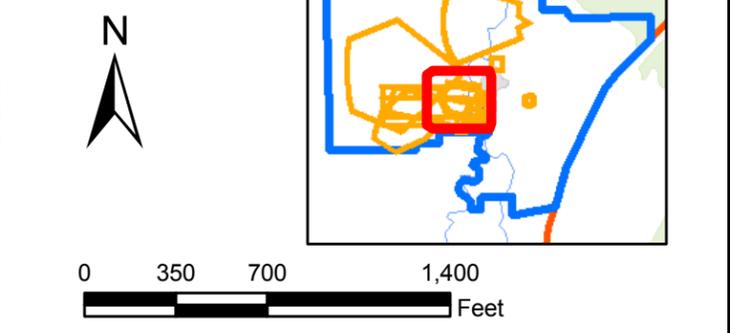
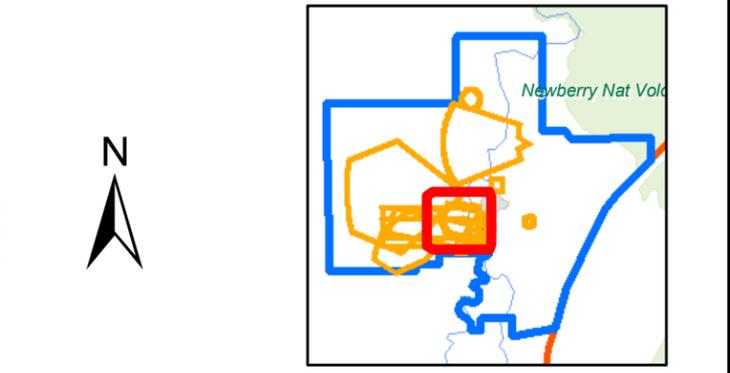
OFFICE: MNRVL
 DRAWN BY: K. Masterson
 DATE: 03/20/07
 DRAWING NUMBER: CABO_052_fig5_6
 TITLE: AntiTankRng_metals_SI

Legend

- Anti-Tank Range AOC Boundary
- Grenade Courts AOC Boundary
- Range Complex No. 1 AOC Boundary
- Soil Samples Results Greater than Background and Greater than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Surface Water Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Soil Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- ▲ Groundwater Sample Results Less than Background and/or Less than Eco or Human Health Screening Values

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.

SS-MR001 Yellow highlighted sample location indicates data obtained from the Camp Abbot FUDS Preliminary Assessment/Site Inspection Report, Weston (2005).

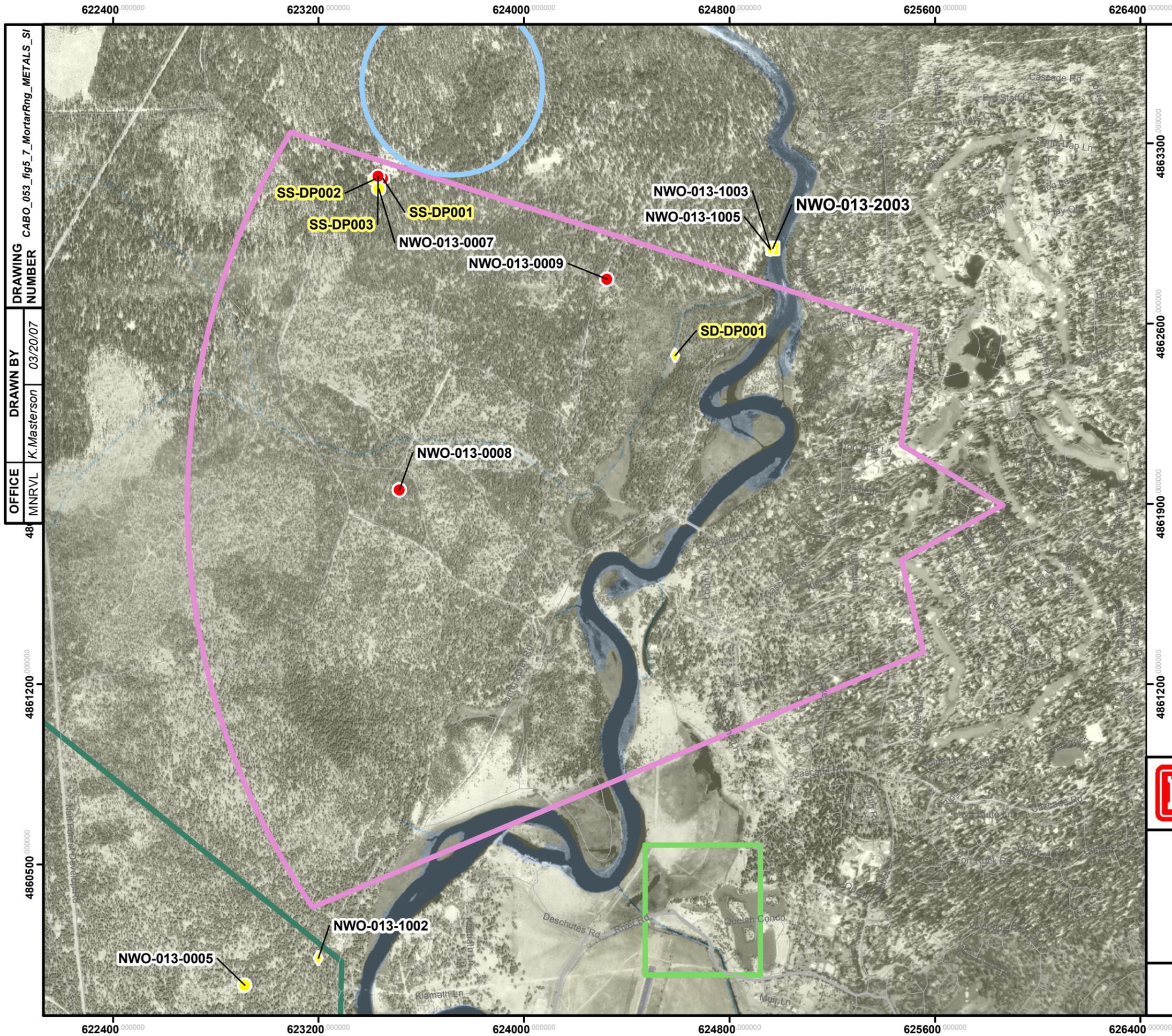


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 5-6
METALS RESULTS
ANTI-TANK RANGE
 CAMP ABBOT

Shaw Environmental, Inc.



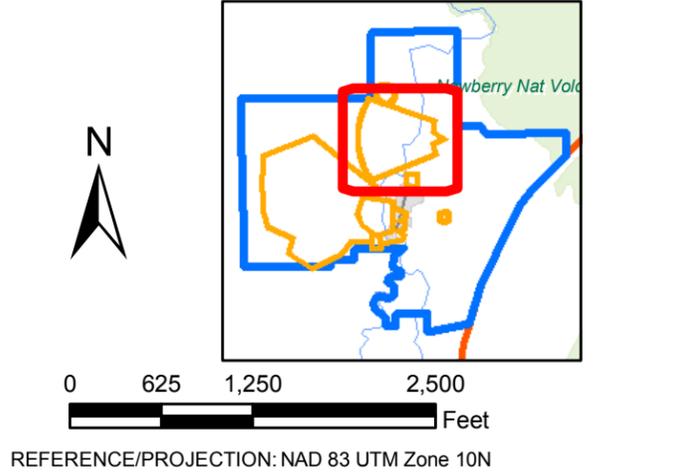
DRAWING NUMBER: CABO_053_fig5_7_MortarRng_METALS_SI
 DRAWN BY: K. Masterson
 DATE: 03/20/07
 OFFICE: MNRVL
 NUMBER: 48

Legend

- Burial Pit AOC Boundary
- Demolition Area AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary
- Soil Samples Results Greater than Background and Greater than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Surface Water Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Soil Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- Surface Water Sample Results Less than Background and/or Less than Eco or Human Health Screening Values

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.

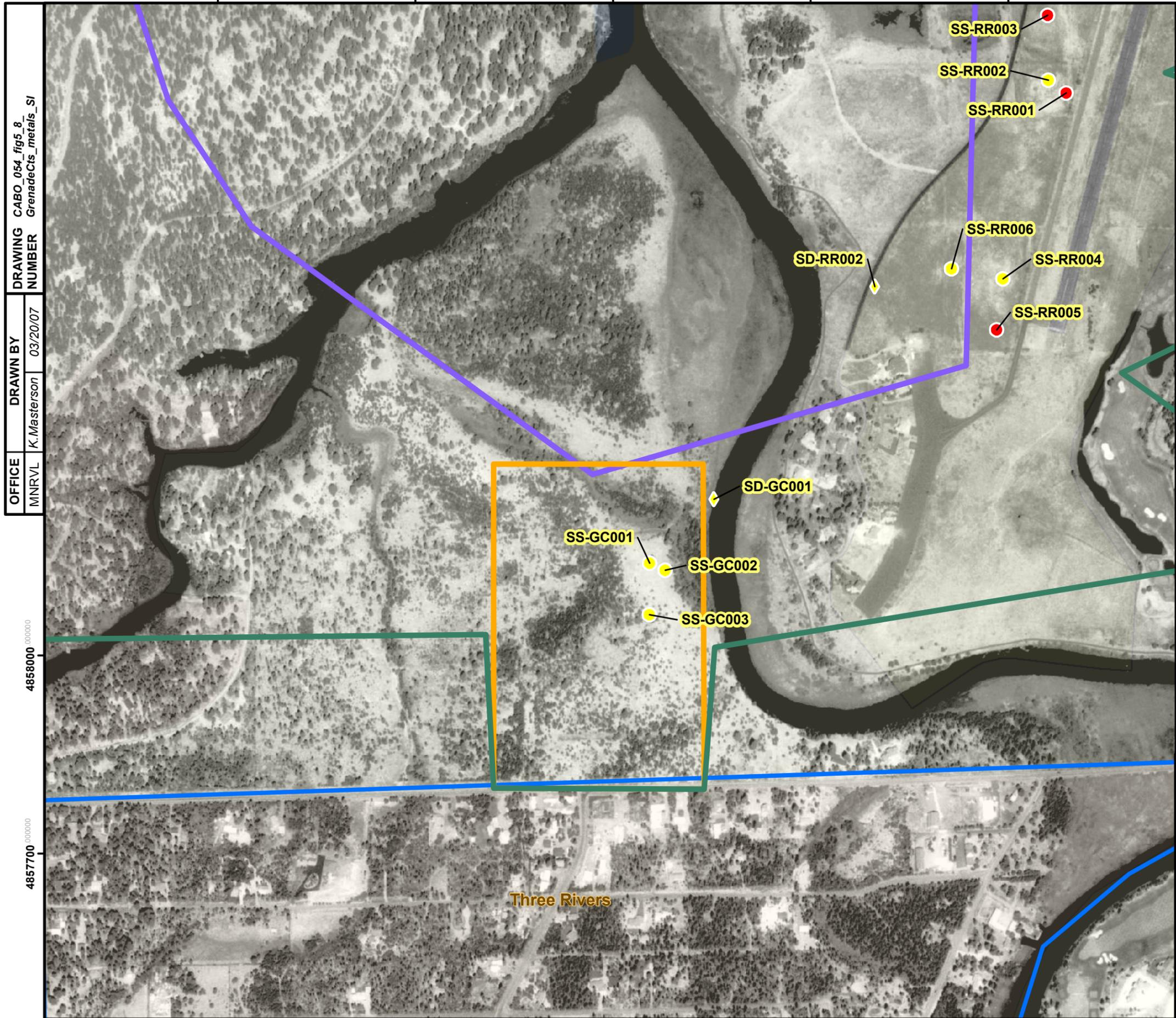
SS-MR001 Yellow highlighted sample location indicates data obtained from the Camp Abbot FUDS Preliminary Assessment/Site Inspection Report, Weston (2005).



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FIGURE 5-7
METALS RESULTS
DEMOLITION AREA / MORTAR RANGE
CAMP ABBOT

Shaw Shaw Environmental, Inc.



DRAWING CABO_054_fig5_8
NUMBER GrenadeCts_metals_SI

DRAWN BY
K.Masterson 03/20/07

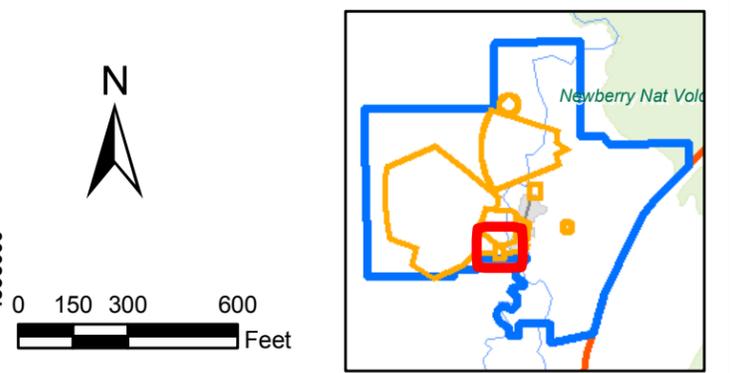
OFFICE
MNRVL

Legend

-  Camp Abbot FUDS Boundary
-  Anti-Tank Range AOC Boundary
-  Grenade Courts AOC Boundary
-  Range Complex No. 1 AOC Boundary
-  Soil Samples Results Greater than Background and Greater than Eco or Human Health Screening Values
-  Sediment Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
-  Soil Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
-  Surface Water Sample Results Less than Background and/or Less than Eco or Human Health Screening Values

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.

SS-MR001 Yellow highlighted sample location indicates data obtained from the Camp Abbot FUDS Preliminary Assessment/Site Inspection Report, Weston (2005).



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

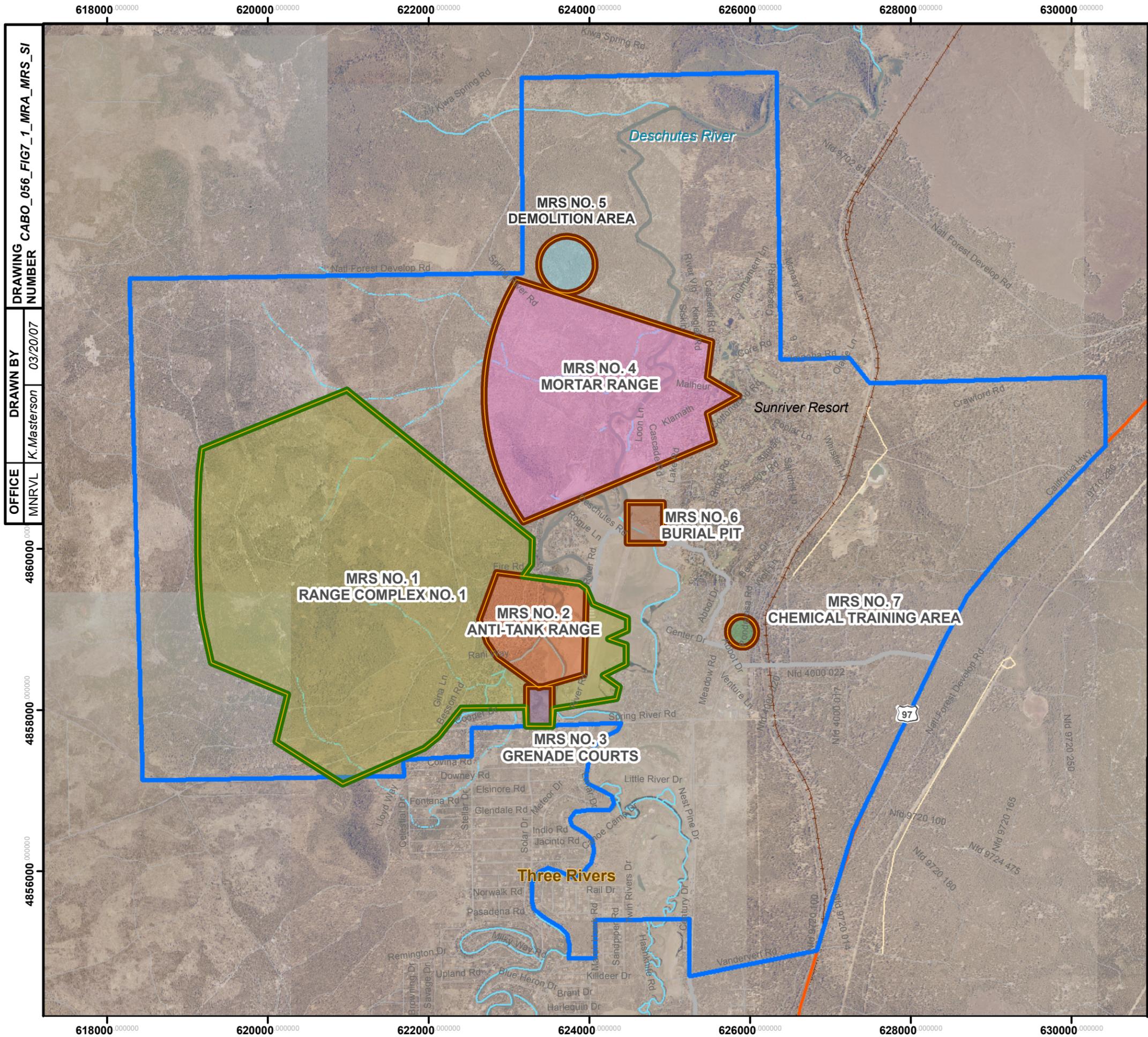


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FIGURE 5-8
METALS RESULTS
GRENADA COURTS
 CAMP ABBOT



Shaw Environmental, Inc.



DRAWING CABO_056_FIG7_1_MRA_MRS_SI
 NUMBER
 OFFICE MNRVL
 DRAWN BY K.Masterson
 DATE 03/20/07

Legend

- Camp Abbot FUDS Boundary
- ASR Supplement Ranges
- MRS Boundary
- MRS No. 1 Boundary

NOTES:
 1) Aerial photo was obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-AFPO National Agricultural Inventory Project (NAIP), 2003.

618000 620000 622000 624000 626000 628000 630000
 4866000
 4864000
 4862000
 4860000
 4858000
 4856000

N

0 0.5 1 2 Miles

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 7-1
MRS BOUNDARIES
 CAMP ABBOT

Shaw Shaw Environmental, Inc.

Tables

**Table 2-1
Munitions Information**

AOC	Munitions	Munitions Constituents
Range Complex No. 1	Small Arms General	Lead, single (nitrocellulose)- or double-base (nitrocellulose and nitroglycerin) propellant, copper, zinc
	.50-caliber Machine Gun	Lead, single (nitrocellulose)- or double-base (nitrocellulose and nitroglycerin) propellant, perchlorate, copper, zinc
Anti-Tank Range	M6A1, Rocket, HEAT, 2.36-inch	Pentolite (Pentaerythritol tetranitrate [PETN] and TNT), Ballistite (nitrocellulose and nitroglycerin), M400 (fuze), steel (iron, chromium, copper, lead, manganese, nickel, aluminum) and cast iron (iron)
	M6A3, Rocket, HEAT, 2.36-inch	Pentolite (PETN and TNT), Ballistite (nitroglycerin and nitrocellulose), M400 (fuze), steel (iron, chromium, copper, lead, manganese, nickel, aluminum) and cast iron (iron)
	M9A1 Rifle Grenade Anti-Tank	Pentolite (PETN and TNT), or TNT, cast iron (iron)
	M11A2 Practice Rifle Grenade	Inert, cast iron (iron)
	M7A1, Practice Rocket, 2.36-inch	5 Sticks of Ballistite (nitrocellulose and nitroglycerin), steel and cast iron (iron)
	M7A3, Practice Rocket, 2.36-inch	5 Sticks of Ballistite (nitrocellulose and nitroglycerin), steel (iron, chromium, copper, lead, manganese, nickel, aluminum) and cast iron (iron)
	M1A1 Anti-Tank Mine	TNT, steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M2 Anti-personnel Mine	TNT, steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
Demolition Area	Explosives Detonating Cord	PETN
	Explosives Dynamite Commercial	Nitroglycerin
	Explosives TNT	TNT
	Detonators	Mercury Fulminate, lead azide, tetryl
	Blasting Caps Electric Commercial	Sensitive explosive
	Fuzes, Boosters, or Bursters	TNT or 50/50 Pentolite, mercury fulminate, tetryl
Mortar Range	60 mm HE M49	TNT, Ballistite (nitrocellulose and nitroglycerin), steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
	60 mm Practice M50A2	Inert with black powder pellets, forged steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
	81 mm, HE, M43	TNT, Ballistite (nitrocellulose and nitroglycerin), forged steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
	81 mm, TP M43A1	Black powder, forged steel (iron, chromium, copper, lead, manganese, nickel, aluminum)

Table 2-1 (Cont.)

AOC	Munitions	Munitions Constituents
Grenade Courts	Mk II, Hand Grenade, Frag	TNT (Flaked or Granular), older models used E.C. Blank Smokeless Powder (nitrocellulose) or E.C. Blank Powder (nitrocellulose, barium nitrate, potassium nitrate, charcoal, and sulfur), perchlorate, cast iron (iron)
	AN-M8 Smoke Grenade HC	Hexachloroethane-zinc, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	CN, M7, and M7A1 Hand Grenade	CN Gas, potassium bicarbonate, perchlorate, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M18 Smoke Grenade	Smoke composition, steel sheet metal, fuze – mercury fulminate
	AN-M14, Incendiary Grenade	Igniter mixture III, Delay mixture V, FF mixture VII, incendiary mixture, Thermite, TH3 and thermite, plain, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M15, Smoke Grenade, WP	White Phosphorous, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M21, Practice Hand Grenade	Black Powder, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
Burial Pit	Small Arms General	Lead, single (nitrocellulose)- or double-base (nitrocellulose and nitroglycerin) propellant, copper, zinc;
	Small Arms General-complete rounds	Lead, single (nitrocellulose)- or double-base (nitrocellulose and nitroglycerin) propellant; lead, brass
	Mk II, Hand Grenade, Frag	TNT (Flaked or Granular), older models used E.C. Blankfire Powder (nitrocellulose, barium nitrate, potassium nitrate, charcoal, and sulfur), cast iron (iron)
	AN-M14, Incendiary Grenade	Igniter mixture III, Delay mixture V, FF mixture VII, incendiary mixture, Thermite, TH3 and thermite, plain, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M15, Smoke Grenade, WP	White Phosphorous. Steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)

Table 2-1 (Cont.)

AOC	Munitions	Munitions Constituents
Burial Pit	M6A1, Rocket, HEAT, 2.36-inch	Pentolite (PETN and TNT), Ballistite (nitrocellulose and nitroglycerin), steel (iron, chromium, copper, lead, manganese, nickel, aluminum) and cast iron (iron)
	M7A1, Practice Rocket, 2.36-inch	5 Sticks of Ballistite (nitrocellulose and nitroglycerin), steel (iron, chromium, copper, lead, manganese, nickel, aluminum) and cast iron (iron)
	60 mm, HE, M49	TNT, Ballistite (nitrocellulose and nitroglycerin), steel
	81 mm, HE, M43	TNT, Ballistite (nitrocellulose and nitroglycerin), forged steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
	60 mm, Practice, M50A2	Inert with black powder pellets, forged steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
AOC	Munitions	Munitions Constituents
Burial Pit (cont.)	Riot Control Agents	No data sheets provided
	Less Sensitive Explosives (Ammonium Nitrate, Explosive D, etc.	No data sheets provided
	Chemical ID, Toxic Gas Set M2	28 Heat-sealed Ampoules with 3.8 ounces of Mustard
	Toxic Chemical Munitions	No data sheets provided
Chemical Training Area	AN-M8 Smoke Grenade HC	Hexachloroethane-zinc, steel sheet metal
	AN-M14, Incendiary Grenade	Igniter mixture III, Delay mixture V, FF mixture VII, incendiary mixture, Thermite, TH3 and thermite, plain, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M15, Smoke Grenade, WP	White Phosphorous, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	Pot Tear Gas M1	Chloracetophenone mixture
	Chemical Agent Identification Set (CAIS), M1, (K955)	Mustard, Lewisite, Chloropicrin, and Phosgene, Adamsite, chloracetophenone
	Chemical Agent Identification Set, Instructional (CAIS), M2 (K942)	28 Heat-sealed Ampoules with 3.8 ounces of Mustard
	Chemical Agent Identification Set, Instructional (CAIS), M1 (K941)	24 bottles of 32 ounces of Mustard, Chloropicrin, Lewisite, Adamsite, Chloracetophenone, Triphosgene
	Toxic Chemical Munitions	Mustard, distilled mustard

Sources: USACE, 1995 and 2004b.

Table 2-2
Army Checklist for Important Ecological Places ^a
Camp Abbot

		Yes / No	Comments
1	Locally important ecological place identified by the Integrated Natural Resource Management Plan, BRAC Cleanup Plan or Redevelopment Plan, or other official land management plans	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
2	Critical habitat for Federal designated endangered or threatened species	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
3	Marine Sanctuary	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
4	National Park	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
5	Designated Federal Wilderness Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
6	Areas identified under the Coastal Zone Management Act	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
7	Sensitive Areas identified under the National Estuary Program or Near Coastal Waters Program	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
8	Critical areas identified under the Clean Lakes Program	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
9	National Monument	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
10	National Seashore Recreational Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
11	National Lakeshore Recreational Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
12	Habitat known to be used by Federal designated or proposed endangered or threatened species	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Numerous T&E species may occur on or near the Site, as identified by USFWS and ODFW (USACE, 1995).
13	National preserve	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
14	National or State Wildlife Refuge	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
15	Unit of Coastal Barrier Resources System	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
16	Coastal Barrier (undeveloped)	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
17	Federal land designated for protection of natural ecosystems	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
18	Administratively Proposed Federal Wilderness Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
19	Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
20	Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which fish spend extended periods of time	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
21	Terrestrial areas utilized for breeding by large or dense aggregations of animals	<input type="checkbox"/> / <input checked="" type="checkbox"/>	

Table 2-2 (Cont.)

		Yes / No	Comments
22	National river reach designated as Recreational	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
23	Habitat known to be used by state designated endangered or threatened species	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Numerous T&E species may occur on or near the Site, as identified by USFWS and ODFW (USACE, 1995).
24	Habitat known to be used by species under review as to its Federal endangered or threatened status	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
25	Coastal Barrier (partially developed)	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
26	Federally designated Scenic or Wild River	<input checked="" type="checkbox"/> / <input type="checkbox"/>	The Deschutes River that flows through the site is a federally designated Wild and Scenic River.
27	State land designated for wildlife or game management	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
28	State-designated Scenic or Wild River	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
29	State-designated Natural Areas	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
30	Particular areas, relatively small in size, important to maintenance of unique biotic communities	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
31	State-designated areas for protection or maintenance of aquatic life	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
32	Wetlands	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Several linear miles of wetlands occur within and near the site.
33	Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Soils at the site are generally very thin to absent, with surface outcroppings of volcanic rocks.

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

**Table 5-A
Summary of Camp Abbot Background Values**

Metal	Soil Background Concentration 95th UTL/95th Percentile ^a (Based on 10 Samples) (mg/kg)	Sediment Background Concentration Based on 1 Sample ^b (mg/kg)	Groundwater Background Concentration Based on 1 Sample ^b (ug/L)	Surface Water Background Concentration Dissolved Fraction Based on 1 Sample ^b (ug/L)	Surface Water Background Concentration Total Fraction Based on 1 Sample ^b (ug/L)
Aluminum	26,600	17300	<80.2	<44.3	<21.2
Antimony	< 0.93	<0.16	<0.13	<0.13	<0.13
Barium	176	111	4.3	3.6	<2.9
Cadmium	0.59	0.25	<0.17	<0.17	<0.17
Chromium	19.2	30.8	<1.3	<1.3	<1.3
Cobalt	13	7.2	<0.086	<0.063	<0.032
Copper	23.7	25.8	<2.1	<2.1	6.4
Iron	21,300	14100	146	71.9	<5.5
Lead	4.2	3.7	<0.18	0.33	0.43
Magnesium	17,700	1850	2100	2020	7150
Manganese	586	175	9.9	4.3	1.1
Mercury	0.022	<0.0082	<0.046	<0.058	<0.035
Molybdenum	1.8 ^c	<0.28	<0.37	<0.32	<0.47
Nickel	42.4	31.4	0.39	0.61	0.37
Zinc	43.5	29.3	<0.189	<13.2	<12

Note: 95th UTLs are provided for analytes with normal or lognormal distributions. 95th percentiles are provided for analytes with distributions that are neither normal nor lognormal, or that have greater than 15 percent nondetects (per EPA, 1989)

mg/kg - milligrams per kilogram.

ug/L - micrograms per liter

UTL - Upper tolerance limit.

< - analytical result was less than value indicated

^a Supporting calculations for soil background values are provided in Appendix L

^b Background sample analytical results provided in Appendix G

^c Statistics based on 8 samples

**Table 5-1
Summary of Site Inspection Samples Collected
Camp Abbot**

Location	Sample Number	UTM Northing	UTM Easting	Sample Purpose	Matrix	Sample Date	Start Depth (ft)	End Depth (ft)	Laboratory Sample Number	Lead by SW-846 6020A	Perchlorate by LC/MS *	TAL Metals by SW-846 6020A	Selected Metals ** by SW-846 6020A	Mercury by SW-846 7470A/7471A	Explosives by SW-846 8330A	Nitroglycerine and PETN by SW-846 8330A (Modified)
Range Complex No. 1																
013A001	NWO-013-0001	4858093	621600	REG	SS	26-Sep-06	0.08	0.5	610006-005	X						
	NWO-013-0002	4858093	621600	FD	SS	26-Sep-06	0.08	0.5	610006-004	X						
013A002	NWO-013-0003	4858487	621288	REG	SS	23-Sep-06	0.08	0.5	609148-005	X						
013A003	NWO-013-0004	4859863	622550	REG	SS	26-Sep-06	0.08	0.5	610006-001	X						
013A004	NWO-013-0005	4860031	622913	REG	SS	27-Sep-06	0.08	0.5	609148-016				X	X	X	X
013A005	NWO-013-1001	4857972	622045	REG	SD	26-Sep-06	0.08	0.3	610006-003	X						
013A006	NWO-013-1002	4860136	623200	REG	SD	27-Sep-06	0.08	0.3	609148-017				X	X	X	X
013A008	NWO-013-3001	4858066	622282	REG	GW	27-Sep-06	0	0	610002-001		X		X	X	X	X
Anti-Tank Range																
013A007	NWO-013-0006	4859336	623819	REG	SS	25-Sep-06	0.08	0.5	609148-010				X	X	X	X
Demolition Area																
013A009	NWO-013-0007	4863123	623435	REG	SS	25-Sep-06	0.08	0.5	609148-011							X
Mortar Range																
013A010	NWO-013-0008	4861954	623515	REG	SS	25-Sep-06	0.08	0.25	609148-012				X	X	X	X
013A011	NWO-013-0009	4862772	624323	REG	SS	27-Sep-06	0.08	0.5	609148-018				X	X	X	X
013A012	NWO-013-1003	4862888	624959	REG	SD	27-Sep-06	0.08	0.3	609148-019				X	X	X	X
	NWO-013-1005	4862888	624959	FD	SD	27-Sep-06	0.08	0.3	609148-020				X	X	X	X
013A014	NWO-013-2003	4862892	624969	REG	SW	27-Sep-06	0	0	610002-002 610002-005 (Filtered)		X		X	X	X	X
Background Samples																
013A020	NWO-013-5001	4858714	618507	REG	SS	23-Sep-06	0.08	0.5	609148-006			X		X		
013A021	NWO-013-5002	4860037	619058	REG	SS	23-Sep-06	0.08	0.5	609148-009			X		X		
013A022	NWO-013-5003	4860555	618763	REG	SS	23-Sep-06	0.08	0.5	609148-008			X		X		
013A023	NWO-013-5004	4862801	618569	REG	SS	23-Sep-06	0.08	0.5	609148-007			X		X		
013A024	NWO-013-5005	4861453	627964	REG	SS	23-Sep-06	0.08	0.5	609148-002			X		X		
013A025	NWO-013-5006	4861025	628306	REG	SS	23-Sep-06	0.08	0.5	609148-001			X		X		
013A026	NWO-013-5007	4859378	628478	REG	SS	23-Sep-06	0.08	0.5	609148-003			X		X		
013A027	NWO-013-5008	4856917	627046	REG	SS	23-Sep-06	0.08	0.5	609148-004			X		X		
013A028	NWO-013-5009	4859995	624682	REG	SS	26-Sep-06	0.08	0.5	610006-002			X		X		
013A029	NWO-013-5010	4859265	624521	REG	SS	25-Sep-06	0.08	0.5	609148-013			X		X		
	NWO-013-5011	4859265	624521	FD	SS	25-Sep-06	0.08	0.5	609148-014			X		X		
013A030	NWO-013-5012	4857999	624196	REG	SD	25-Sep-06	0	0.17	609148-015			X		X		
013A031	NWO-013-6001	4857997	624185	REG	SW	25-Sep-06	0	0	610002-004 610002-006 (Filtered)		X	X		X		
013A032	NWO-013-6002	4857309	621727	REG	GW	28-Sep-06	0	0	610002-003		X	X		X		

Notes:

* DataChem internal standard operating procedure "LC/MS-CLO4-Rev2."

** Selected metals are aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc.

- FD - field duplicate
- ft - feet
- GW - groundwater
- REG - regular field sample
- SDG - sample delivery group
- SS - surface soil (< 0.5ft bgs)
- SD - sediment
- SW - surface water
- TAL - target analyte list
- UTM - Universal Transverse Mercator

**Table 5-2
Summary of PA/SI Sampling
Camp Abbot**

PA/SI Sample ID	UTM Northing	UTM Easting	Matrix	Sample Date	Sample Depth Start (ft)	Sample Depth End (ft)	Perchlorate	TAL Metals plus Mercury	Pesticides/PC Bs	SVOCs	NBEC
Landfill Samples											
CAFD-SS-LF001	4860383.83	624681.6	SS	14-May-04	0	0.5		X	X	X	
CAFD-SS-LF002	4860383.83	624681.6	SS	14-May-04	0.5	2		X	X	X	
CAFD-SW-LF001	4860333.52	624667.07	SW	14-May-04	0	0.25		X	X	X	
CAFD-SD-LF004	4860331.93	624677.61	SD	14-May-04	0	0.5		X	X	X	
Range Complex No. 1											
CAFD-SS-MR001	4859530.73	623885.04	SS	14-May-04	0	0.5		X			
CAFD-SS-MR002	4859417.31	623879.94	SS	14-May-04	0	0.5		X			
CAFD-SS-MR003	4859403.82	623961.16	SS	14-May-04	0	0.5		X			
CAFD-SS-RR001	4858852.12	624088.2	SS	14-May-04	0	0.5		X			
CAFD-SS-RR002	4858871.61	624061.26	SS	14-May-04	0	0.5		X			
CAFD-SS-RR003	4858969.95	624060.17	SS	14-May-04	0	0.5		X			
CAFD-SS-RR004	4858570.64	623992.21	SS	16-May-04	0	0.5		X			
CAFD-SS-RR005	4858493.26	623982.66	SS	16-May-04	0	0.5		X			
CAFD-SS-RR006	4858585.82	623914.16	SS	16-May-04	0	0.5		X			
CAFD-SD-MR001	4859573.29	623822.85	SD	16-May-04	0	0.25		X			
CAFD-SD-RR001	4859009.48	623989.78	SD	16-May-04	0	0.25		X			
CAFD-SD-RR002	4858558.94	623797.51	SD	16-May-04	0	0.25		X			
Explosive Munitions Ranges											
CAFD-SS-DP001	4863163.46	623450.8	SS	15-May-04	0	0.5		X			X
CAFD-SS-DP002	4863160.88	623420.02	SS	15-May-04	0	0.25		X			X
CAFD-SS-DP003	4863172.31	623431.83	SS	15-May-04	0	0.33		X			X
CAFD-SD-DP001	4862476.27	624588.73	SD	15-May-04	0	0.25		X			X
Grenade Court											
CAFD-SS-GC001	4858139.91	623455.83	SS	16-May-04	0	0.25		X			X
CAFD-SS-GC002	4858129.23	623479.43	SS	16-May-04	0	0.25		X			X
CAFD-SS-GC003	4858061.55	623455.38	SS	16-May-04	0	0.25		X			X
CAFD-SD-GC001	4858236.53	623553.34	SD	16-May-04	0	0.18		X			X
Camp Abbot Groundwater											
CAFD-GW-MW001	4859781.2	625171.72	GW	16-May-04	-	-	X				X

Notes:

ft - feet

GW - groundwater

NBEC - nitrogen-based explosive compounds

PCBs - polychlorinated biphenyls

SS - soil

SD - sediment

SVOCs - semivolatile organic compounds

SW - surface water

TAL - target analyte list

UTM - Universal Transverse Mercator Zone 10

Source: *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report (Weston 2005).*

Table 5-3
Range Complex No.1
Groundwater Analytical Detections and Comparison to Background
and Human Health Screening Values

Location								013A008	
Sample Date								27-Sep-06	
Sample Number								NWO-013-3001	
Sample Purpose								REG	
Fraction	Parameter	Filtered	Units	Maximum Concentration from Media Background Sample	EPA Region 9 PRGs - Tap Water	Federal Drinking Water Criteria MCLs	Result	VQ	
Metals	Iron	N	ug/L	146	11000	300	38	J	
Metals	Lead	N	ug/L	<0.18	No criteria	15	0.44	J	
Metals	Magnesium	N	ug/L	2100	No criteria	No criteria	3140		
Metals	Manganese	N	ug/L	9.9	880	50	4.4		
Metals	Molybdenum	N	ug/L	<0.37	180	No criteria	0.72	J	
Metals	Nickel	N	ug/L	0.39	730	No criteria	0.37	J	

Notes:

[Bold Face] - Result exceeds Maximum Concentration from Media Background Sample

< - less than indicated value

EPA - Environmental Protection Agency

PRG - Preliminary Remediation Goal

MCL - Maximum Contaminant Level

REG - regular sample

ug/L - microgram per liter

VQ - validation qualifier

Validation Qualifier Definitions

U - Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

Table 5-4
Range Complex No. 1
Sediment Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values

Location						013A005		013A006		PA/SI		PA/SI		SRR	
Sample Date						26-Sep-06		27-Sep-06		16-May-04		16-May-04		16-May-04	
Sample Number						NWO-013-1001		NWO-013-1002		SD-MR001		SD-RR001		SD-RR002	
Sample Depth (bgs) (ft)						0.08 to 0.3		0.08 to 0.3		0 - 0.25		0 - 0.25		0 - 0.25	
Sample Purpose						REG		REG		REG		REG		REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	111	48	No criteria			<i>162</i>		79.5		92.2		70.9	
Metals	Chromium	mg/kg	30.8	37	210			14.2		13.1		28.4		12.2	
Metals	Copper	mg/kg	25.8	10	3100			<i>17.4</i>		24.7	JK	<i>27.4</i>	JK	20.7	JK
Metals	Iron	mg/kg	14100	20	23000			<i>20300</i>		<i>17900</i>		<i>18100</i>		7980	
Metals	Lead	mg/kg	3.7	35	400	3.7		3.9		352		2.2		3.3	
Metals	Magnesium	mg/kg	1850	No criteria	No criteria			2680		2970		6690		1890	
Metals	Manganese	mg/kg	175	1100	1800			463		213		197		86.4	
Metals	Mercury	mg/kg	<0.0082	0.2	23			0.016	J	0.07	BJK	<0.21	U	<0.14	U
Metals	Molybdenum	mg/kg	<0.28	No criteria	390			0.44	J	NA		NA		NA	
Metals	Nickel	mg/kg	31.4	18	1600			<i>24.4</i>		27.2		30.6		23.7	
Metals	Zinc	mg/kg	29.3	3	23000			36.8		28.3		52.2		36.5	

Notes:

[Bold Face] - Result exceeds Maximum Concentration from Media Background Sample

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041* , Shaw Environmental, Inc., September 2006

< - less than indicated value

EPA - Environmental Protection Agency

mg/kg - milligram per kilogram

NA - not analyzed for analyte

ND - not detected

PRG - Preliminary Remediation Goal

REG - regular sample

VQ - validation qualifier

Validation Qualifier Definitions

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

JK - The analyte was positively identified. The associated numerical value is an unknown bias estimate.

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

U - not detected above indicated value

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

**Table 5-5
Range Complex No. 1
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location						013A001		013A001		013A002		013A003		013A004		PA/SI Sample	
Sample Date						26-Sep-06		26-Sep-06		23-Sep-06		26-Sep-06		27-Sep-06		14-May-04	
Sample Number						NWO-013-0001		NWO-013-0002		NWO-013-0003		NWO-013-0004		NWO-013-0005		SS-RR001	
Sample Depth (bgs) (ft)						0.08 to 0.5		0.08 to 0.5		0.08 to 0.5		0.08 to 0.5		0.08 to 0.5		0 - 0.5	
Sample Purpose						REG		FD		REG		REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ										
Metals	Barium	mg/kg	176	85	No criteria									146		93.6	
Metals	Chromium	mg/kg	19.2	0.4	210									15.3		14.3	
Metals	Copper	mg/kg	23.7	50	3100									16.9		26.8	JK
Metals	Iron	mg/kg	21300	200	23000									20800		13300	
Metals	Lead	mg/kg	4.2	16	400	4.3		4.3		4.6		6.3		7.7		2.2	
Metals	Magnesium	mg/kg	17700	No criteria	No criteria									2940		2110	
Metals	Manganese	mg/kg	586	100	1800									372		145	
Metals	Mercury	mg/kg	0.022	0.1	23									<0.0084	U	0.07	BJK
Metals	Molybdenum	mg/kg	1.8	2	390									0.41	J	NA	
Metals	Nickel	mg/kg	42.4	30	1600									26.6		23.6	
Metals	Zinc	mg/kg	43.5	50	23000									36.7		54.9	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

a - Source - Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041, Shaw Environmental, Inc., September 2006

< - less than indicated value

EPA - Environmental Protection Agency

FD - field duplicate

mg/kg - milligram per kilogram

NA - not analyzed

ND - not detected

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

VQ - validation qualifier

Validation Qualifier Definitions

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

JK - The analyte was positively identified. The associated numerical value is an unknown bias estimate.

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

U - not detected above indicated value

PA/SI Report Data are from Camp Abbot FUDS Preliminary Assessment/Site Inspection Report (Weston 2005).

Table 5-5 (Cont.)
Range Complex No. 1
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values

Location						PA/SI Sample		PA/SI Sample		SRR Samp 1		SRR Samp 2		SRR Samp 3		MGR Si	
Sample Date						14-May-04		14-May-04		16-May-04		16-May-04		16-May-04		14-Ma	
Sample Number						SS-RR002		SS-RR003		SS-RR004		SS-RR005		SS-RR006		SS-MF	
Sample Depth (bgs) (ft)						0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0	
Sample Purpose						REG		REG		REG		REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	
Metals	Barium	mg/kg	176	85	No criteria	97.9		111		92.3		88.7		67.6		66.3	
Metals	Chromium	mg/kg	19.2	0.4	210	13.4		13		12		10.3		14.9		11.3	
Metals	Copper	mg/kg	23.7	50	3100	20.7	JK	22.2	JK	23.4	JK	23.1	JK	24	JK	16	
Metals	Iron	mg/kg	21300	200	23000	9690		10900		8280		5470		17700		10100	
Metals	Lead	mg/kg	4.2	16	400	2.6		2.4		2.9		3.5		1.7		4.8	
Metals	Magnesium	mg/kg	17700	No criteria	No criteria	1430		2730		2760		1950		8170		3500	
Metals	Manganese	mg/kg	586	100	1800	175		145		215		87.2		252		214	
Metals	Mercury	mg/kg	0.022	0.1	23	0.1	BJK	<0.15	U	0.07	BJK	0.11	BJK	0.1	BJK	0.96	
Metals	Molybdenum	mg/kg	1.8	2	390	NA		NA		NA		NA		NA		NA	
Metals	Nickel	mg/kg	42.4	30	1600	16.9		21.3		24.1		20.3		38.1		23.9	
Metals	Zinc	mg/kg	43.5	50	23000	36.4		33		39.1		29.6		45.8		27.2	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

a - Source - Final Site-Specific Work Plan, Camp Abbot, FUDS ID F100R0041, Shaw Environmental, Inc., Se

< - less than indicated value

EPA - Environmental Protection Agency

FD - field duplicate

mg/kg - milligram per kilogram

NA - not analyzed

ND - not detected

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

VQ - validation qualifier

Validation Qualifier Definitions

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

JK - The analyte was positively identified. The associated numerical value is an unknown bias estimate.

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

U - not detected above indicated value

PA/SI Report Data are from Camp Abbot FUDS Preliminary Assessment/Site Inspection Report (Weston 2005).

**Table 5-5 (Cont.)
Range Complex No. 1
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location			ump 1	MGR Samp 2	MGR Samp 3					
Sample Date			y-04	14-May-04	14-May-04					
Sample Number			t001	SS-MR002	SS-MR003					
Sample Depth (bgs) (ft)			.5	0 - 0.5	0 - 0.5					
Sample Purpose			G	REG	REG					
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	176	85	No criteria		128		105	
Metals	Chromium	mg/kg	19.2	0.4	210		10.5		13.2	
Metals	Copper	mg/kg	23.7	50	3100	JK	19.1	JK	27.2	JK
Metals	Iron	mg/kg	21300	200	23000		14700		17900	
Metals	Lead	mg/kg	4.2	16	400		6.3		24	
Metals	Magnesium	mg/kg	17700	No criteria	No criteria		2560		29.5	
Metals	Manganese	mg/kg	586	100	1800		429		374	
Metals	Mercury	mg/kg	0.022	0.1	23		0.06	BJK	<0.13	U
Metals	Molybdenum	mg/kg	1.8	2	390		NA		NA	
Metals	Nickel	mg/kg	42.4	30	1600		20.1		23.4	
Metals	Zinc	mg/kg	43.5	50	23000		72.8		65.7	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., Se

< - less than indicated value

EPA - Environmental Protection Agency

FD - field duplicate

mg/kg - milligram per kilogram

NA - not analyzed

ND - not detected

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

VQ - validation qualifier

Validation Qualifier Definitions

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

JK - The analyte was positively identified. The associated numerical value is an unknown bias estimate.

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

U - not detected above indicated value

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

**Table 5-6
Explosive Munitions Ranges Surface Water Analytical Detections (Total)
and Comparison to Background, Human Health, and Ecological Screening Values**

Location								013A014	
Sample Date								27-Sep-06	
Sample Number								NWO-013-2003	
Sample Purpose								REG (Total)	
Fraction	Parameter	Filtered	Units	Maximum Concentration from Media Background Sample (Total)	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Tap Water	Federal Drinking Water Criteria MCLs	Result	VQ
Metals	Iron	N	ug/L	<5.5	1000	11000	300	56.7	
Metals	Lead	N	ug/L	0.43	2.5	No criteria	15	0.24	J
Metals	Magnesium	N	ug/L	7150	82000	No criteria	No criteria	2120	
Metals	Manganese	N	ug/L	1.1	120	880	50	6.5	
Metals	Molybdenum	N	ug/L	<0.47	370	180	No criteria	0.5	J
Metals	Nickel	N	ug/L	0.37	52	730	No criteria	0.38	J

Notes:

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., September 2006

< - less than indicated value

EPA - Environmental Protection Agency

MCL - Maximum Contaminant Level

PRG - Preliminary Remediation Goal

REG - regular sample

ug/L - microgram per liter

VQ - validation qualifier

Validation Qualifier Definitions

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

**Table 5-7
Explosive Munitions Ranges Surface Water Analytical Detections (Dissolved)
and Comparison to Background, Human Health, and Ecological Screening Values**

Location								013A014	
Sample Date								27-Sep-06	
Sample Number								NWO-013-2003	
Sample Purpose								REG (Dissolved)	
Fraction	Parameter	Filtered	Units	Maximum Concentration from Media Background Sample (Dissolved)	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Tap Water	Federal Drinking Water Criteria MCLs	Result	VQ
Metals	Barium	Y	ug/L	3.6	4	No criteria	No criteria	3.3	J
Metals	Iron	Y	ug/L	71.9	1000	11000	300	95.5	
Metals	Lead	Y	ug/L	0.33	2.5	No criteria	15	0.33	J
Metals	Magnesium	Y	ug/L	2020	82000	No criteria	No criteria	2180	
Metals	Manganese	Y	ug/L	4.3	120	880	50	7.3	
Metals	Nickel	Y	ug/L	0.61	52	730	No criteria	0.35	J

Notes:

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., September 2006

EPA - Environmental Protection Agency

MCL - Maximum Contaminant Level

PRG - Preliminary Remediation Goal

REG - regular sample

ug/L - microgram per liter

VQ - validation qualifier

Validation Qualifier Definitions

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

**Table 5-8
Explosive Munitions Ranges
Sediment Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location						013A012	013A012	Demo Pit			
Sample Date						27-Sep-06	27-Sep-06	14-May-04			
Sample Number						NWO-013-1003	NWO-013-1005	SD-DP001			
Sample Depth (bgs) (ft)						0.08 to 0.3	0.08 to 0.3	0 - 0.25			
Sample Purpose						REG	FD	REG			
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	111	48	No criteria	65		61.8		43.3	BJK
Metals	Chromium	mg/kg	30.8	37	210	14.1		12.5		7.4	
Metals	Copper	mg/kg	25.8	10	3100	10		10.3		21.2	JK
Metals	Iron	mg/kg	14100	20	23000	16500		16700		2830	
Metals	Lead	mg/kg	3.7	35	400	3.7		3.2		2.9	
Metals	Magnesium	mg/kg	1850	No criteria	No criteria	2860		2400		733	BJK
Metals	Manganese	mg/kg	175	1100	1800	163		174		20.1	
Metals	Mercury	mg/kg	<0.0082	0.2	23	0.0088	U	0.0065	U	0.11	BJK
Metals	Nickel	mg/kg	31.4	18	1600	23.8		20.5		13.2	
Metals	Zinc	mg/kg	29.3	3	23000	39.8		38.9		10.6	BJK

Notes:

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

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., September 2006

< - less than indicated value

EPA - Environmental Protection Agency

PRG - Preliminary Remediation Goal

REG - regular sample

FD - field duplicate

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

U - Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

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

JK - The analyte was positively identified. The associated numerical value is an unknown bias estimate.

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

**Table 5-9
Explosive Munitions Ranges
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location						013A007		013A010		013A011		PA/SI Sample	
Sample Date						25-Sep-06		25-Sep-06		27-Sep-06		15-May-04	
Sample Number						NWO-013-0006		NWO-013-0008		NWO-013-0009		SS-DP001	
Sample Depth (bgs) (ft)						0.08 to 0.5		0.08 to 0.25		0.08 to 0.5		0 - 0.5	
Sample Purpose						REG		REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	176	85	No criteria	87.3		137		198		191	
Metals	Chromium	mg/kg	19.2	0.4	210	16.4		18.5		22.3		13.9	
Metals	Copper	mg/kg	23.7	50	3100	19		16.1		23.3		19.7	JK
Metals	Iron	mg/kg	21300	200	23000	17400		<u>23500</u>		<u>28800</u>		<u>23400</u>	
Metals	Lead	mg/kg	4.2	16	400	27.8		4.1		4.3		3	
Metals	Magnesium	mg/kg	17700	No criteria	No criteria	1510	J	2470		5400		3690	
Metals	Manganese	mg/kg	586	100	1800	187		475		496		524	
Metals	Mercury	mg/kg	0.022	0.1	23	0.027		0.015	J	0.027		0.12	U
Metals	Molybdenum	mg/kg	1.8	2	390	0.28	J	0.69	J	0.45	J	NA	
Metals	Nickel	mg/kg	42.4	30	1600	25.6		24.7		40		26.4	
Metals	Zinc	mg/kg	43.5	50	23000	37		37.1		40.2		38.8	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., September 2006

EPA - Environmental Protection Agency

mg/kg - milligram per kilogram

NA - analyte not analyzed for

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

VQ - validation qualifier

Validation Qualifier Definitions

U - Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

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

JK - The analyte was positively identified. The associated numerical value is an unknown bias estimate.

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

**Table 5-9 (Cont.)
Explosive Munitions Ranges
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location						PA/SI Sample		PA/SI Sample	
Sample Date						15-May-04		15-May-04	
Sample Number						SS-DP002		SS-DP003	
Sample Depth (bgs) (ft)						0 - 0.25		0 - 0.33	
Sample Purpose						REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ
Metals	Barium	mg/kg	176	85	No criteria	145		262	
Metals	Chromium	mg/kg	19.2	0.4	210	8.8		13.5	
Metals	Copper	mg/kg	23.7	50	3100	13.9	JK	20.4	JK
Metals	Iron	mg/kg	21300	200	23000	15300		20800	
Metals	Lead	mg/kg	4.2	16	400	3.5		3.7	
Metals	Magnesium	mg/kg	17700	No criteria	No criteria	2340		2140	
Metals	Manganese	mg/kg	586	100	1800	523		645	
Metals	Mercury	mg/kg	0.022	0.1	23	0.13	U	0.12	U
Metals	Molybdenum	mg/kg	1.8	2	390	NA		NA	
Metals	Nickel	mg/kg	42.4	30	1600	16.6		19.3	
Metals	Zinc	mg/kg	43.5	50	23000	38.1		48.1	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., Septem

EPA - Environmental Protection Agency

mg/kg - milligram per kilogram

NA - analyte not analyzed for

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

VQ - validation qualifier

Validation Qualifier Definitions

U - Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

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

JK - The analyte was positively identified. The associated numerical value is an unknown bias estimate.

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

Table 5-10
Grenade Courts
Sediment Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values

Location						PA/SI Sample	
Sample Date						16-May-04	
Sample Number						SD-GC001	
Sample Depth (bgs) (ft)						0 - 0.17	
Sample Purpose						REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level^a	EPA Region 9 PRGs - Residential Soil	Result	VQ
Metals	Barium	mg/kg	111	48	No criteria	89.6	
Metals	Chromium	mg/kg	30.8	37	210	21.1	
Metals	Copper	mg/kg	25.8	10	3100	27.5	JK
Metals	Iron	mg/kg	14100	20	23000	15500	
Metals	Magnesium	mg/kg	1850	No criteria	No criteria	1900	
Metals	Manganese	mg/kg	175	1100	1800	85.2	
Metals	Nickel	mg/kg	31.4	18	1600	34.4	
Metals	Zinc	mg/kg	29.3	3	23000	21.9	

Notes:

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

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041* , Shaw Environmental, Inc., September 2006

EPA - Environmental Protection Agency

mg/kg - milligram per kilogram

PRG - Preliminary Remediation Goal

REG - regular sample

VQ - validation qualifier

Validation Qualifier Definitions

JK - The analyte was positively identified. The associated numerical value is an unknown bias estimate.

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

**Table 5-11
Grenade Courts
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location						PA/SI Sample		PA/SI Sample		PA/SI Sample	
Sample Date						16-May-04		16-May-04		16-May-04	
Sample Number						SS-GC001		SS-GC002		SS-GC003	
Sample Depth (bgs) (ft)						0 - 0.25		0 - 0.25		0 - 0.25	
Sample Purpose						REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	176	85	No criteria	<i>118</i>		<i>102</i>		<i>119</i>	
Metals	Chromium	mg/kg	19.2	.4	210	<i>11.5</i>		<i>13.9</i>		<i>12.5</i>	
Metals	Copper	mg/kg	23.7	50	3100	15.6	JK	15.8	JK	16	JK
Metals	Iron	mg/kg	21300	200	23000	<i>16500</i>		<i>19100</i>		<i>18500</i>	
Metals	Lead	mg/kg	4.2	16	400	2	JK	1.5	UJK	2	UJK
Metals	Magnesium	mg/kg	17700	No criteria	No criteria	4980		6180		5810	
Metals	Manganese	mg/kg	586	100	1800	<i>303</i>		<i>318</i>		<i>392</i>	
Metals	Nickel	mg/kg	42.4	30	1600	<i>30.2</i>		<i>35.9</i>		<i>32.7</i>	
Metals	Zinc	mg/kg	43.5	50	23000	31.1		34.2		31.3	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., September 2006

EPA - Environmental Protection Agency

mg/kg - milligram per kilogram

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

VQ - validation qualifier

Validation Qualifier Definitions

U - Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.

JK - The analyte was positively identified. The associated numerical value is an unknown bias estimate.

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).