



U.S. Army
Corps of Engineers
Omaha District



FINAL SITE INSPECTION REPORT

Fort Flagler Military Reservation

Jefferson County, WA

FUDS PROPERTY No. F10WA0316

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

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

September 2007



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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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Formerly Used Defense Sites
Military Munitions Response Program

September 2007

Submitted to:

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

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List of Acronyms

°F	degrees Fahrenheit
ADR	Automated Data Review
AOC	area of concern
ARC	Defense Environmental Programs Fiscal Year 2006 Annual Report to Congress
ASR	Archives Search Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CN	chloroacetophenone
CSM	conceptual site model
DERP	Defense Environmental Restoration Program
DMM	discarded military munitions
DoD	Department of Defense
DQO	data quality objective
EOD	Explosive Ordnance Disposal
EDR	Environmental Data Resources, Inc.
EPA	Environmental Protection Agency
ER	Engineering Regulation
FR	Federal Register
ft	foot or feet
Ft. Flagler	Fort Flagler Military Reservation
FUDS	Formerly Used Defense Sites
GPL	GPL Laboratories, LLLP
GPS	Global Positioning System
HE	high explosive
HRS	Hazard Ranking System
HTRW	hazardous, toxic, or radioactive wastes
INPR	Inventory Project Report
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
mg/kg	milligram(s) per kilogram
mm	millimeter
MMRP	Military Munitions Response Program
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MTCA	State of Washington Model Toxics Control Act
NCP	National Contingency Plan
NDAI	No Department of Defense Action Indicated
NWO	Northwest Region (Omaha District Military Munitions Design Center)

List of Acronyms (Cont.)

OB/OD	open burning/open demolition
PETN	pentaerythritol tetranitrate
PRG	Preliminary Remediation Goals
PSAP	Program Sampling and Analysis Plan
QA/QC	quality assurance/quality control
RAC	Risk Assessment Code
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
SLERA	Screening-Level Ecological Risk Assessment
Shaw	Shaw Environmental, Inc.
SHPO	State Historic Preservation Office
SI	Site Inspection
SOP	standard operating procedures
SSWP	Site-Specific Work Plan
State Parks	Washington State Parks and Recreation Commission
TCRA	time-critical removal action
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
USC	United States Code
USGS	United States Geological Survey
UTL	upper tolerance limit
UXO	unexploded ordnance
WA	Washington
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology

Glossary of Terms

Comprehensive Environmental Response, Compensation, and Liability Act of 1980

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

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

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

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

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

Military Munitions – Ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the U.S. Coast Guard, the U.S. Department of Energy, 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 Restoration Program to address DoD sites suspected
4 of containing munitions and explosives of concern (MEC) or munitions constituents (MC).
5 Under the MMRP, the U.S. Army Corps of Engineers (USACE) is conducting environmental
6 response activities at Formerly Used Defense Sites (FUDS) for the Army, DoD's Executive
7 Agent for the FUDS program. Shaw Environmental, Inc. (Shaw) is responsible for conducting
8 Site Inspections (SIs) at FUDS in the northwest region managed by the Omaha District Military
9 Munitions 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 (CERCLA). The SI collects the minimum amount of information necessary to make this
14 determination, as well as it (i) determines the potential need for a removal action; (ii) collects or
15 develops additional data, as appropriate, for Hazard Ranking System scoring by the
16 Environmental Protection Agency; and (iii) collects data, as appropriate, to characterize the
17 release for effective and rapid initiation of the Remedial Investigation and Feasibility Study. An
18 additional objective of the MMRP SI is to collect the additional data necessary to complete the
19 Munitions Response Site Prioritization Protocol (MRSP).

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 confirm
23 the presence or absence of MEC and/or associated MC contamination.

24 *Fort Flagler Military Reservation*

25 This report presents the results of an SI conducted at Fort Flagler Military Reservation (Ft.
26 Flagler), FUDS property number F10WA0316, located on the west side of Puget Sound near Port
27 Townsend in Jefferson County, Washington. Ft. Flagler was acquired by the U.S. Government
28 in 1866 and a coastal defense artillery battery was constructed beginning in 1897. The coastal
29 defense batteries were closed in 1945. Between 1942 and 1953, Ft. Flagler was used for
30 amphibious training and maneuvers. Ft. Flagler was decommissioned in 1953 and the property
31 was transferred in 1954 to the State of Washington for use as a state park.

32 *Technical Project Planning*

33 The approach for the SI was developed by Shaw in consultation with site stakeholders. A
34 Technical Project Planning meeting conducted in July 2006 was attended by representatives from
35 the USACE Omaha Design Center, USACE Seattle District, the Washington Department of

36 Ecology (WDOE), Washington State Parks and Recreation Commission (State Parks), and Shaw.
37 The stakeholders agreed to the approach and identified 11 areas of concern (AOCs), the Range
38 Complex (which includes all of the coastal artillery batteries), Ammunition Bunker, Transition
39 Range 1, Transition Range 2, Gas Chamber, Rifle Grenade/Anti-Tank Rocket Range, Live
40 Grenade Court, Practice Grenade Court, Rifle Range, Demolition Area, and Quartermaster
41 Wharf Disposal Area, for further evaluation in the SI.

42 *SI Field Activities*

43 SI field activities, conducted in February 2007, included a site reconnaissance to look for
44 evidence of MEC and to avoid MEC during sampling. Samples were collected from surface soil
45 and sediment.

46 *SI Recommendations*

47 Results of the SI provide the basis for conclusions and/or recommendations for further actions at
48 each of the ranges identified in the MMRP Range Inventory found in the *Defense Environmental*
49 *Programs Annual Report to Congress (ARC) Fiscal Year 2006* (DoD, 2006).

50 *Range Complex*

51 The Range Complex consists of the nine artillery batteries, Transition Range 1, and the Gas
52 Chamber. Based on historical evidence including the configuration, and limited use of the
53 batteries, it is unlikely that munitions would have been discarded. Results from the SI field
54 reconnaissance activities indicate there is no evidence of MEC at the Range Complex.
55 Therefore, a recommendation for NDAI with respect to MEC is made for the Range Complex
56 No sampling was conducted at the nine artillery batteries or Gas Chamber within the Range
57 Complex. Significant MC from firing the artillery guns is unlikely because of infrequent use and
58 the extended time period since use stopped. Residue from the gas used (CN-1) at the gas
59 chamber is not expected as well. Soil and sediment sampling for lead was completed within
60 Transition Range 1. Analytical results show that lead concentrations in soil and sediment were
61 below background concentrations or human health and ecological screening values. Therefore, a
62 recommendation for NDAI for MC is made for the Range Complex

63 *Transition Range 2*

64 Based on historical use of the range and results of the SI field activities, there is no evidence of
65 MEC or munitions debris (other than small arms use) at the Transition Range 2. Analytical
66 results from soil and sediment sampling indicated that lead concentrations were below
67 background concentrations. A recommendation for NDAI for both MEC and MC is made for
68 Transition Range 2.

69 *Rocket Range*

70 Based on historical use of the Rocket Range, previous clearance activities, and results of the SI
71 field activities, there is evidence of MEC at this range and a moderate risk to park users.

72 Therefore, a recommendation for RI/FS for MEC is made for the Rocket Range.

73 Analytical results from three soil samples and one sediment sample did not exceed background.

74 Therefore, a recommendation for NDAI for MC is made for the Rocket Range.

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

77 *Additional Munitions Response Sites*

78 Based on USACE guidance, only those ranges identified in the ARC (DoD, 2006) are assigned
79 to a munitions response area (MRA)/munitions response site (MRS) and scored using the
80 MRSPP protocols until DoD can determine the eligibility of the other AOCs. Recommendations
81 for identification for the remaining AOCs are made below.

82 *Ammunition Bunker*

83 The Ammunition Bunker is not recommended to be identified as an MRS. The Ammunition
84 Bunker is also located within the boundaries of MRS No.1 - Range Complex. While the AOC
85 was shown on a War Department map from 1945, no evidence of the bunker could be found at
86 the location indicated on the map. There is no evidence that the Ammunition Bunker has any
87 MEC or MC associated with it.

88 *Live Grenade Court*

89 The Live Grenade Court is recommended to be identified as an MRS. The Live Grenade Court
90 is not within one of the existing MRSs. While no evidence of the court (throwing bays, impact
91 area) was identified in the field due to very heavy vegetation growth, the trees at the reported
92 location indicate that it was once cleared (younger growth forest than surrounding forest). In
93 addition, the reported former use as a live grenade court suggests a potential for MEC and MC
94 risk. If the Live Grenade Court is identified as an MRS, additional investigations for MEC and
95 MC are recommended.

96 *Practice Grenade Court*

97 The Practice Grenade Court is recommended to be identified as an MRS. The Practice Grenade
98 Court is not within one of the existing MRSs. While no evidence of the court (throwing bays,
99 impact area) was identified in the field due to very heavy vegetation growth, the trees at the
100 reported location indicate that it was once cleared (younger growth forest than surrounding
101 forest). In addition, the reported former use as a practice grenade court suggests a potential for
102 MEC and MC risk. If the Practice Grenade Court is identified as an MRS, additional
103 investigations for MEC and MC are recommended.

104 *Rifle Range*

105 The Rifle Range is recommended to be identified as an MRS. The Rifle Range is within the
106 boundary of the MRS No. 1 - Range Complex. There is direct evidence that this range was used
107 as a rifle range and the MC risk is present based on lead concentrations above site background,
108 human health, and ecological screening values. If the Rifle Range is identified as an MRS,
109 additional investigations for MC are recommended.

110 *Demolition Area*

111 The Demolition Area is recommended to be identified as an MRS. The Demolition Area is not
112 within one of the existing MRSs. The War Department map (Appendix L) identified this area as
113 a “Demolition Area Rifle Grenade”, and it appears that the location was a beach area that has
114 been backfilled. There is no apparent surface MEC risk at this location. However, there may be
115 a subsurface MEC or MC risk. If the Demolition Area is identified as an MRS, additional
116 investigations for MEC and MC are recommended.

117 *Quartermaster Wharf Disposal Area*

118 The Quartermaster Wharf Disposal Area is recommended to be identified as an MRS. The
119 Quartermaster Wharf Area is within MRS No.1 the Range Complex. The area is thought to have
120 been used for disposal of unwanted materials. Small arms ammunition has been found on the
121 beach and other munitions may have been discarded there as well. There is a potential risk for
122 MEC and MC from disposal of munitions. If the Quartermaster Wharf Disposal Area is
123 identified as an MRS, additional investigations for MEC and MC are recommended.

124 **1.0 Introduction**

125 This Site Inspection (SI) Report presents the results of an SI conducted at the Fort Flagler
126 Military Reservation (Ft. Flagler) Formerly Used Defense Site (FUDS) located near Port
127 Townsend, Washington (WA). Shaw Environmental, Inc. (Shaw) has prepared this report for the
128 U.S. Army Corps of Engineers (USACE) in accordance with Task Order 003, issued under
129 USACE Contract No. W912DY-04-D-0010. Shaw is responsible for conducting SIs at FUDS in
130 the northwest region managed by the Omaha District Military Munitions Design Center (NWO)
131 as directed by the Performance Work Statement (Appendix A).

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

135 **1.1 Project Authorization**

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

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

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

153 **1.2 Site Name and Location**

154 Ft. Flagler, property number F10WA0316, is located on the west side of Puget Sound, 4 miles
155 southeast of Port Townsend in Jefferson County, WA (Figure 1-1). The former Ft. Flagler is
156 included in the MMRP Inventory in the *Defense Environmental Programs Annual Report to*

157 Congress (ARC) Fiscal Year 2006 (DoD, 2006) and in the *Inventory Project Report (INPR)*
 158 *Supplement* (USACE, 2004b), with three identified ranges and eleven sub-ranges as follows:

Range Name	Range Identifier	Approximate Area (acres)	UTM Coordinates (meters)¹
Range Complex	F10WA031602R01	27,682	N 5331074; E 522671
Battery Bankhead	F10WA031602R01-SR01	17,973	N 5329672; E 523706
Battery Calwell	F10WA031602R01-SR02	5,684	N 5331074; E 521940
Battery Downes	F10WA031602R01-SR03	5,348	N 5332161; E 521004
Battery Gratton	F10WA031602R01-SR04	8,537	N 5326888; E 526837
Battery Lee	F10WA031602R01-SR05	5,375	N 5329733; E 525170
Battery Rawlins	F10WA031602R01-SR06	6,844	N 5331074; E 521940
Battery Revere	F10WA031602R01-SR07	7,320	N 5333898; E 519236
Battery Wansboro	F10WA031602R01-SR08	5,221	N 5326461; E526816
Battery Wilhelm	F10WA031602R01-SR09	8,299	N 5335138; E 517957
Transition Range 1	F10WA031602R01-SR10	41	N 5326035; E 522914
Gas Chamber	F10WA031602R01-SR11	11	N 5326441; E 522914
Rocket Range	F10WA031602R02	25	N 5326746; E 521086
Transition Range 2	F10WA031602R03	0	N 5326788; E 521932

159 Coordinates for the ranges are in Universal Transverse Mercator, Zone 10N, NAD 83.

160 Of the 27,682 total acres reported for the Range Complex, the INPR Supplement indicates 550
 161 acres were on land and 27,132 acres were water acres. Due to overlapping range fans, the
 162 acreage of the individual sub-ranges is greater than the acreage of the Range Complex itself.
 163 Figure 1-2 shows the ranges identified in the ARC.

164 Transition Range 1 and the Gas Chamber are evaluated separately in this SI to aid in the
 165 evaluation of impacts. However, these two sub-ranges of the Range Complex are included in the
 166 MRSPP scoring of the Range Complex.

167 Additional areas at the former Ft. Flagler that were not identified in the INPR Supplement and
 168 Range Inventory are evaluated in this SI. The additional areas are:

- 169 • Ammunition Bunker
- 170 • Live Grenade Court
- 171 • Practice Grenade Court
- 172 • Rifle Range
- 173 • Demolition Area, and
- 174 • Quartermaster Wharf Disposal Area.

175 These additional areas were identified in the *Archives Search Report (ASR)* (USACE, 1995) and
176 from a War Department map (circa 1945) (Appendix L) that was obtained at the TPP meeting.

177 **1.3 Purpose, Scope, and Objectives of the Site Inspection**

178 The primary objective of the MMRP SI is to determine whether or not a FUDS project warrants
179 further response action under CERCLA. The SI collects the minimum amount of information
180 necessary to make this determination, as well as it (i) determines the potential need for a removal
181 action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking System
182 (HRS) scoring by Environmental Protection Agency (EPA); and (iii) collects data, as
183 appropriate, to characterize the release for effective and rapid initiation of the Remedial
184 Investigation and Feasibility Study (RI/FS). An additional objective of the MMRP SI is to
185 collect the additional data necessary to complete the Munitions Response Site Prioritization
186 Protocol (MRSPP).

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

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

- 196 • There is no indication of MEC;
- 197 and
- 198 • MC contamination does not exceed screening levels determined from Technical
- 199 Project Planning (TPP).

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

- 201 • There is evidence of MEC hazard. MEC hazard may be indicated by direct
- 202 observation of MEC during the SI, by indirect evidence (e.g., a false crater
- 203 potentially caused by impact of unexploded ordnance [UXO]), or by a report of
- 204 MEC being found in the past without record that the area was subsequently

205 cleared;
206 or

- 207 • MC contamination exceeds screening levels determined from TPP.

208 **Is a time-critical removal action (TCRA) warranted?** A TCRA may be needed if:

- 209 • High MEC hazard is identified. Shaw will immediately report any MEC findings
210 so that USACE can determine the hazard in accordance with the MRSPP. An
211 example of a high hazard would be finding sensitive MEC at the surface in a
212 populated area with no barriers to restrict access;
213 or

- 214 • Elevated MC risk is identified. Identification of a complete exposure pathway
215 (e.g., confirming MC concentrations above health-based risk standards in a water
216 supply well) would trigger notification of affected stakeholders. Data would be
217 presented at a second TPP meeting regarding the possible need for a TCRA.

218 For purposes of applying these decision rules, USACE has provided guidance that evidence of
219 MEC will generally be a basis of recommending RI/FS. Evidence of MEC may include
220 confirmed presence of MEC from historical sources or SI field work, or presence of munitions
221 debris (MD).

222 **1.4 Munitions Response Site Prioritization Protocol**

223 The MRSPP was published as a rule on October 5, 2005 (70 FR 58028). This rule implements
224 the requirement established in section 311(b) of the National Defense Authorization Act for
225 Fiscal Year 2002 for the DoD to assign a relative priority for munitions responses to each
226 location in the DoD's inventory of defense sites known or suspected of containing UXO,
227 discarded military munitions, or MC (70 FR 58016).

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

231 **2.0 Property Description and History**

232 The setting, history, and use of Ft. Flagler are described in the following sections. Unless
233 otherwise referenced, this information is taken from the ASR (USACE, 2005b).

234 **2.1 Historical Military Use**

235 Ft. Flagler (Figure 2-1) was used primarily for coastal defense installation between 1899 and
236 1945. During World War II, the Navy also operated an underwater listening station at Ft.
237 Flagler. Between 1942 and 1953, troops posted at Ft. Flagler also received small arms and
238 grenade training. In 1950, all harbor defenses around Puget Sound were decommissioned
239 including Ft. Flagler. The site was used for amphibious training and maneuvers after the coastal
240 artillery weapons were removed. In 1953, Ft. Flagler was closed and in 1954 the property was
241 transferred to the State of Washington for use as a state park.

242 **2.2 Munitions Information**

243 The type of munitions used at Ft. Flagler consisted of:

- 244 • Coastal artillery batteries ranging in size from 3-inch to 12-inch,
- 245 • Small arms,
- 246 • 37-mm portable anti-aircraft guns,
- 247 • Mark II hand grenades,
- 248 • M21 practice hand grenades,
- 249 • .50-caliber machine guns, and
- 250 • 2.36-inch and 3.5-inch anti-tank rockets.

251 Table 2-1 contains a detailed list of the munitions and associated MC reportedly used at the areas
252 of concern (AOCs).

253 **2.3 Ownership History**

254 The U.S. Government acquired 550 acres of land for Ft. Flagler in 1866. Construction of the
255 first coastal batteries did not begin until 1897. Additional acreage was acquired over the years
256 until the site grew to 809 acres. In 1953, Ft. Flagler was closed and in 1954 the property was
257 transferred to the State of Washington for use as a state park.

258 Ft. Flagler has permanent residents (park employees) and offers camping facilities to recreational
259 users. The area south of Ft. Flagler is populated with private residences. Figure 2-1 shows the
260 current land use from an aerial photograph perspective. Parcel ownership within the identified
261 range areas is shown on Figure 2-2.

262 **2.4 Physical Setting**

263 **2.4.1 Topography and Vegetation**

264 The Ft. Flagler FUDS lies within the Puget Trough Section of the Pacific Border Physiographic
265 Province. The elevation of the area ranges from sea level to approximately 180 feet (ft) (Figure
266 2-3).

267 **2.4.2 Land Use**

268 The FUDS is located entirely within the boundaries of the Ft. Flagler State Park and is currently
269 owned by the Washington State Parks and Recreation Commission (State Parks) and the United
270 States Geological Survey (USGS), which maintains an experimental station at the northeast tip of
271 the site. Campgrounds, picnic areas, buildings, and visitor facilities are currently in use at the
272 FUDS.

273 **2.4.3 Nearby Population**

274 The community nearest the former Ft. Flagler is Port Townsend, WA, with an estimated
275 population of 8,334 (U.S. Census, 2000) (Figure 2-4). Jefferson County has a 2000 estimated
276 population of 28,666 or approximately 15.4 people per square mile. There are 212 household
277 and 280 housing units within a 2-mile radius of the site, and 5,620 households and 6,342 housing
278 units within a 4-mile radius of the site. Estimated population (2000 census) within a 2-mile
279 radius and 4-mile radius of the Ft. Flagler FUDS property boundary is 361 and 12,204,
280 respectively.

281 **2.4.4 Climate**

282 The climate at Ft. Flagler FUDS is a west coast marine type with comparatively cool, dry
283 summers and mild but wet and cloudy winters. The area is within the “rain shadow” of the
284 Olympic Mountains and is the driest area in western Washington State. The wettest months are
285 generally November and December, with the driest months being July and August. The highest
286 monthly average temperature for Port Townsend is 72.2 degrees Fahrenheit (°F) in August and
287 the lowest monthly average temperature is 36.3°F in January. Port Townsend’s average annual
288 precipitation is 19.12 inches per year, with an average annual snowfall of 4 inches.

289 **2.4.5 Area Water Supply**

290 There are no groundwater wells on Ft. Flagler, and domestic water is obtained from the local
291 municipal water supplier (Jefferson County Public Utility District No. 1), from groundwater
292 wells located outside the FUDS boundary. The nearest private well is located approximately 250
293 ft south of the southwest corner of the FUDS boundary. The well depth is listed as 58 ft below
294 ground surface and the screen interval is listed as 15 to 53 ft below ground surface. Groundwater
295 wells within a 4-mile radius of the FUDS are shown on Figure 2-5. Groundwater flow direction
296 is outward from the interior of Marrowstone Island and the site towards Puget Sound and
297 associated bays and inlets. The wells shown on Figure 2-5 are upgradient of Ft. Flagler.

298 **2.4.6 Surface Water Features**

299 The primary surface water feature in the area is Puget Sound, a saltwater, tidal water body that
300 surrounds the site on three sides. There are no established streams on Ft. Flagler. Figure 2-6
301 shows the surface water features in the vicinity of Ft. Flagler.

302 **2.4.7 Geologic and Hydrogeologic Setting**

303 The Ft. Flagler FUDS lies within the Puget Trough Section of the Pacific Border Physiographic
304 Province. The geology of the area is controlled by the last glaciation period between 12,000 and
305 15,000 years ago. Glacial deposits consist of thick sequences of glacial till and sand and gravel.
306 Soil at the site consists of coastal beaches, Whidbey gravelly sandy loam, and Dick loamy sand.

307 Much of the shoreline at Ft. Flagler is bordered by steep slopes that are 20 to 30 ft in height.
308 Limited observations made during SI field activities of shoreline or slope conditions did not
309 indicate that any identified AOCs have been impacted by erosion.

310 **2.4.7.1 Bedrock Geology**

311 Bedrock beneath Ft. Flagler is Eocene (58 to 35 million years ago) fractured sandstone and shale.
312 Depth to bedrock beneath Ft. Flagler is greater than 1,200 feet below sea level (Sinclair and
313 Garrigues, 1994).

314 **2.4.7.2 Overburden Soils**

315 There is a very thick sequence (greater than 1,200 feet) of glacial deposits consisting of thick
316 sequences of glacial till and sands and gravels. Soil at the site consists of coastal beaches,
317 Whidbey gravelly sandy loam, and Dick loamy sand.

318 **2.4.7.3 Hydrogeology**

319 Groundwater occurs within the glacial deposits and water levels are generally within a few feet
320 of sea level (Sinclair and Garrigues, 1994). Therefore, depth to groundwater can be estimated
321 based on surface elevation. Groundwater flow direction is outward from the interior of the site
322 towards Puget Sound and associated bays and inlets.

323 **2.4.8 Sensitive Environments**

324 The ranges and other areas of interest at the Ft. Flagler addressed by this SI are used as a State
325 Park. The ranges and other areas do qualify as Important Ecological Places or Sensitive
326 Environments as defined by USACE (2006) or EPA (1997), as shown in Table 2-2. Figure 2-7
327 shows the locations of sensitive receptors such as schools and churches in the vicinity of the
328 FUDS.

329 **2.5 Previous Investigations for MC and MEC**

330 The following summarizes previous investigations at Ft. Flagler. Previous investigations at Ft.
331 Flagler have addressed MEC but not MC.

332 **2.5.1 Archives Search Report**

333 The USACE completed an ASR in April 2005 that compiled available information on the history
334 and use of Ft. Flagler, with emphasis on types and areas of ordnance use and disposal. The ASR
335 included a visit to the site in July 2003 (USACE, 2005b). The primary purpose of the site visit
336 was to assess the presence of MEC through non-intrusive means. The ASR evaluated the
337 following areas: Rocket Range, Rifle Range, Transition Range, Quartermaster Wharf Disposal
338 Area, and Off Shore Ordnance Area. A Risk Assessment Code (RAC) scoring was included in
339 the ASR. The areas scored were grouped by site usage rather than by AOC name. Possible
340 scores ranged from 5 (low risk) to 1 (high risk). The RAC scores are presented in the table
341 below.

Area	RAC Score	MEC Found
Rocket Range	5	No
Rifle Range	5	No
Transition Range	5	No
Quartermaster Wharf Disposal Area	3	No – Small Arms Only
Remaining Lands	5	No
Offshore Ordnance Area	5	No

342 The other AOCs addressed in this SI were not identified or scored in the ASR.

343 **2.5.2 Inventory Project Report Supplement**

344 The USACE completed an INPR Supplement in 2004, which compiled available information for
345 Ft. Flagler. As noted above in Section 1.2 of this SI, the INPR Supplement identified three
346 AOCs: the Range Complex, the Rocket Range, and Transition Range 2 (location unknown).
347 The Range Complex consisted of the nine artillery batteries, Transition Range 1, and the Gas
348 Chamber (USACE, 2004b).

349 **2.5.3 Other Investigations**

350 Ft. Flagler was certified as being decontaminated in 1954 by the USACE and again in 1959 by
351 the 170th Ordnance Detachment from Fort Lewis, Washington (USACE, 2005b).

352 A Findings and Determination of Eligibility and an INPR were completed in 1991, which
353 concluded that Ft. Flagler had been formerly used by the War Department (USACE, 1991).

354 In 1992, a TCRA was completed to locate four anti-tank rockets with live warheads that were
355 unaccounted during military training and not located during the 1954 and 1959 visual
356 inspections. The USACE determined that because of advances in technology for locating
357 subsurface UXO, an additional survey should be completed to locate the unaccounted for

358 munitions (IT, 1992) and other MEC from the rocket range. The removal action included the use
359 of magnetometers for locating subsurface MEC and MD. The removal action included the 100
360 percent clearance of two adjacent areas within the Rocket Range. A third area within the Rocket
361 Range was also surveyed, but at a lesser confidence than the other two areas due to very heavy
362 vegetation. The removal action found the following items:

- 363 • 2.36-inch expended rocket motors (172 items);
- 364 • 2.36-inch rockets with live warhead (3 items);
- 365 • 2.36-inch rockets with live fuse (2 items);
- 366 • 3.5-inch expended rocket motors (2 items);
- 367 • Live training hand grenade (1 item);
- 368 • Bangalore torpedo fuse housing, inert (1 item);
- 369 • Anti-tank/anti-vehicle mines, inert (12 items); and
- 370 • Empty .30-caliber casings (16 items).

371 During an undated HTRW program, 13 underground fuel tanks were removed. MEC or MC
372 related items were not addressed in that project (USACE, 1991).

373 *2.6 Other Land Uses that May Have Contributed to Contamination*

374 No other land uses have been identified that may have contributed to contamination.

375 *2.7 Past Regulatory Activities*

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

377 *2.8 Previous MEC Finds*

378 The only MEC that has been located at Ft. Flagler were the three 2.36-inch rockets with live
379 warheads, two 2.36-inch rockets with live fuzes, and one live training hand grenade during the
380 1992 TCRA. The three rockets with live warheads were destroyed on site and the two rockets
381 with live fuzes and live practice hand grenade were removed from the site by the Army EOD
382 Unit from Fort Lewis.

383 3.0 *SI Tasks and Findings*

384 SI tasks conducted for this FUDS property involved compiling and reviewing historical reports
385 and information, using this information in the TPP process, preparing the *Site-Specific Work*
386 *Plan* (SSWP), conducting field work, and preparing this SI Report. Following the TPP meeting,
387 the SSWP was prepared to define the SI field activities necessary to collect the information
388 needed to address the data gaps and data quality objectives (DQOs). Field work was conducted
389 at the site between February 20 and 22, 2007.

390 3.1 *Technical Project Planning*

391 TPP involved compiling and reviewing historical reports and information to identify data gaps
392 and develop a path forward. The TPP meeting for the Ft. Flagler FUDS was held on July 24,
393 2006, and conducted in two parts. A daytime meeting was held at the Washington Department
394 of Ecology office located in Lacey, Washington. Representatives from the USACE – Omaha
395 Design Center and Seattle District, the Washington Department of Ecology (WDOE), State
396 Parks, and Shaw were in attendance. By agreement with the USACE, nearby landowners (other
397 than State Parks) were not present at this meeting.

398 In the evening, a separate meeting intended to present the SI objectives to nearby landowners or
399 interested members of the public was held at the Retreat Center at Ft. Flagler State Park. This
400 meeting was attended by the same people that attended the earlier meeting, with three additional
401 State Parks volunteers in attendance. No landowners or members of the general public attended.
402 A formal site tour was not conducted as part of this meeting; however some of the areas of
403 interest are readily visible from public roads and the park's paved pathways.

404 Agencies Meeting

405 **AOCs:** There was general agreement among stakeholders on SI objectives and approach. It was
406 presented that the Range Complex included the artillery batteries, Transition Range 1, and the
407 Gas Chamber. However, Transition Range 1 and the Gas Chamber will be evaluated separately
408 to allow for a more efficient evaluation of impacts. State Parks/WDOE representatives provided
409 a copy of a War Department map (circa 1945) that identified several potential AOCs that were
410 not included in the ASR. A copy of the map is included in Appendix L. Based on this map and
411 the resulting discussion, the following AOCs were added and documented in the *TPP*
412 *Memorandum* (Shaw, 2006b):

- 413 • **Demolition Area:** The Demolition Area is shown on the historic map provided by the
414 State Park. The area is now used for a campground near the spit. The name suggests it is
415 the open burning/open demolition (OB/OD) area. Comparison of topography from the
416 old map to current maps suggests that this area has been infilled to create a raised flat
417 area for picnicking and camping.

- 418 • **Live and Practice Grenade Courts:** The Live and Practice Grenade Courts are shown
419 on the historic map; they are currently located within little used areas of the State Park.
- 420 • **Ammunition Bunker:** An Ammunition Bunker is shown on the historic map; it was
421 located between Batteries Calwell and Downes.
- 422 • **Transition Range 2:** Transition Range 2 is shown on historic map; it is currently located
423 within an unused area of the State Park. Note that this transition range was identified in
424 the INPR Supplement but the location was unknown.

425 Other areas shown on the historical map included a Squad Tactical Area and an Embarkation
426 Area. These sites likely did not involve the use or firing of weapons or munitions.

427 **Sampling:** Shaw agreed with WDOE that visual reconnaissance for MEC should be conducted
428 at the battery locations. Originally, Shaw proposed conducting MC sampling around the
429 batteries. However, based on the discussion of the configuration and use of the batteries and on
430 observations made while driving through the park, Shaw proposed no MC sampling be
431 conducted around the batteries because of the following reasons:

- 432 • The batteries are permanent structures in which the guns were emplaced in concrete
433 structures and serviced by paved roads. It is unlikely that there was casual disposal of
434 MEC in the vicinity of a battery.
- 435 • The guns were seldom used.
- 436 • Areas around the batteries are paved and contain storm drains. It is extremely unlikely
437 that there are any remaining affected sediments from guns that were operated pre-World
438 War II.

439 The Ft. Flagler State Park currently obtains water from the public supply. State Parks indicated
440 there may have been a well in the past and provided research into the possibility.

441 **Concerns:** One of WDOE representative's main concerns was the camping area at the Rocket
442 Range AOC (Rifle Grenade/Anti-Tank Rocket Range in TPP Memo [Shaw, 2006b] and SSWP
443 [Shaw, 2007]). A UXO clearance was conducted in the adjacent wooded area in 1992.
444 Additional review of old aerial photographs and topographic maps would be helpful to evaluate
445 the history of this area.

446 **Public Meeting**

- 447 • Bob Brown, volunteer archivist for State Parks said that he and another volunteer,
448 Howard Briggs had found "lots of archive material" at USACE Seattle. Mr. Brown
449 found a map in the museum, showing AOCs not included in the ASR.
- 450 • Rifle Range – Reconstructed exactly as it was when used. Should be lots of lead in the
451 berm in front of the target. There are reports that they had to build a wall on the hill
452 behind the targets to protect the power station below Battery Lee. Mr. Brown thought
453 that the ponds have always been there, but Mr. Briggs thought that there may have been
454 cattle there at one time. Mike Zimmerman (State Parks) noted that the sea washed over
455 this area a year or two ago.

- 456 • Demolition Area – Mr. Brown and Mr. Briggs do not know use of this area. Mr. Briggs
457 said that in the 1960's there were warning signs in this area for UXO. Mr. Briggs also
458 said that there was a concrete breakwater in this area that was removed.
- 459 • As shown on the map, there was a Transition Range just east of the main gate. An old-
460 timer has said that this was an area used for firing.
- 461 • Grenade Courts – These are still visible. However, during field reconnaissance no
462 ground evidence of the grenade courts was found. The only indication that the area was
463 once cleared was that the forest trees were primarily alder and fir, while the surrounding
464 area was a more mature forest growth consisting of fir, hemlock, and cedar.
- 465 • Areas with alder trees and no fir trees signify disturbance.
- 466 • Mr. Zimmerman had heard that during the Korean War, amphibious groups landed on the
467 spit and that this may have been the cause of the split in the spit.
- 468 • There are two 90-millimeter (mm) sites west of the coast guard house with concrete pads
469 still visible at low tide.
- 470 • Comparison of the map found by Mr. Brown and the present topography indicates that
471 fill has been placed in the area of the campsite and the demolition area shown on the map.
472 Mr. Zimmerman asked if the Seattle District would have records of this work.
- 473 • Mr. Brown thought that he had heard that there was a disposal area across the road south
474 of Bankhead Battery.
- 475 • Part of the lagoon area near the Rifle Range is on USGS property.
- 476 • It was suggested that the retired rangers be interviewed. Mr. Zimmerman said that he
477 could provide names.
- 478 • Greg Johnson (WDOE) said that he would like to see analysis of older aerial
479 photographs.
- 480 • Mr. Brown indicated that it has always been State Parks policy to encourage people to
481 stay on the trails. He and Mr. Briggs noted that there is very dense brush off most of the
482 trails.

483 Based on the TPP meeting and subsequent evaluation of information obtained at the meeting, 11
484 AOCs were identified and addressed in the *TPP Memorandum* (Shaw, 2006b) and the SSWP
485 (Shaw, 2007). These AOCs are shown on Figure 3-1 and include:

- 486 • Range Complex (coastal artillery batteries),
- 487 • Ammunition Bunker,
- 488 • Transition Range 1,
- 489 • Transition Range 2,
- 490 • Gas Chamber,
- 491 • Rocket Range AOC (Rifle Grenade/Anti-Tank Rocket Range in TPP Memo [Shaw,
492 2006b] and SSWP [Shaw, 2007]),

- 493 • Live Grenade Court,
- 494 • Practice Grenade Court,
- 495 • Rifle Range,
- 496 • Demolition Area, and
- 497 • Quartermaster Wharf Disposal Area.

498 Note that on Figure 3-1, a number of the battery range boundaries have been moved slightly to
499 match the actual battery locations shown on the aerial photographs. In addition, the boundary of
500 the Rocket Range has been expanded to include the surveyed boundaries of the 1992 TCRA
501 (USACE, 1996). The boundary of Transition Range 1 has been moved to agree with that shown
502 on the ASR and represents a more accurate location of the range.

503 TPP meeting results were documented in the *TPP Memorandum* (Shaw, 2006b), which was
504 issued final on December 18, 2006 after incorporating comments from the stakeholders. The
505 proposed technical approach was defined in the *SSWP* (Shaw, 2007), which was issued final on
506 February 18, 2007 after incorporating comments from the stakeholders.

507 A more complete discussion of the TPP meeting is contained in Appendix B. As discussed
508 during the TPP meeting and documented in the *TPP Memorandum* (Shaw, 2006b), the following
509 project decision rules were developed:

510 **Based on the presence or absence of MEC, is an NDAI or is an RI/FS warranted?**

- 511 • If no evidence of MEC (non-small arms, MD, or magnetic anomalies) was found during
512 prior investigations and none is observed during SI site reconnaissance, the site will be
513 considered a potential candidate for NDAI with respect to MEC hazard.
- 514 • If MEC was found and/or if abundant or concentrated areas of MD or magnetic
515 anomalies were observed during prior investigations or during SI site reconnaissance, the
516 site will be considered a potential candidate for further investigation with respect to MEC
517 hazard.
- 518 • If any evidence is identified that is inconsistent with the CSM for the site (e.g., if MD
519 indicating the potential use of high explosive (HE) munitions at a site for which the CSM
520 was based on practice munitions), the above decision rules will be revised appropriately.

521 **Based on the presence or absence of MC, is an NDAI or is an RI/FS warranted?**

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

530 **Is a time-critical removal action warranted?**

- 531 • A time-critical removal action may be needed if high MEC hazard is identified. Shaw
532 will immediately report any MEC findings so that USACE can determine the appropriate
533 response. An example of a high hazard would be finding sensitive MEC at the surface in
534 a populated area with no barriers to restrict access.

535 **3.2 Additional Records Research**

536 **3.2.1 Coordination with State Historic Preservation Office**

537 The Washington State Historic Preservation Office (SHPO) was contacted to determine if there
538 are any areas of cultural or archaeological significance on FUDS property that could be impacted
539 by SI activities at Ft. Flagler. The SHPO recommended that the State Parks and USACE
540 archeologists review the plans and provide comments (Washington SHPO, 2006; Appendix C).
541 The USACE Seattle District project manager reviewed sampling plans with the district
542 archeologist and no concerns were identified. A copy of the Draft SSWP was provided to the Ft.
543 Flagler State Park for review and comment. No concerns were raised during their review.

544 The USACE Seattle District contacted local tribes and provided opportunity for their comment
545 on impacts to cultural resources. The tribes commented back that no additional oversight is
546 required. However, if something of cultural significance is identified during field work, the tribe
547 shall be notified immediately and the location avoided.

548 **3.2.2 Coordination with Natural Resources Offices**

549 The Washington Department of Fish and Wildlife (WDFW) was contacted to determine if there
550 are threatened or endangered species that could be impacted by SI activities at Ft. Flagler.
551 Information obtained from the WDFW indicates that there are sensitive habitats along several
552 beaches at Ft. Flagler; however, none are in the vicinity of the proposed sampling on the beach at
553 the Quartermaster Wharf Disposal Area. The information provided also identified two bald
554 eagle nesting trees at Ft. Flagler. The activities performed in the vicinity of these sites did not
555 cause disturbance.

556 The USACE Seattle District completed a *Determination of No Effect on Listed Species under the*
557 *Endangered Species Act during Sediment Sampling at Fort Flagler State Park, Jefferson County,*
558 *Washington, 2007* (USACE, 2007) for proposed sampling activities at Ft. Flagler. The results of
559 the study were that planned sampling activities would have no effect on listed species. A copy of
560 the determination is included in Appendix L.

561 **3.2.3 Historical Aerial Photographs**

562 Limited historical aerial photographs are available for the Ft. Flagler FUDS. Available historical
563 photographs were reviewed and considered during the planning process. However, the available
564 aerial photography was not of sufficient resolution or of sufficient scale to determine detailed
565 surface feature such as target berms or firing lines.

566 **3.2.4 Environmental Database Search**

567 A search of available environmental records was conducted by Environmental Data Resources,
568 Inc. (EDR, 2005). The government records search met the requirements of Standard Practice for
569 Environmental Site Assessments (ASTM International, 2007). Search results indicated the
570 AOCs did not appear on mapped sites in known federal, state, or local databases. NAVMAG
571 Indian Island immediately west of Ft. Flagler on Indian Island has one National Priorities Site
572 (NPL) and one delisted NPL site and is located approximately 2 miles from the FUDS.
573 NAVMAG Indian Island is also listed on several other federal and state lists including Resource
574 Conservation and Recovery Act (RCRA) list identifying sites that generate, transport, store, treat,
575 and/or dispose of hazardous waste. Additional information on the databases searched and the
576 results for surrounding properties is included in the EDR report found in Appendix L.

577 **3.2.5 Rights of Entry**

578 Prior to mobilizing to the site, the Project Manager for the USACE Seattle District office
579 obtained the Right of Entry from the State Parks and the USGS for the property where the SI
580 field activities were performed.

581 **3.3 Field Work**

582 SI field activities, conducted the week of February 20, 2007, included site reconnaissance and
583 collection of surface soil and sediment samples at Transition Range 1, Transition Range 2,
584 Rocket Range, Live Grenade Court, Rifle Range, and the Quartermaster Wharf Disposal Area.
585 The following conditions were recorded in the field log book (Appendix D) and/or by digital
586 photographs (Appendix E):

- 587 • Presence or absence of evidence of MEC,
- 588 • Changes, if any, in sample location because of field constraints,
- 589 • Vegetative cover, and
- 590 • Other conditions encountered that impacted sample collection.

591 **3.4 Sampling and Analysis**

592 Sampling included collection of surface soil and sediment samples at AOCs and for
593 determination of soil and sediment background concentrations. Table 3-1 summarizes the soil
594 and sediment sampling completed at Ft. Flagler. Samples were collected and analyzed in
595 accordance with the SSWP (Shaw, 2007) using the standard operating procedures (SOPs) from
596 the *Type I Work Plan, Site Inspections at Multiple Sites, NWO Region* (Shaw, 2006a).
597 Laboratory analysis was performed by GPL Laboratories, LLLP (GPL) of Frederick, Maryland
598 using methods defined in the SSWP. Analytical results are provided in Appendix F.

599 **3.5 Laboratory Analysis and Data Quality Review**

600 The data review process compares sample results to pre-established criteria referenced in Shaw's
601 FUDS MMRP Program Sampling and Analysis Plan (PSAP) Addendum, (Shaw, 2005) to

602 confirm that the data are of acceptable technical quality. GPL provided Shaw with a Level 4
603 data package including “Contract Laboratory Program (CLP)-Like” summary forms, Staged
604 Electronic Data Deliverables (SEDD) Stage 2b (version Draft 5.0), and Automated Data Review
605 (ADR) compatible A1, A2, & A3 files for all sample delivery groups (SDG). Shaw conducted a
606 data assessment on all samples collected in support of this SI. One hundred percent of the
607 analytical data have been reviewed based on EPA CLP *National Functional Guidelines for*
608 *Organic Data Review*, October 1999 and EPA CLP *National Functional Guidelines for*
609 *Inorganic Data Review*, October 2004. Automated Data Review software (version 8.1) was used
610 to assist in the data validation process for all areas with the exception of initial calibration
611 blanks, continuing calibration blanks, interference check standards, serial dilutions, and second-
612 column confirmation which were reviewed manually. Data were evaluated against specific
613 criteria to verify the achievement of all precision, accuracy, representativeness, completeness,
614 comparability, and sensitivity goals established to meet the project DQOs.

615 The overall quality of the data collected is discussed in the Analytical Data QA/QC Report
616 (Appendix G). Results of the analyses as discussed in this evaluation are indicative of the media
617 analyzed. Some results were qualified as described in the report. No data were qualified “R” as
618 unusable. Overall, the data reflect expected site conditions and they are fully usable for their
619 intended purpose.

620 **3.6 Screening Values**

621 The following subsections describe the development of screening values for this SI.

622 **3.6.1 Background Data**

623 As agreed upon at the TPP meeting, 10 background soil samples were collected from the Ft.
624 Flagler area and analyzed for metals. Background sample locations are shown on Figure 3-2.
625 The background sampling locations were selected to be away from known AOCs and other areas
626 of military activity.

627 The background soil sample analytical results were used to calculate background metal soil
628 concentrations using published EPA Guidance (1989, 1992, 1994, 1995, and 2006). The
629 background concentrations are either a 95th upper tolerance limit (UTL) for normally and
630 lognormally distributed analytes or the 95th percentile for nonparametric distributed analytes.
631 The individual background soil sample analytical results are provided in Appendix G. Table 3-2
632 lists the soil and sediment background concentrations used in this report. A summary of the soil
633 background calculations is presented in Appendix L.

634 The method for comparing sediment results to background was not defined in the TPP process.
635 For purposes of comparison in this SI, the background concentrations for sediments are taken to
636 be the background sample value. The approach for determining if a release has occurred is
637 consistent with the EPA’s Hazard Ranking System (40 CFR Part 300: Appendix A): “The
638 minimum standard to establish an observed release by chemical analysis is analytical evidence of

639 a hazardous substance in the media significantly above the background level.” Table 2-3,
640 “Observed Release Criteria for Chemical Analysis” in the above referenced regulation, has the
641 following criteria:

- 642 1. If the sample measurement is less than or equal to the sample quantitation limit, no
643 observed release is established.
- 644 2. If the sample measurement is greater than or equal to the sample quantitation limit,
645 then an observed release is established as follows:
 - 646 • If the background concentration is not detected (or is less than the detection limit),
647 an observed release is established when the sample measurement equals or exceeds
648 the sample quantitation limit.
 - 649 • If the background concentration equals or exceeds the detection limit, an observed
650 release is established when the sample measurement is three times or more above
651 the background concentration.

652 In the discussions for each AOC, these criteria are used to determine whether a release of MC
653 has occurred in sediment regardless of whether the analyte is considered a hazardous substance.
654 However, these criteria are not applied for soils because a statistically based determination of
655 background has been established, and an exceedance of the 95th UTL or 95th percentile,
656 depending on the individual analyte, is used to establish a release of MC.

657 *3.6.2 Human Health Screening Values*

658 Human health screening values for soil and sediment analytical results were established using the
659 following reference sources:

- 660 • EPA Region 9 Preliminary Remediation Goals (PRGs) for Residential Soil.
- 661 • State of Washington Model Toxics Control Act (MTCA) Cleanup Regulation, Chapter
662 173-340 WAC.

663 In cases where screening values were listed from both sources, the lower value is used for
664 screening. The human health screening values are listed on Table 3-3.

665 *3.6.3 Ecological Screening Values*

666 According to the *Screening-Level Ecological Risk Assessment (SLERA) Guidance for FUDS*
667 *MMRP Site Inspections* (USACE, 2006), only sites that are considered to be IEP or are to be
668 managed for ecological purposes, require a SLERA. As shown in Table 2-2 and discussed in
669 Section 2.4.7, the site does meet some of the 33 criteria for designation as an IEP. Shaw
670 developed a SLERA (Appendix L) using ecological screening values obtained from the WDOE
671 Toxics Cleanup Program and other appropriate sources as described in the *TPP Memorandum*
672 included as Appendix B in this SI Report (see Section 2.4.7). The SLERA uses these screening
673 values to identify ecological chemicals of concern and then evaluates the pathways and receptors
674 to determine the potential for ecological impacts. The ecological screening values for soil and
675 sediment are listed on Table 3-4 and Table 3-5, respectively.

676 **3.7** *Variances from the SSWP*

677 No variances to the SSWP (Shaw, 2007) occurred during field activities.

678 **3.8** *Second TPP Meeting*

679 A second TPP meeting was held on August 28, 2007 via teleconference. The teleconference was
680 attended by representatives of WDOE, State Parks, USACE – Omaha Design Center, USACE –
681 Seattle District, and Shaw. SI results and conclusions and SI recommendations were reviewed
682 by all. All attendees concurred with the report conclusions and recommendations. A copy of the
683 Meeting agenda and meeting minutes are included in Appendix B.

684 4.0 *Range Complex AOC*

685 4.1 *History and Land Use*

686 The Range Complex is a single AOC that includes the ten coastal artillery batteries listed below:

- 687 • Battery Bankhead,
- 688 • Battery Calwell,
- 689 • Battery Downes,
- 690 • Battery Gratton,
- 691 • Battery Lee,
- 692 • Battery Rawlins,
- 693 • Battery Revere (Anti-Torpedo Boat Battery),
- 694 • Battery Wansboro,
- 695 • Battery Wilhelm, and
- 696 • Anti-Aircraft Artillery Battery.

697 Each battery consisted of a massive concrete structure that provided a base for the artillery guns,
698 which ranged in size from 3-inch to 12-inch (see Appendix E, Photographs 43 and 44). Each
699 battery was self contained with propulsion and projectile storage rooms and troop offices. In the
700 ARC (DoD, 2006), the Range Complex also includes Transition Range 1 and the Gas Chamber.
701 In this SI, these two AOCs are separated out from the batteries to allow for a more efficient
702 evaluation of all areas. Transition Range 1 is discussed in Section 6.0 and the Gas Chamber is
703 discussed in Section 8.0.

704 Currently, the Range Complex AOC is part of the Ft. Flagler State Park, which offers camping,
705 boating, fishing, shoreline use, hiking, and historical interpretive information. For the
706 foreseeable future, it is likely that the Range Complex AOC will continue to be part of the Ft.
707 Flagler State Park.

708 The Range Complex consists of the batteries, the offshore impact areas, and the associated safety
709 fans. The water depth in Puget Sound increases rapidly outside of the tidal zone. Water depths
710 within 100 yards of the mean high tide are generally less than 20 ft. The Range Complex
711 consisted of artillery batteries that fired thousands of feet out into Puget Sound, where water
712 depths are in excess of several hundred feet and are not reasonably accessible.

713 According to the ASR the Range Complex AOC was used as a coastal defense battery. The
714 range fans for the batteries extended beyond the FUDS boundary and over the open waters of
715 Puget Sound. Firing of the artillery guns at near-shore targets is not expected. The configuration
716 of the guns in the batteries would not allow downward directed firing at near-shore targets. The

717 only scenario for MEC occurring on the beach or near-shore areas (within 100 yards of shore)
718 would be if an incomplete firing of the gun occurred and the projectile would land short of the
719 target. No firing onto land occurred. The Anti-Torpedo Boat Battery was located at Battery
720 Revere after the original 10-inch gun tubes were removed in 1941. It is unknown how often the
721 artillery guns were fired or whether the firing included high explosive rounds in addition to
722 spotting charges practice rounds. In a report dated 1933, it was stated that in the same year the
723 two guns at Battery Revere were fired 111 and 94 times, respectively, as part of a testing
724 program. It is not known if projectiles contained explosive charges.

725 **4.2 Previous Investigations**

726 A site visit was completed as part of the ASR in 2003. The ASR team did not find any notable
727 indication of MEC or MC related the Range Complex. No evaluation of offshore areas was
728 conducted.

729 **4.3 MEC Evaluation**

730 Potential MEC for the Range Complex include propellant bags and high explosive projectiles.

731 **4.3.1 Field Observations and Historical Evidence of MEC**

732 A visual reconnaissance of each of the Range Complex batteries was conducted to verify the
733 CSM that no MEC was present. The visual reconnaissance consisted of walking around each of
734 the batteries to look for evidence of MEC. The path walked during the visual reconnaissance
735 was recorded using a hand-held Global Positioning System (GPS) unit. The visual
736 reconnaissance tracks are shown on Figure 4-1. No evaluation of the beach areas below the
737 batteries or the offshore area was completed.

738 Each battery consists of a massive concrete structure on which the artillery guns were mounted
739 (see Appendix E, Photographs 43 and 44). The area around each bunker is well maintained with
740 grass and shrubs which are well cared for. There was no evidence of MEC, nor have there ever
741 been any reports of MEC or MD associated with the batteries.

742 **4.3.2 MEC Risk Assessment**

743 This section presents a qualitative assessment of the risk associated with potential MEC at the
744 Range Complex. This assessment is based on historical documentation, prior investigation, and
745 visual inspection conducted during this SI. A MEC assessment is provided to convey relative
746 risk on a scale from low to high and is not intended to be a thorough risk assessment as would be
747 conducted for an RI/FS.

748 Shaw completed a visual reconnaissance of the Range Complex the week of February 20, 2007.
749 No MEC or MD was observed or identified. Figure 4-1 shows the reconnaissance pathways and
750 photograph locations for this AOC.

751 The Range Complex batteries are located on bluffs above the shoreline on Puget Sound. Battery
752 Bankhead is located near the center of Ft. Flagler (Figure 4-1). All batteries are within Ft.
753 Flagler State Park and are intended to be accessible and visited by park visitors. Human
754 receptors in this AOC include park workers and visitors. Human exposure would be through
755 direct contact with the munitions.

756 MEC has not been reported historically and none was observed during the SI reconnaissance of
757 the Range Complex. The MEC risk for this area is considered to be low based on the following:

- 758 • No MEC or MD has been reported in the over 50 years of park use; and
- 759 • The use of munitions at the Range Complex was limited to the individual batteries, which
760 were self contained and the guns were seldom fired.
- 761 • All firing was direct toward open water of Puget Sound, where water depths are several
762 hundred feet.

763 **4.4 Munitions Constituents Evaluation**

764 Potential MC at the range complex include explosive compounds nitroguanidine, ammonium
765 picrate, TNT, and others and metals contained in steel (chromium, copper, iron, lead, and
766 nickel).

767 **4.4.1 Terrestrial Pathway**

768 Terrestrial receptors could be exposed to MC if soil was directly affected by firing of the battery
769 guns. As agreed to during the TPP process, based on the configuration and limited use, it is
770 unlikely that munitions would have been discarded. Also, significant MC from firing the guns is
771 unlikely because of infrequent use and the extended time period since use stopped. No sampling
772 was proposed for the Range Complex. The CSM did not indicate the likely presence of MC in
773 the surface soils.

774 **4.4.2 Surface Water Pathway**

775 Because of the unlikely occurrence of MEC and MC at the batteries, the surface water exposure
776 pathway is considered incomplete. As agreed to during the TPP process no surface water or
777 sediment samples were to be collected.

778 **4.4.3 Groundwater Pathway**

779 Because of the unlikely occurrence of MEC and MC at the batteries, the groundwater exposure
780 pathway is considered incomplete. As agreed to during the TPP process, groundwater is not a
781 complete pathway at Ft. Flagler and no groundwater samples were planned or collected.

782 **4.4.4 Air Pathway**

783 Because of the unlikely occurrence of MEC and MC at the batteries, the air exposure pathway is
784 considered incomplete. As agreed to during the TPP process no air samples were collected.

785 **5.0 Ammunition Bunker**

786 **5.1 History and Land Use**

787 The Ammunition Bunker is a single AOC that is located within the Range Complex (Figure 5-1).
788 The location of this AOC is taken from the War Department map that was obtained during the
789 TPP meeting. The ammunition bunker was likely used from between 1942 and 1953 to store
790 munitions used for training during and following World War II. The War Department map is
791 included in Appendix L.

792 The Ammunition Bunker AOC is part of the Ft. Flagler State Park, which offers camping,
793 boating, fishing, shoreline use, hiking, and historical interpretive information. For the
794 foreseeable future, it is likely that the Ammunition Bunker AOC will continue to be part of the
795 Ft. Flagler State Park.

796 **5.2 Previous Investigations**

797 This AOC has not been previously investigated.

798 **5.3 MEC Evaluation**

799 The Ammunition Bunker was used between 1945 and 1953 for ammunition storage likely
800 associated with amphibious assault training. All types of munitions used at Ft. Flagler between
801 1945 and 1953 may have been stored here. However, munitions for the artillery batteries would
802 probably not have been stored at this location as each battery had its own storage bunker. The
803 types of munitions may have included small arms, training grenades containing riot control gas
804 (chloroacetophenone [CN]), 2.36-inch and 3.5-inch practice and high explosive rockets, practice
805 and live hand grenades, and candles, etc that were used for gas training.

806 **5.3.1 Field Observations and Historical Evidence of MEC**

807 A visual reconnaissance was completed in the area of the reported Ammunition Bunker between
808 Batteries Calwell and Downes. No evidence of the presence of the Ammunition Bunker was
809 found. Figure 5-1 shows the reconnaissance pathways for this AOC. The reconnaissance area is
810 very heavily forested with thick underbrush and no indication (structure or foundation) of the
811 bunker was found. There was no MEC located or MD identified during the visual
812 reconnaissance. There have been no reports of MEC or MD at this AOC.

813 **5.3.2 MEC Risk Assessment**

814 The following presents a qualitative assessment of the risk associated with potential MEC. A
815 MEC assessment is provided to convey relative risk on a scale from low to high and is not
816 intended to be a thorough risk assessment as would be conducted for an RI/FS.

817 Shaw completed a visual reconnaissance of the Ammunition Bunker AOC the week of February
818 20, 2007. No MEC or MD was observed or identified. MEC has not been reported historically
819 and none was observed during the SI reconnaissance of the AOC. The MEC risk for this area is
820 considered to be low based on the following:

- 821 • No MEC or MD has been reported in the over 50 years of park use;
- 822 • No MEC or MD was identified during the SI visual reconnaissance.
- 823 • The only information available on the location of the Ammunition Bunker is from a
824 historical map.

825 *5.4 Munitions Constituents Evaluation*

826 Potential MC from the Ammunition Bunker include explosive compounds and metals contained
827 in steel (chromium, copper, iron, lead, and nickel), perchlorate in fuze and rocket propellant, and
828 lead from bullets.

829 *5.4.1 Terrestrial Pathway*

830 Terrestrial receptors may be exposed to MC if munitions were disposed or discarded to the soil
831 near the Ammunition Bunker. As agreed to during the TPP process, a soil sample would be
832 collected from this AOC if evidence of MEC or MD were located during the visual
833 reconnaissance. As discussed above in Section 5.3.1, no MEC or MD was identified at this AOC
834 and therefore no soil samples were collected.

835 *5.4.2 Surface Water Pathway*

836 As agreed to during the TPP process, the surface water pathway at Ft. Flagler was to be assessed
837 through sediments as there is no continuously running streams at Ft. Flagler. Surface water and
838 sediment receptors may be exposed to MC if munitions were disposed or discarded to the soil
839 near the Ammunition Bunker. As agreed to during the TPP process, a sediment sample would be
840 collected from this AOC if evidence of MEC or MD were located during the visual
841 reconnaissance. As discussed above in Section 5.3.1, no MEC or MD was identified at this AOC
842 and therefore no sediment samples were collected.

843 *5.4.3 Groundwater Pathway*

844 Groundwater was initially considered a potentially affected media because it is present within
845 100 ft of ground surface. However, the groundwater pathway is not complete as there is no
846 source of MC and no downgradient groundwater users in the area. As agreed to during the TPP
847 process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples were
848 planned or collected.

849 **5.4.4 Air Pathway**

850 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil
851 particles. However, air is not an affected media under current land use, thus the pathway is
852 incomplete.

853 **6.0 Transition Range 1**

854 **6.1 History and Land Use**

855 Transition Range 1 is a single AOC shown on Figure 6-1. The boundaries of this AOC were
856 taken from the INPR Supplement. The Transition Range consisted of individual firing lanes
857 which soldiers transitioned along, engaging targets from various positions (fox hole, window,
858 and prone) and at varying distances. In the ARC (DoD, 2006), Transition Range 1 is included in
859 the Range Complex as well as the Gas Chamber. In this SI, Transition Range 1 and the Gas
860 Chamber AOCs are separated out from the batteries to allow for a more efficient evaluation of all
861 areas.

862 Currently, the Transition Range 1 AOC is part of the Ft. Flagler State Park, which offers
863 camping, boating, fishing, shoreline use, hiking, and historical interpretive information. The
864 AOC is located south of the Cantonment Area, park administrative offices, and visitor areas and
865 near Battery Wansboro. The park waste water treatment plant is within the footprint of the AOC.
866 Hiking trails traverse the Transition Range 1 AOC. For the foreseeable future, it is likely that the
867 Transition Range 1 AOC will continue to be part of the Ft. Flagler State Park.

868 According to the INPR Supplement Transition Range 1 was used between 1942 and 1953 for
869 small arms use.

870 **6.2 Previous Investigations**

871 The ASR field team visited the location of Transition Range 1 and did not note any specific
872 features, other than the berm between the range and the cantonment area.

873 **6.3 MEC Evaluation**

874 Because this AOC was used for small arms only (.50-caliber ammunition was not used), MEC
875 (other than small arms) is not expected to be present.

876 **6.3.1 Field Observations and Historical Evidence of MEC**

877 A visual reconnaissance of Transition Range 1 was completed during the week of February 20,
878 2007. The northern end of the range is used for picnicking and the waste-water treatment plant is
879 also located nearby. The remainder of the AOC is heavily wooded with thick undergrowth. The
880 only evidence of the range is a berm that runs east to west (Appendix E, Photo 24), which may
881 have been a protective berm behind the firing line due to its proximity to the cantonment area.
882 No evidence of firing positions or target areas was identified during the visual reconnaissance.
883 Figure 6-1 shows the reconnaissance pathway for this AOC.

884 **6.3.2 MEC Risk Assessment**

885 The following presents a qualitative assessment of the risk associated with potential MEC. A
886 MEC assessment is provided to convey relative risk on a scale from low to high and is not
887 intended to be a thorough risk assessment as would be conducted for an RI/FS.

888 Shaw completed a visual reconnaissance of the Transition Range 1. No MEC or MD was
889 observed or identified. MEC has not been reported historically and none was observed during
890 the SI reconnaissance of the AOC. The MEC risk for this area is considered to be low based on
891 the following:

- 892 • The AOC is a Transition Range and only small arms were reportedly used. No MEC or
893 MD has been reported in the over 50 years of park use;
- 894 • No MEC or MD was identified during the SI visual reconnaissance.

895 **6.4 Munitions Constituents Evaluation**

896 Potential MC for Transition Range 1 is lead from bullets.

897 **6.4.1 Terrestrial Pathway**

898 Terrestrial receptors may be exposed to MC if the soil was directly exposed to lead from the
899 firing of small arms. Two surface soil samples (NWO-039-0002 and NWO-039-0003) were
900 proposed and collected and analyzed for lead by EPA Method SW-846 6020A. Sample locations
901 and results are shown on Figure 6-2. Soil sample locations were selected in the field as indicated
902 in the SSWP. Because no range surface features (firing points or targets) were identified,
903 locations were selected based on proximity to locations shown in the SSWP and accessibility.

904 The soil samples were collected from the upper 6 inches of soil after the removal of forest litter
905 (leaves, twigs, fir needles) and composited using the wheel method described in the *Final Type I*
906 *Work Plan* (Shaw, 2006a). Each sample was sieved by the laboratory with a # 10 sieve prior to
907 analysis to remove any particulate lead.

908 **6.4.1.1 Comparison to Background Data**

909 The detected lead concentrations were compared to the soil background concentrations. The
910 comparison is shown on Table 6-1. The detected lead concentrations of 13.8 milligrams per
911 kilogram (mg/kg) (sample NWO-039-0002) and 18.6 mg/kg (sample NWO-039-0003) were
912 below the Ft. Flagler background concentration of 32.6 mg/kg.

913 **6.4.1.2 Comparison to Human Health Screening Values**

914 Soil analytical results are only compared to human health screening values if background
915 concentrations are exceeded. Because there were no exceedances of background concentrations,
916 no comparison is completed.

917 **6.4.1.3 Comparison to Ecological Screening Values**

918 As stated in the decision rules (Section 3.1), soil analytical results are only compared to
919 ecological screening values if background concentrations are exceeded. Because there were no
920 exceedances of background concentrations, no comparison is completed.

921 **6.4.2 Surface Water Pathway**

922 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors
923 for sediments are park workers, visitors, and wildlife. One sediment sample (NWO-039-1002)
924 was proposed and collected and analyzed for lead by EPA Method SW-846 6020A. The sample
925 location and results are shown on Figure 6-2.

926 The sediment sample was collected from a low area where water appeared to collect. The
927 sediment sample was a discrete sample. The sample was sieved by the laboratory with a # 10
928 sieve prior to analysis to remove any particulate lead.

929 **6.4.2.1 Comparison to Background Data**

930 The sediment sample (NWO-039-1002) lead analytical result (40.4 mg/kg) was compared to the
931 sediment background concentration of 12.8 mg/kg (Table 6-2). As discussed in Section 3.6.1 a
932 significant exceedance of background is indicted if the sample result is greater than 3 times the
933 background value. According to this rule, the Transition Range 1 sediment sample significantly
934 exceeded background (a ratio of 3.2). It is noted that the sediment result is only 1.2 times the
935 background value for soil.

936 **6.4.2.2 Comparison to Human Health Screening Values**

937 The sediment lead analytical result (40.4 mg/kg) significantly exceeded the background
938 concentration (12.8 mg/kg) but did not exceed the human health screening value of 400 mg/kg.

939 **6.4.2.3 Comparison to Ecological Screening Values**

940 The sediment lead analytical result (40.4 mg/kg) significantly exceeded the background
941 concentration (12.8 mg/kg) but did not exceed the ecological screening value of 260 mg/kg.

942 **6.4.3 Groundwater Pathway**

943 Groundwater was initially considered a potentially affected media because it is present within
944 100 ft of ground surface. However, the groundwater pathway is not complete as there is a
945 limited source of MC and no downgradient groundwater users in the area. As agreed to during
946 the TPP process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples
947 were planned or collected.

948 **6.4.4 Air Pathway**

949 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil
950 particles. However, air is not an affected media under current land use, thus the pathway is
951 incomplete.

952 **7.0 Transition Range 2**

953 **7.1 History and Land Use**

954 Transition Range 2 is a single AOC shown on Figure 7-1. The location of this AOC is only
955 known from the War Department map that was obtained during the TPP meeting. This War
956 Department map is included in Appendix L. The INPR Supplement (USACE, 2004b) identified
957 Transition Range 2, but the location was unknown. The Transition Range likely consisted of
958 individual firing lanes which soldiers transitioned along, engaging targets from various positions
959 (fox hole, window, and prone) and at varying distances.

960 Currently, the Transition Range 2 AOC is part of the Ft. Flagler State Park, which offers
961 camping, boating, fishing, shoreline use, hiking, and historical interpretive information. The
962 AOC is located along the southern boundary of the State Park, near the main entrance road. An
963 access road traverses the southern boundary of the Transition Range 2 AOC. It is likely that for
964 the foreseeable future, the Transition Range 2 AOC will continue to be part of the Ft. Flagler
965 State Park.

966 According to the INPR Supplement, available information indicated that ranges of this type were
967 typically 55 x 130 yards in size and contained 12 targets; however, the location of the AOC was
968 not known. Small arms were used at the AOC between 1942 and 1954

969 **7.2 Previous Investigations**

970 There have been no previous investigations at this AOC.

971 **7.3 MEC Evaluation**

972 Because this AOC was used for small arms only, MEC (other than small arms) is not expected to
973 be present.

974 **7.3.1 Field Observations and Historical Evidence of MEC**

975 A visual reconnaissance of Transition Range 2 was completed during the week of February 20,
976 2007. The location of the range is in a very heavily wooded area with dense undergrowth. No
977 visual evidence of the range could be identified due to the heavy vegetation. The only indication
978 that the area was once cleared was that the forest trees were primarily alder and fir, while the
979 surrounding area was a more mature forest growth consisting of fir, hemlock, and cedar. The
980 length and coverage of the visual reconnaissance routes indicated in the SSWP could not be
981 achieved due to the thick vegetation preventing traverse. No evidence of firing positions or
982 target areas was identified during the visual reconnaissance, or could be observed on aerial
983 photographs. Figure 7-1 shows the reconnaissance pathway completed for this AOC.

984 **7.3.2 MEC Risk Assessment**

985 The following section presents a qualitative assessment of the risk associated with potential
986 MEC, as based on historical documentation. A MEC assessment is provided to convey relative
987 risk on a scale from low to high and is not intended to be a thorough risk assessment as would be
988 conducted for an RI/FS.

989 Shaw completed a visual reconnaissance of the Transition Range 2. No MEC or MD was
990 observed or identified. MEC has not been reported historically and none was observed during
991 the SI reconnaissance of the AOC. The MEC risk for this area is considered to be low based on
992 the following:

- 993 • The AOC is a Transition Range and only small arms were reportedly used. No MEC or
994 MD has been reported in the over 50 years of park use;
- 995 • No MEC or MD was identified during the SI visual reconnaissance.

996 **7.4 Munitions Constituents Evaluation**

997 Potential MC for Transition Range 2 is lead from bullets.

998 **7.4.1 Terrestrial Pathway**

999 Terrestrial receptors may be exposed to MC if the soil was directly exposed to lead from the
1000 firing of small arms. Two surface soil samples (NWO-039-0004 and NWO-039-0005) were
1001 proposed and collected and analyzed for lead by EPA Method SW-846 6020A. Sample locations
1002 and results are shown on Figure 7-2. Soil sample locations were selected in the field as indicated
1003 in the SSWP. Because no range surface features (firing points or targets) were identified,
1004 sampling locations were selected based on proximity to locations shown in the SSWP and
1005 accessibility.

1006 The soil samples were collected from the upper 6 inches of soil after the removal of forest litter
1007 (leaves, twigs, fir needles) and composited using the wheel method described in the *Final Type I*
1008 *Work Plan* (Shaw, 2006a). Each sample was sieved by the laboratory with a # 10 sieve prior to
1009 analysis to remove any particulate lead.

1010 **7.4.1.1 Comparison to Background Data**

1011 The detected lead concentrations of 6.7 mg/kg (NWO-039-0004) and 8.5 mg/kg (NWO-039-
1012 0005) were compared to the soil background concentration (32.6 mg/kg). The comparisons are
1013 shown on Table 7-1. The detected lead concentrations for both samples were below the Ft.
1014 Flagler background concentration.

1015 *7.4.1.2 Comparison to Human Health Screening Values*

1016 Soil analytical results are only compared to human health screening values if background
1017 concentrations are exceeded. Because there were no exceedances of background concentrations,
1018 no comparison is completed.

1019 *7.4.1.3 Comparison to Ecological Screening Values*

1020 Soil analytical results are only compared to ecological screening values if background
1021 concentrations are exceeded. Because there were no exceedances of background concentrations,
1022 no comparison is completed.

1023 *7.4.2 Surface Water Pathway*

1024 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors
1025 for sediments are park workers and visitors and wildlife. One sediment sample (NWO-039-
1026 1003) and a field duplicate (NWO-039-1004) were proposed and collected and analyzed for lead
1027 by EPA Method SW-846 6020A. The sample location and results are shown on Figure 7-2.

1028 The sediment sample was collected from a low area where water collected. The sediment sample
1029 was a discrete sample. The sample was sieved by the laboratory with a # 10 sieve prior to
1030 analysis to remove any particulate lead.

1031 *7.4.2.1 Comparison to Background Data*

1032 The sediment sample and field duplicate lead analytical results of 28.4 mg/kg (NWO-039-1003)
1033 and 22 mg/kg (NWO-039-1004) were compared to the sediment background concentration of
1034 12.8 mg/kg (Table 7-2). As discussed in Section 3.6.1 a significant exceedance of background is
1035 indicated if the sample result is greater than 3 times the background value. The Transition Range
1036 2 sediment sample and field duplicate do not significantly exceed background.

1037 *7.4.2.2 Comparison to Human Health Screening Values*

1038 Sediment analytical results are only compared to human health screening values if background
1039 concentrations are significantly exceeded. Because there were no significant exceedances of
1040 background concentrations, no comparison is completed.

1041 *7.4.2.3 Comparison to Ecological Screening Values*

1042 Sediment analytical results are only compared to ecological screening values if background
1043 concentrations are significantly exceeded. Because there were no significant exceedances of
1044 background concentrations, no comparison is completed.

1045 *7.4.3 Groundwater Pathway*

1046 Groundwater was initially considered a potentially affected media because it is present within
1047 100 ft of ground surface. However, the groundwater pathway is not complete as there is no
1048 source of MC and no downgradient groundwater users in the area. As agreed to during the TPP
1049 process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples were
1050 planned or collected.

1051 **7.4.4 Air Pathway**

1052 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil
1053 particles. However, air is not an affected media under current land use, thus the pathway is
1054 incomplete.

1055 **8.0 Gas Chamber**

1056 **8.1 History and Land Use**

1057 The Gas Chamber is a single AOC shown on Figure 8-1. The boundaries of this AOC were
1058 taken from the INPR Supplement. The Gas Chamber was located in rooms inside the bunker of
1059 Battery Wansboro after the artillery guns were removed. According to the INPR Supplement the
1060 Gas Chamber was used between 1942 and 1954 to familiarize and train troops in the use of gas
1061 masks. The room used for the gas chamber is empty. In the ARC (DoD, 2006), the Gas
1062 Chamber is included in the Range Complex as well as Transition Range 1. In this ASR, the Gas
1063 Chamber and Transition Range 1 AOCs are separated out from the batteries to allow for a more
1064 efficient evaluation of all areas.

1065 Currently, the Gas Chamber AOC is part of the Ft. Flagler State Park, which offers camping,
1066 boating, fishing, shoreline use, hiking, and historical interpretive information. The AOC is
1067 located within Battery Wansboro on the southeast side of the FUDS. The AOC is used by
1068 visitors on a daily basis. For the foreseeable future, it is likely that the Gas Chamber AOC will
1069 continue to be part of the Ft. Flagler State Park.

1070 **8.2 Previous Investigations**

1071 The ASR team visited the gas chamber and reported that there was no remaining evidence of the
1072 gas chamber.

1073 **8.3 MEC Evaluation**

1074 The only munitions identified as used at this AOC were gas grenades containing riot control
1075 agent CN-1.

1076 **8.3.1 Field Observations and Historical Evidence of MEC**

1077 The SI field team visited the location of the gas chamber and found no evidence of the chamber.
1078 There have been no reports of any MEC or riot control gas canisters found at Ft. Flagler.

1079 **8.3.2 MEC Risk Assessment**

1080 The following section presents a qualitative assessment of the risk associated with potential
1081 MEC, as based on historical documentation. A MEC assessment is provided to convey relative
1082 risk on a scale from low to high and is not intended to be a thorough risk assessment as would be
1083 conducted for an RI/FS.

1084 Shaw completed a visual reconnaissance of the Gas Chamber AOC. No MEC or MD was
1085 observed or identified. MEC has not been reported historically and none was observed during

1086 the SI reconnaissance of the AOC. The MEC risk for this area is considered to be low based on
1087 the following:

- 1088 • The AOC is a gas chamber that was used to familiarize troops with the use of gas masks.
1089 No munitions other than a riot control gas grenade would have been used in the chamber;
- 1090 • No MEC or MD was identified during the SI visual reconnaissance.

1091 ***8.4 Munitions Constituents Evaluation***

1092 Potential MC is CN gas that is generated either by burning a candle or activating a riot control
1093 grenade.

1094 ***8.4.1 Terrestrial Pathway***

1095 The use of the gas chamber was within rooms contained in the concrete bunker of Battery
1096 Wansboro. As agreed to during the TPP process, riot control agents are not persistent and any
1097 release to soil would be expected to be neutralized by weathering and time and not be present in
1098 the soil today. There is no complete soil pathway and no soil samples were planned or collected
1099 from this AOC.

1100 ***8.4.2 Surface Water Pathway***

1101 Riot control agents are not persistent and any release to sediment or surface water would be
1102 expected to be neutralized by weathering and time and not be present today. There is no
1103 complete sediment or surface water pathway and no samples were planned or collected from this
1104 AOC.

1105 ***8.4.3 Groundwater Pathway***

1106 Groundwater is considered a potentially affected media because it is present within 100 ft of
1107 ground surface. However, riot control agents are not persistent and any release to soil and
1108 eventually groundwater would be expected to be neutralized by weathering and time and not be
1109 present in the soil today. There is no complete groundwater pathway and no groundwater
1110 samples were planned or collected.

1111 ***8.4.4 Air Pathway***

1112 Air is a potential medium of concern because of the possibility of inhalation of contaminated soil
1113 particles. However, air is not an affected media under current land use, thus the pathway is
1114 incomplete.

1115 *9.0 Rocket Range*

1116 *9.1 History and Land Use*

1117 The Rocket Range AOC (Rifle Grenade/Anti-Tank Rocket Range in TPP Memo [Shaw, 2006b]
1118 and SSWP [Shaw, 2007]) was an amphibious assault training area located near the lower
1119 campground at the Ft. Flagler State Park. This AOC is shown on Figure 9-1. A portion of this
1120 AOC was cleared of UXO in 1992 (USACE, 1997) during a TCRA. The TCRA is discussed
1121 below in Section 9.2. This AOC includes a 1000-inch Machine Gun Range, which was
1122 identified on the War Department map that was obtained during the TPP meeting. The War
1123 Department map is included in Appendix L.

1124 Currently, the Rocket Range AOC is part of the Ft. Flagler State Park, which offers camping,
1125 boating, fishing, shoreline use, hiking, and historical interpretive information. A camping area is
1126 located within this AOC. For the foreseeable future, it is likely that the Range Complex AOC
1127 will continue to be part of the Ft. Flagler State Park.

1128 According to the ASR the Rocket Range was used between 1942 and 1954 for amphibious
1129 assault exercises. Munitions used included 3.5-inch and 2.36-inch rockets, and small arms. The
1130 1000-inch/Machine Gun Range included small arms and machine gun use. The two areas are
1131 included as one AOC in this SI. The location of the beach portion of this AOC coincides with
1132 the Debarkation Area identified in the War Department map (Appendix L). The map identified
1133 the Debarkation Area as having “beach obstacles.”

1134 *9.2 Previous Investigations*

1135 In 1992, a UXO clearance was completed in the area of the Rocket Range. The objective of the
1136 UXO clearance project was to “locate, identify, segregate, and dispose of suspected explosive
1137 ordnance, inert ordnance, explosives, and ordnance debris” (IT, 1992). Geophysical surveys
1138 using magnetometers were used to clear the surface and subsurface of UXO and MD. A section
1139 of the beach adjacent to the range was also cleared. The initial survey area (Phase 1) was
1140 thought to be the most likely area of UXO contamination. However, the project boundaries were
1141 later extended to the east to include additional impact area (Phase 2 area). Figure 9-2 shows the
1142 area of the TCRA. The area contained within Phases 1 and 2 were “100 percent cleared”
1143 (USACE, 1997) and all UXO and munitions related debris were removed and disposed. The
1144 area within Phase 3 was heavily timbered with heavy undergrowth. No brush clearing was done
1145 in the Phase 3 area and a very limited clearance was performed because of the heavy vegetation.
1146 Within the Phase 3 area, 3 live 2.36-inch rockets with warheads were found. These were
1147 detonated by the 27th Army EOD unit from Fort Lewis. The following MEC and MD were
1148 recovered during the 1992 removal action.

- 1149 • 2.36-inch expended rocket motors (172 items);

- 1150 • 2.36-inch rockets with live warhead (3 items);
- 1151 • 2.36-inch rockets with live fuse (2 items);
- 1152 • 3.5-inch expended rocket motors (2 items);
- 1153 • 1 live training hand grenade;
- 1154 • 1 Bangalore torpedo fuse housing, inert;
- 1155 • Anti-tank/anti-vehicle mines, inert (12 items); and
- 1156 • Empty .30-caliber casings (16 items).

1157 The USACE issued a Closure Report for the range in 1996 (USACE, 1996). The Closure Report
1158 evaluated three alternatives for the Rocket Range. The alternatives were: No Further Action;
1159 Perform Additional Ordnance and Explosive Detection and Removal; and Barricade the
1160 Ordnance and Explosive Site. The report concluded that based on the assessment of previous
1161 removal activities and present safety risk to the general public, the No Further Action was
1162 selected. The report concluded that the Phase 1 and 2 areas have been cleared of “recoverable
1163 OE, with complete QC performed. The 100 percent search and removal action performed has
1164 significantly reduced the public risk of exposure to OE.” For the Phase 3 area, No Further
1165 Action was selected based on limited accessibility because of dense vegetation and excessive
1166 cost to remove the dense vegetation to make geophysical investigation effective (USACE, 1996)

1167 **9.3 MEC Evaluation**

1168 Potential MEC within the Rocket Range AOC are listed on Table 2-1 and include rockets, hand
1169 grenades, mines, and small arms. Explosive hazards from the mines and small arms are not
1170 expected.

1171 **9.3.1 Field Observations and Historical Evidence of MEC**

1172 A visual reconnaissance of the Rocket Range in the vicinity of the Phase 3 area of the 1992
1173 TCRA was completed during the week of February 20, 2007. The location of the reconnaissance
1174 area is in very heavily wooded area with dense undergrowth. No MEC or MD was identified.
1175 Figure 9-1 shows the reconnaissance pathway for this AOC.

1176 Historical evidence from the 1992 removal action indicates that no MEC or MD remains in the
1177 Phase 1 and 2 areas. However, the Phase 3 area may contain additional UXO or MD.

1178 **9.3.2 MEC Risk Assessment**

1179 The following section presents a qualitative assessment of the risk associated with potential
1180 MEC, as based on historical documentation. A MEC assessment is provided to convey relative
1181 risk on a scale from low to high and is not intended to be a thorough risk assessment as would be
1182 conducted for an RI/FS.

1183 The potential for MEC at the Rocket Range within the Phase 1 and 2 areas of the 1992 removal
1184 action is low. However, within the Phase 3 area the potential is moderate. This is based on the
1185 following:

- 1186 • A thorough UXO clearance was completed for the Phase 1 and 2 areas in 1992.
- 1187 • A USACE Closure Report (USACE, 1996) concluded that the clearance performed in the
1188 Phase 1 and 2 areas had significantly reduced the risk to the public.
- 1189 • The Closure Report concluded that while the clearance was not totally completed, the
1190 trees and dense vegetation provide a natural barricade to public accessibility.

1191 **9.4 Munitions Constituents Evaluation**

1192 Potential MC for this AOC include explosives (including nitroglycerin and pentaerythritol
1193 tetranitrate [PETN]), metals from steel (chromium, copper, iron, lead, and nickel), lead from
1194 bullets, and perchlorate used in propellant for 3.5-inch rockets.

1195 **9.4.1 Terrestrial Pathway**

1196 Terrestrial receptors may be exposed to MC because of releases from munitions that were used at
1197 the Rocket Range. As agreed to during the TPP process three surface soil samples (NWO-039-
1198 0006, NWO-039-0007, and NWO-039-0008) and one field duplicate (NWO-039-0009) were
1199 proposed and collected and analyzed for select metals by EPA Method SW-846 6020A and
1200 explosives, including nitroglycerine and PETN using EPA Method SW-846 8330A. Soil
1201 samples for perchlorate were not identified in the TPP Memo (Shaw 2006b) or SSWP (Shaw,
1202 2007). Due to the high solubility of perchlorate in water and the large amounts of precipitation
1203 that occurs at Ft. Flagler, perchlorate is not expected to remain in the soil. Sample locations and
1204 results are shown on Figures 9-3 and 9-4. The select metals list consisted of chromium, copper,
1205 iron, lead, molybdenum, and nickel. These metals were selected based on the expected metal
1206 constituents of sheet metal and cast iron munitions bodies and bullets. Aluminum and
1207 manganese were also included in the select metals analysis list as they may be useful in
1208 determining naturally occurring concentrations of metals in soils using the method of Myers and
1209 Thorbjornsen (2004).

1210 The soil samples were collected from the upper 6 inches of soil after the removal of forest litter
1211 (leaves, twigs, fir needles) and composited using the wheel method described in the *Final Type I*
1212 *Work Plan* (Shaw, 2006a). Samples NWO-039-0006 and NWO-039-0007 were collected from
1213 locations where MEC or MD were located during the 1992 removal action. The location of
1214 sample NWO-039-0008 was selected from a location within the reconnaissance area of the AOC
1215 near the location identified in the SSWP.

1216 **9.4.1.1 Comparison to Background Data**

1217 The detected metals concentrations in soil are listed on Table 9-1. There were no exceedances of
1218 the SI background soil concentrations in any sample. Explosives were not detected.

1219 **9.4.1.2 Comparison to Human Health Screening Values**

1220 Soil analytical results are only compared to human health screening values if background
1221 concentrations are exceeded. Because there were no exceedances of background concentrations,
1222 no comparison is completed.

1223 **9.4.1.3 Comparison to Ecological Screening Values**

1224 Soil analytical results are only compared to ecological screening values if background
1225 concentrations are exceeded. Because there were no exceedances of background concentrations,
1226 no comparison is completed.

1227 **9.4.2 Surface Water Pathway**

1228 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors
1229 for sediments are park workers and visitors and wildlife. One sediment sample (NWO-039-
1230 1005) was proposed and collected and analyzed for select metals by EPA Method SW-846
1231 6020A and explosives, including nitroglycerine and PETN, using EPA Method SW-846 8330A.
1232 The sample location and results are shown on Figures 9-3 and 9-4.

1233 The sediment sample was collected from a low area where water collected. The sediment sample
1234 was a discrete sample.

1235 **9.4.2.1 Comparison to Background Data**

1236 The sediment sample metals analytical results were compared to the sediment background
1237 concentrations (Table 9-2). As discussed in Section 3.6.1 a significant exceedance of
1238 background is indicted if the sample result is greater than 3 times the background value. The
1239 Rocket Range sediment sample analytical results do not significantly exceeded background
1240 concentrations. No explosives were detected.

1241 **9.4.2.2 Comparison to Human Health Screening Values**

1242 Sediment analytical results are only compared to human health screening values if background
1243 concentrations are exceeded. Because there were no exceedances of background concentrations,
1244 no comparison is completed.

1245 **9.4.2.3 Comparison to Ecological Screening Values**

1246 Sediment analytical results are only compared to ecological screening values if background
1247 concentrations are exceeded. Because there were no exceedances of background concentrations,
1248 no comparison is completed.

1249 **9.4.3 Groundwater Pathway**

1250 Groundwater was initially considered a potentially affected media because it is present within
1251 100 ft of ground surface. However, the groundwater pathway is not complete as there is no
1252 source of MC and no downgradient groundwater users in the area. As agreed to during the TPP
1253 process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples were
1254 planned or collected.

1255 **9.4.4 Air Pathway**

1256 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil
1257 particles. However, air is not an affected media under current land use, thus the pathway is
1258 incomplete.

1259 **10.0 Live Grenade Court**

1260 **10.1 History and Land Use**

1261 The Live Grenade Court is a single AOC as shown on Figure 10-1. This AOC is located in the
1262 southeast corner of the FUDS and Ft. Flagler State Park and just north of the Practice Grenade
1263 Court AOC. The AOC was used to train troops in the use of live grenades. The location of this
1264 AOC is taken from the War Department map that was obtained during the TPP meeting. The
1265 War Department map is included in Appendix L.

1266 Currently, the Live Grenade Court AOC is part of the Ft. Flagler State Park, which offers
1267 camping, boating, fishing, shoreline use, hiking, and historical interpretive information. For the
1268 foreseeable future, it is likely that the Live Grenade Court AOC will continue to be part of the Ft.
1269 Flagler State Park.

1270 The court is assumed to be used by the Army between 1942 and 1954. The court was used for
1271 training in the use of live (explosive) and/or training hand grenades. Grenades were thrown from
1272 individual throwing bays constructed from sandbags or concrete, or from a trench. Grenades
1273 were thrown toward targets in an impact area approximately 25 yards from the throwing line (see
1274 Figure 11 Conceptual Site Model Grenade Court; Appendix J). A danger area of approximately
1275 600 ft beyond the court boundary would have been established around each court.

1276 **10.2 Previous Investigations**

1277 There have been no previous investigations of this AOC. The AOC is only known from a War
1278 Department map (Appendix L)

1279 **10.3 MEC Evaluation**

1280 The likely munitions used included the Mk II fragmentation hand grenade. M21 practice
1281 grenades, which contained only small spotting charges of black powder, may also have been
1282 used. These munitions were in common usage during the period of use of this grenade court.

1283 **10.3.1 Field Observations and Historical Evidence of MEC**

1284 A visual reconnaissance survey of the Live Grenade Court was completed on February 20, 2007.
1285 The location of the court is in a very heavily wooded area with dense undergrowth. No visual
1286 evidence of the court could be identified due to the heavy vegetation. The only indication that
1287 the area was once cleared was that the forest trees were primarily alder and fir, while the
1288 surrounding area was a more mature forest growth consisting of fir, hemlock, and cedar. The
1289 length and coverage of the visual reconnaissance routes indicated in the SSWP could not be
1290 achieved due to the thick vegetation preventing traverse. No evidence of throwing bays or target
1291 areas were identified during the visual reconnaissance, or on review of aerial photographs.
1292 Figure 10-1 shows the reconnaissance pathway for this AOC.

1293 **10.3.2 MEC Risk Assessment**

1294 The following section presents a qualitative assessment of the risk associated with potential
1295 MEC. A MEC assessment is provided to convey relative risk on a scale from low to high and is
1296 not intended to be a thorough risk assessment as would be conducted for an RI/FS.

1297 Based on the assumed presence of the Live Grenade Court from the War Department map
1298 (Appendix L), the types of live munitions used at the court (Mk II Fragmentation Hand
1299 Grenade), and the dense vegetation surrounding and within the Live Grenade Court the risk
1300 associated with potential MEC is low.

1301 **10.4 Munitions Constituents Evaluation**

1302 Potential MC for the Live Grenade Court are explosives, cast iron, and steel (chromium, copper,
1303 iron, lead, and nickel).

1304 **10.4.1 Terrestrial Pathway**

1305 Terrestrial receptors may be exposed to MC if there were releases from munitions that were used
1306 at the Live Grenade Court. As agreed to during the TPP process, one surface soil sample (NWO-
1307 039-0010) was proposed and collected and analyzed for select metals by EPA Method SW-846
1308 6020A and explosives, including nitroglycerine and PETN using EPA Method SW-846 8330A.
1309 The sample location and results are shown on Figures 10-2 and 10-3.

1310 The soil sample was collected from the upper 6 inches of soil after the removal of forest litter
1311 (leaves, twigs, fir needles) and composited using the wheel method described in the *Final Type I*
1312 *Work Plan* (Shaw, 2006a). The sample was collected from near the assumed center of the
1313 grenade court as no evidence of target areas was identified during the reconnaissance.

1314 **10.4.1.1 Comparison to Background Data**

1315 Results from the metals analysis were compared to site background concentrations. Chromium
1316 (36.3 mg/kg) and nickel (85.8 mg/kg) were detected above their respective background
1317 concentrations of 35.2 mg/kg and 80.2 mg/kg. Explosives were not detected.

1318 **10.4.1.2 Comparison to Human Health Screening Values**

1319 Soil analytical results that exceeded background concentrations were compared to human health
1320 screening values. The analytical results for chromium (36.3 mg/kg) and nickel (85.8 mg/kg)
1321 were below their respective EPA Region 9 PRGs of 210 mg/kg and 1,600 mg/kg, respectively
1322 (Table 10-1).

1323 **10.4.1.3 Comparison to Ecological Screening Values**

1324 Soil analytical results that exceeded background concentrations were compared to ecological
1325 screening values. The analytical result for chromium (36.3 mg/kg) was below its respective
1326 ecological screening level of 42 mg/kg. The analytical result for nickel (85.8 mg/kg) was above
1327 the ecological screening level of 30 mg/kg. A SLERA was completed for the elevated nickel

1328 concentration in soil. The evaluation concluded that while the sample concentration exceeded
1329 the most conservative screening level (plants), the site background concentration (80.2 mg/kg)
1330 also exceeded the screening level by a nearly equal amount. This suggests that the screening
1331 value is not appropriate for this site. The soil invertebrate and wildlife screening values are
1332 higher than the background and sample concentrations. A copy of the SLERA is provided in
1333 Appendix L. Based on this evaluation, the nickel concentration in soil is not an ecological
1334 concern.

1335 *10.4.2 Surface Water Pathway*

1336 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors
1337 for sediments are park workers and visitors and wildlife. As agreed to during the TPP process no
1338 sediment samples were to be collected from the Live Grenade Court as the land surface is flat
1339 and no overland flow is expected.

1340 *10.4.3 Groundwater Pathway*

1341 Groundwater was initially considered a potentially affected media because it is present within
1342 100 ft of ground surface. However, the groundwater pathway is not complete as there is no
1343 source of MC and no downgradient groundwater users in the area. As agreed to during the TPP
1344 process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples were
1345 planned or collected.

1346 *10.4.4 Air Pathway*

1347 Air is a potential medium of concern because of the possibility of inhalation of contaminated soil
1348 particles. However, air is not an affected media under current land use, thus the pathway is
1349 incomplete.

1350 **11.0 Practice Grenade Court**

1351 **11.1 History and Land Use**

1352 The Practice Grenade Court is a single AOC as shown on Figure 11-1. This AOC is located in
1353 the southeast corner of the FUDS and Ft. Flagler State Park and just south of the Live Grenade
1354 Court AOC. The location of this AOC is taken from the War Department map that was obtained
1355 during the TPP meeting. This War Department map is included in Appendix L. The AOC was
1356 used to train troops in the use of grenades using either inert grenades or grenades with small
1357 spotting charges.

1358 Currently, the Practice Grenade Court AOC is part of the Ft. Flagler State Park, which offers
1359 camping, boating, fishing, shoreline use, hiking, and historical interpretive information. For the
1360 foreseeable future, it is likely that the Practice Grenade Court AOC will continue to be part of the
1361 Ft. Flagler State Park. The AOC is within a heavily forested area with heavy underbrush.

1362 The AOC is assumed to have been used between 1942 and 1954 similar to other troop training
1363 activities at Ft. Flagler. The courts were used for training in the use of practice and/or training
1364 hand grenades. Grenades were thrown from individual throwing bays constructed from sandbags
1365 or concrete, or from a trench. Grenades were thrown toward targets in an impact area
1366 approximately 25 yards from the throwing line (see Figure 11 Conceptual Site Model Grenade
1367 Court; Appendix J). No danger area would have been established around a practice grenade
1368 court.

1369 **11.2 Previous Investigations**

1370 There have been no previous investigations of this AOC. The AOC is only known from a War
1371 Department map (Appendix L)

1372 **11.3 MEC Evaluation**

1373 The munitions used at the practice courts likely would have included the Mk1A1 training
1374 grenades, an inert device made of cast iron with the approximate shape, size, and weight of an
1375 actual hand grenade. The munitions used at the practice court may also have included the M21
1376 practice grenades, reusable devices which contained only small charges of black powder to
1377 simulate the detonation of a live grenade. These munitions were in common use for the period of
1378 use of this practice court.

1379 **11.3.1 Field Observations and Historical Evidence of MEC**

1380 A visual reconnaissance survey of the Practice Grenade Court was completed on February 20,
1381 2007. The location of the court is in a very heavily wooded area with dense undergrowth. No
1382 visual evidence of the range could be identified due to the heavy vegetation. The only indication
1383 that the area was once cleared was that the forest trees were primarily alder and fir, while the

1384 surrounding area was a more mature forest growth consisting of fir, hemlock, and cedar. The
1385 length and coverage of the visual reconnaissance routes indicated in the SSWP could not be
1386 achieved due to the thick vegetation preventing traverse. No evidence of throwing bays or target
1387 areas were identified during the visual reconnaissance, or from review of aerial photographs.
1388 Figure 11-1 shows the reconnaissance pathway for this AOC.

1389 *11.3.2 MEC Risk Assessment*

1390 The following section presents a qualitative assessment of the risk associated with potential
1391 MEC. A MEC assessment is provided to convey relative risk on a scale from low to high and is
1392 not intended to be a thorough risk assessment as would be conducted for an RI/FS.

1393 Based on the assumed presence of the Practice Grenade Court from the War Department map
1394 (Appendix L) and the types of practice munitions used at the court that only contained a small
1395 spotting charge (Mk 1A1 Practice Hand Grenade and M21 Practice Hand Grenade), the risk
1396 associated with potential MEC is low.

1397 *11.4 Munitions Constituents Evaluation*

1398 Potential MC for the Practice Grenade Court would be metals from steel (chromium, copper,
1399 iron, lead, and nickel). The only explosive was black powder, which consists of potassium
1400 nitrate, sulfur, and charcoal.

1401 *11.4.1 Terrestrial Pathway*

1402 Terrestrial receptors may be exposed to MC if there were releases from munitions that were used
1403 at the Practice Grenade Court. As agreed to during the TPP process, there are no MC of concern
1404 associated with practice grenades. No soil samples were collected from this practice grenade
1405 court.

1406 *11.4.2 Surface Water Pathway*

1407 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors
1408 for sediments are park workers and visitors and wildlife. As agreed to during the TPP process,
1409 no sediment samples were to be collected from the Practice Grenade Court as the potential MC is
1410 iron from grenade bodies and black powder, which contains no hazardous substances. In
1411 addition, the land surface at the Practice Grenade Court is flat and no overland flow is expected.

1412 *11.4.3 Groundwater Pathway*

1413 Groundwater was initially considered a potentially affected media because it is present within
1414 100 ft of ground surface. However, the groundwater pathway is not complete as there is no
1415 source of MC and no downgradient groundwater users in the area. As agreed to during the TPP
1416 process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples were
1417 planned or collected.

1418 **11.4.4 Air Pathway**

1419 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil
1420 particles. However, air is not an affected media under current land use, thus the pathway is
1421 incomplete.

1422 **12.0 Rifle Range**

1423 **12.1 History and Land Use**

1424 The Rifle Range is a single AOC shown on Figure 12-1. According to the ASR there was a rifle
1425 range near the lighthouse when Ft. Flagler was first built. The butt to this range was torn down
1426 in 1932 to salvage lead and copper from the expended bullets. A new range was reportedly built
1427 on the same location during World War II. The range was used to train troops in the use of small
1428 arms.

1429 Currently, the Rifle Range AOC is part of the Ft. Flagler State Park, which offers camping,
1430 boating, fishing, shoreline use, hiking, and historical interpretive information. This AOC is
1431 located near the lighthouse at Marrowstone Point. Hiking trails traverse the Rifle Range AOC,
1432 and an interpretive trail occupies the rifle range location.

1433 The target area was cleared of brush by State Park volunteers and one of the targets was
1434 reconstructed. The configuration of this range is firing from south to north. The berm in front of
1435 the targets is clearly visible and State Park volunteers have reported that a wall was built behind
1436 the targets to protect the power plant below Battery Lee. For the foreseeable future, it is likely
1437 that the Range Complex AOC will continue to be part of the Ft. Flagler State Park.

1438 According to the ASR, the Rifle Range was used between 1942 and 1954 for small arms use, and
1439 use of the area as a range likely occurred as far back as 1900.

1440 **12.2 Previous Investigations**

1441 The INPR, INPR Supplement, and ASR identified the Rifle Range. The ASR team visited the
1442 Rifle Range and noted that the range was positioned such that “the land between the firing lines
1443 and the butts is a wetland affected by tides...; the range couldn’t be used for anything other than
1444 a known distance range for rifles or carbines.”

1445 **12.3 MEC Evaluation**

1446 Because this AOC was used for small arms only, MEC (other than small arms) is not expected to
1447 be present.

1448 **12.3.1 Field Observations and Historical Evidence of MEC**

1449 A visual reconnaissance, without the use of a magnetometer, was completed on February 22,
1450 2007. During the visual reconnaissance, the field team noted a target berm and a reconstructed
1451 target. No MEC or MD was identified.

1452 The ASR field team noted that because of the wetlands area between the firing lines and target
1453 the range would only have been used for small arms use.

1454 **12.3.2 MEC Risk Assessment**

1455 The following section presents a qualitative assessment of the risk associated with potential
1456 MEC. A MEC assessment is provided to convey relative risk on a scale from low to high and is
1457 not intended to be a thorough risk assessment as would be conducted for an RI/FS.

1458 The CSM for this range is that it was used only for small arms training. This was confirmed
1459 during the SI field reconnaissance. Based on this, the risk associated with potential MEC is low
1460 at the Rifle Range.

1461 **12.4 Munitions Constituents Evaluation**

1462 The potential MC for the Rifle Range is lead.

1463 **12.4.1 Terrestrial Pathway**

1464 Terrestrial receptors may be exposed to MC if the soil was directly exposed to lead from the
1465 firing of small arms. Two surface soil samples (NWO-039-0011 and NWO-039-0012) were
1466 proposed and collected and analyzed for lead by EPA Method SW-846 6020A. Sample locations
1467 and results are shown on Figure 12-2. Soil sample locations were from the top and bottom of the
1468 target berm as indicated in the SSWP.

1469 The soil samples were collected from the upper 6 inches of soil after the removal of vegetation
1470 and composited using the wheel method described in the *Final Type I Work Plan* (Shaw, 2006a).
1471 Each sample was sieved by the laboratory with a # 10 sieve prior to analysis to remove any
1472 particulate lead.

1473 **12.4.1.1 Comparison to Background Data**

1474 The detected lead concentrations were compared to the soil background concentrations. The
1475 comparison is shown on Table 12-1. The detected lead concentrations of 235 mg/kg (sample
1476 NWO-039-0011) and 587 mg/kg (sample NWO-039-0012) were above the Ft. Flagler
1477 background concentration of 32.6 mg/kg.

1478 **12.4.1.2 Comparison to Human Health Screening Values**

1479 Soil lead analytical results are only compared to human health screening values if background
1480 concentrations are exceeded. Analytical results from both samples exceeded background. The
1481 lead analytical results were compared to the EPA Region 9 Residential PRG of 400 mg/kg. Only
1482 the result from sample NWO-039-0012 (587 mg/kg) exceeded the human health screening value
1483 of 400 mg/kg.

1484 **12.4.1.3 Comparison to Ecological Screening Values**

1485 Soil lead analytical results are only compared to ecological screening values if background
1486 concentrations are exceeded. Analytical results from both samples exceeded background. The
1487 lead analytical results were compared to the ecological screening value of 50 mg/kg. Both
1488 sample results exceed the screening value. A SLERA was completed for the elevated lead

1489 concentration. The SLERA concluded that the lead concentration exceeded both the plant, soil
1490 invertebrate, and wildlife ecological screening values and that the elevated lead concentration is
1491 a concern at the Rifle Range. A copy of the SLERA is included in Appendix L.

1492 *12.4.2 Surface Water Pathway*

1493 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors
1494 for sediments are park workers and visitors and wildlife. One sediment sample (NWO-039-
1495 1006) was proposed and collected and analyzed for lead by EPA Method SW-846 6020A. The
1496 sample location and results are shown on Figure 12-2.

1497 A discrete sediment sample was collected from in front of the target berm where soils may have
1498 washed down the slope. The sample was sieved by the laboratory with a # 10 sieve prior to
1499 analysis to remove any particulate lead.

1500 *12.4.2.1 Comparison to Background Data*

1501 The sediment sample (NWO-039-1006) lead analytical result (219 mg/kg) was compared to the
1502 sediment background concentration of 12.8 mg/kg (Table 12-2). As discussed in Section 3.6.1, a
1503 significant exceedance of background is indicated if the sample result is greater than 3 times the
1504 background value. The Rifle Range sediment sample significantly exceeded background.

1505 *12.4.2.2 Comparison to Human Health Screening Values*

1506 The sediment lead analytical result (219 mg/kg) significantly exceeded the background
1507 concentration (12.8 mg/kg) but did not exceed the human health screening value of 400 mg/kg.

1508 *12.4.2.3 Comparison to Ecological Screening Values*

1509 The sediment lead analytical result (219 mg/kg) significantly exceeded the background
1510 concentration (12.8 mg/kg) but did not exceed the ecological screening value of 260 mg/kg.

1511 *12.4.3 Groundwater Pathway*

1512 Groundwater was initially considered a potentially affected media because it is present within
1513 100 ft of ground surface. However, the groundwater pathway is not complete as there are no
1514 downgradient groundwater users in the area. As agreed to during the TPP process, groundwater
1515 is not a complete pathway at Ft. Flagler. No groundwater samples were planned or collected.

1516 *12.4.4 Air Pathway*

1517 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil
1518 particles. Air may be an affected media due to the high (10 ft) berm and exposure to wind.
1519 Exposure to soil particles through inhalation is included in the development of health-based
1520 screening values for soil. As described in Section 12.4.1, one soil sample contained lead above
1521 the human health screening value.

1522 **13.0 Demolition Area**

1523 **13.1 History and Land Use**

1524 The Demolition Area is a single AOC shown on Figure 13-1. This AOC was not identified until
1525 the TPP meeting, when the location was shown on the old War Department map (Appendix L).
1526 The AOC is located in the northwest corner of the FUDS in an embayment. The War
1527 Department map indicated the area was within a tidal zone that flooded at each high tide. The
1528 area has since been backfilled with gravel and soil to create a picnic and camping area that is
1529 several feet above the high tide mark. The grass is mowed regularly during the growing season.
1530 The depth to the demolition area may be as much as 10 ft, based on comparison of current land
1531 elevation and likely elevation of tidal zone prior to backfilling. All that is known of this area is
1532 from the War Department Map and the notation “Demolition Area.” Based on the name of the
1533 area from the War Department map, the area is thought to have been an OB/OD area, where
1534 munitions that were no longer useful or damaged were destroyed.

1535 Currently, the Demolition Area AOC is part of the Ft. Flagler State Park, which offers camping,
1536 boating, fishing, shoreline use, hiking, and historical interpretive information. This AOC is
1537 located near the lower campground, and used for picnicking, camping, and beach combing. For
1538 the foreseeable future, it is likely that the Demolition Area AOC will continue to be part of the
1539 Ft. Flagler State Park.

1540 There is no record of the dates of use for the Demolition Area. However, based on use of other
1541 training ranges and maneuver areas, the likely period of use is 1942 to 1954.

1542 **13.2 Previous Investigations**

1543 There have been no previous investigations at this AOC.

1544 **13.3 MEC Evaluation**

1545 The types of munitions destroyed at this AOC are unknown. However, on the War Department
1546 map legend the words “Rifle Grenade” were written under “Demolition Area.” This may
1547 indicate that rifle grenades (M6A1, M7A1, M28, and M29 rockets) used at the Debarkation Area
1548 and Rocket Range were the munitions destroyed at the AOC. There is also the potential that
1549 discarded propellant bags and high explosives from the artillery batteries were also detonated at
1550 this location.

1551 **13.3.1 Field Observations and Historical Evidence of MEC**

1552 A visual reconnaissance of the Demolition Area was completed on February 22, 2007. The
1553 visual reconnaissance was completed along the shoreline where potential MEC or MD might be
1554 visible due to shoreline erosion. No evidence of MEC or MD was found. There have been no
1555 historical finds of MEC or debris at this AOC.

1556 **13.3.2 MEC Risk Assessment**

1557 The following section presents a qualitative assessment of the risk associated with potential
1558 MEC, as based on historical documentation. A MEC assessment is provided to convey relative
1559 risk on a scale from low to high and is not intended to be a thorough risk assessment as would be
1560 conducted for an RI/FS.

1561 Based on the assumed former use of this AOC as a demolition area and the fact that the area has
1562 been backfilled, the risk of encountering MEC on the ground surface is considered low. MEC
1563 may be present in the subsurface.

1564 **13.4 Munitions Constituents Evaluation**

1565 Potential MC at this AOC include chromium, copper, iron, lead, molybdenum, and nickel, and
1566 explosives including nitroglycerin and PETN.

1567 **13.4.1 Terrestrial Pathway**

1568 Terrestrial receptors may be exposed to MC if there were releases from munitions that were
1569 disposed at Demolition Area. As agreed to during the TPP process, no soil samples were
1570 collected from this AOC. The area has been backfilled with soil as much as 10 ft thick. The soil
1571 is assumed to be free of MC and no soil sampling was necessary. MC could be present in
1572 subsurface soils where munitions were destroyed. No subsurface soil sampling was completed
1573 as agreed to during the TPP process.

1574 **13.4.2 Surface Water Pathway**

1575 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors
1576 for sediments are park workers and visitors and wildlife. As agreed to during the TPP process no
1577 sediment samples were to be collected from the Demolition Area as the CSM did not indicate the
1578 likely presence of MC in sediments due to the buried nature of the AOC.

1579 **13.4.3 Groundwater Pathway**

1580 Groundwater was initially considered a potentially affected media because it is present within
1581 100 ft of ground surface. However, the groundwater pathway is not complete as there are no
1582 downgradient groundwater users in the area. As agreed to during the TPP process, groundwater
1583 is not a complete pathway at Ft. Flagler. No groundwater samples were planned or collected.

1584 **13.4.4 Air Pathway**

1585 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil
1586 particles. However, air is not an affected media under current land use, thus the pathway is
1587 incomplete.

1588 **14.0 Quartermaster Wharf Disposal Area**

1589 **14.1 History and Land Use**

1590 The Quartermaster Wharf Disposal Area is a single AOC shown on Figure 14-1. The boundaries
1591 of this AOC were taken from the ASR. The boundary has been expanded to the west, toward the
1592 shore to account for additional beach area that may have been used for disposal. Figure 14-1
1593 indicates the extent of the expansion of the boundary. The Quartermaster Wharf Disposal Area
1594 AOC consists of the beach south of the old wharf. According to the ASR this AOC was used as
1595 a disposal area, and several rounds of .30-caliber ammunition were recovered from the area by a
1596 State Park volunteer. The ASR indicated that it appeared that unwanted supplies were disposed
1597 to the beach.

1598 Currently, the Quartermaster Wharf Disposal Area AOC is part of the Ft. Flagler State Park,
1599 which offers camping, boating, fishing, shoreline use, hiking, and historical interpretive
1600 information. This AOC is located near Battery Wansboro, and makes up the eastern shore of the
1601 Park. For the foreseeable future, it is likely that the Quartermaster Wharf Disposal Area AOC
1602 will continue to be part of the Ft. Flagler State Park.

1603 **14.2 Previous Investigations**

1604 The only previous investigation was the visit by the ASR team in 2003.

1605 **14.3 MEC Evaluation**

1606 Potential MEC for the Quartermaster Wharf Disposal Area includes all munitions used at Ft.
1607 Flagler as listed on Table 2-1.

1608 **14.3.1 Field Observations and Historical Evidence of MEC**

1609 The only reported munitions recovered from this area are small arms rounds. However, other
1610 ordnance may have been disposed.

1611 **14.3.2 MEC Risk Assessment**

1612 The following section presents a qualitative assessment of the risk associated with potential
1613 MEC. A MEC assessment is provided to convey relative risk on a scale from low to high and is
1614 not intended to be a thorough risk assessment as would be conducted for an RI/FS.

1615 Based on the assumed former use of this AOC as a disposal area for discarded supplies from the
1616 Quartermaster Wharf, the finding of small arms rounds on the beach, and constant wave action
1617 on the beach that would weather any MEC, the risk of encountering MEC on the beach is
1618 considered low.

1619 **14.4 Munitions Constituents Evaluation**

1620 Potential MC for the Quartermaster Wharf Disposal Area includes explosives (including
1621 nitroglycerin and PETN) and metals. However, because the area may have been used to dispose
1622 of materials other than munitions that contained metals, metals were not considered a chemical
1623 of concern for this AOC. This was as agreed to during the TPP process.

1624 **14.4.1 Terrestrial Pathway**

1625 Terrestrial receptors may be exposed to MC if there were releases from munitions that were
1626 disposed at the Quartermaster Wharf Disposal Area. One soil sample (NWO -039-0013) was
1627 collected from the beach south of Quartermaster Wharf. The sample was analyzed for
1628 explosives, including nitroglycerin and PETN using EPA Method SW-846-8330A. Metals were
1629 not included in the analysis suite as disposal of materials containing metals other than munitions
1630 may have impacted the beach. The sampling location and results are shown in Figure 14-2.

1631 **14.4.1.1 Comparison to Background Data**

1632 There were no detections of explosive compounds in the sample from Quartermaster Wharf
1633 Disposal Area.

1634 **14.4.2 Surface Water Pathway**

1635 The potential receptors for sediments are park workers and visitors and wildlife. There were no
1636 detections of explosive compounds in the sample from Quartermaster Wharf Disposal Area, and
1637 thus there is no exposure to the surface water pathway.

1638 **14.4.3 Groundwater Pathway**

1639 The exposure pathway to groundwater is interrupted by the presence of the Puget Sound tidal
1640 zone. Any potential exposure to groundwater would be circumvented by the exposure to surface
1641 water. Thus, the groundwater pathway is incomplete for the Quartermaster Wharf Disposal
1642 Area.

1643 **14.4.4 Air Pathway**

1644 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil
1645 particles. However, air is not an affected media under current land use, thus the pathway is
1646 incomplete.

1647 *15.0 Summary and Conclusions*

1648 The conclusions of the SI are presented in this section. Recommendations for further action are
1649 presented in Section 16.0. Updated CSMs are presented in Appendix J.

1650 The former Ft. Flagler is included on the MMRP Inventory in the ARC (DoD, 2006), and in the
1651 *INPR Supplement* (USACE, 2004b). Three ranges were identified: The Range Complex, Rocket
1652 Range, and Transition Range 2. The Range Complex contains 11 sub-ranges, including all 9
1653 artillery batteries, Transition Range 1 and the Gas Chamber. The MMRP Inventory listed
1654 Transition Range 2; however, the location was not specified and the *INPR Supplement* stated
1655 that the location was unknown. The ASR (USACE, 2005b) identified a Rifle Range and the
1656 Quartermaster Wharf Disposal Area.

1657 Information obtained at the TPP meeting identified additional areas of munitions use at Ft.
1658 Flagler. These additional areas included the Ammunition Bunker, the location of Transition
1659 Range 2, Live and Practice Grenade Courts, and a Demolition Area.

1660 During the TPP process, the ranges identified in the MMRP Inventory, the ASR, and at the TPP
1661 meeting were organized into 11 AOCs. The organization allowed for the development of data
1662 needs and sampling strategies. Transition Range 1 and the Gas Chamber were named as their
1663 own AOCs, rather than grouping them in the Range Complex with the artillery batteries. The 11
1664 AOCs at Ft. Flagler include the Range Complex (includes all artillery bunkers), Ammunition
1665 Bunker, Transition Range 1, Transition Range 2, Gas Chamber, Rocket Range, Live Grenade
1666 Court, Practice Grenade Court, Rifle Range, Demolition Area, and Quartermaster Wharf
1667 Disposal Area.

1668 For MRSPP scoring, Transition Range 1 and the Gas Chamber are included in The Range
1669 Complex.

1670 *15.1 Range Complex*

1671 No MEC or evidence of MEC, or MD was encountered during the SI visual reconnaissance at
1672 the land area of the Range Complex. No evaluation of the beach, near-shore, or offshore areas
1673 was completed. The artillery gun configuration at the batteries would not allow downward firing
1674 at near-shore targets. All firing from the artillery batteries was at targets located several
1675 thousand feet out in the open waters of Puget Sound, where water depths are as much as several
1676 hundred feet. The risk associated with exposure to potential MEC is low.

1677 As agreed to during the TPP process, no soil or sediment samples were planned or collected from
1678 the Range Complex. The storage and use of propellants and projectiles at the artillery batteries
1679 was entirely within each battery and transportation of all munitions was along well maintained
1680 roads.

1681 **15.2 Ammunition Bunker**

1682 No MEC, evidence of MEC, or MD was encountered during the SI visual reconnaissance in the
1683 area of the reported Ammunition Bunker. The Ammunition Bunker is only known from a War
1684 Department map (Appendix L). The location shown on the map was searched and no evidence
1685 of the bunker was found. The risk associated with potential MEC is low.

1686 Provisional soil and sediment samples were identified for this AOC if evidence of MEC or MD
1687 were located. As discussed above no evidence of the presence of the bunker or MEC or MD was
1688 identified. Therefore, no soil or sediment sampling was completed.

1689 **15.3 Transition Range 1**

1690 The northern portion of the AOC is used for picnicking and parking. The park's waste water
1691 treatment plant is also located in the northern part of the AOC. The remainder of the AOC is
1692 heavily wooded with thick undergrowth. Transition Range 1 is a small arms range and no MEC,
1693 other than small arms would be expected. A visual reconnaissance of Transition Range 1 was
1694 completed and no MEC or MD was identified. The risk associated with potential MEC is low.

1695 Two surface soil samples and one sediment sample were collected from the AOC and analyzed
1696 for lead only. Lead concentrations in both soil samples were below the Ft. Flagler soil
1697 background concentration. The lead concentration in the sediment sample significantly exceeded
1698 (three times background) the sediment background concentration, but was below the human
1699 health and ecological screening values.

1700 **15.4 Transition Range 2**

1701 Transition Range 2 is a small arms range and no MEC, other than small arms would be expected.
1702 The AOC is heavily forested with thick undergrowth. No evidence of the range was found
1703 during the visual reconnaissance and no MEC or MD was identified. The risk associated with
1704 potential MEC is low.

1705 Two surface soil samples and one sediment sample were collected from the AOC and analyzed
1706 for lead. Lead concentrations in both soil samples were below the Ft. Flagler soil background
1707 concentration. The lead concentration in the sediment sample did not significantly exceed the
1708 sediment background concentration. Therefore, no comparison to human health or ecological
1709 screening values was completed.

1710 **15.5 Gas Chamber**

1711 The Gas Chamber was located within rooms inside of the bunker for Battery Wansboro. The
1712 AOC was visited during the SI field activities and found no evidence of the chamber other than
1713 the rooms in the bunker. The only munitions reported to have been used were gas grenades
1714 containing riot control agent CN-1, which have low explosive hazard. No MEC or MD were
1715 identified during the visit. The risk associated with potential MEC is low.

1716 As agreed to during the TPP process no sampling of the gas chamber was completed.

1717 **15.6 Rocket Range**

1718 The Rocket Range (Rifle Grenade/Anti-Tank Rocket Range in TPP Memo [Shaw, 2006b] and
1719 SSWP [Shaw, 2007]) AOC was an amphibious assault training area located near the lower
1720 campground at the Ft. Flagler State Park. A portion of this AOC was cleared of UXO in 1992
1721 (USACE, 1997) during a TCRA. This AOC includes a 1000-inch Machine Gun Range, which
1722 was identified on the War Department map that was obtained during the TPP meeting (Appendix
1723 L).

1724 During the 1992 TCRA, two areas of the AOC had a 100 percent clearance completed and in a
1725 third area only a limited clearance was completed due to thick forest and heavy undergrowth.
1726 During the TCRA over 200 munitions items were recovered and disposed of, including three
1727 2.36-inch rockets with live warheads. A closure report for the area covered during the TCRA
1728 was completed in 1996 (USACE, 1996) and the No Further Action alternative was selected
1729 based on an assessment of previous clearance activities and present risk to public.

1730 During the SI, a visual reconnaissance was completed in the area that received only a limited
1731 clearance during the TCRA. No MEC, evidence of MEC, or MD was found. There is potential
1732 for MEC to be present in areas within the AOC that did not receive 100 percent clearance. The
1733 risk associated with potential MEC is moderate.

1734 Three soil samples and one sediment sample were collected from this AOC. The samples were
1735 analyzed for select metals and explosives, including nitroglycerin and PETN. The soil and
1736 analytical results were all below site background concentrations, and the results from the
1737 sediment sample did not significantly exceed background concentrations. No explosive
1738 compounds were detected in any sample. Because all results were below background
1739 concentrations no evaluation of human health or ecological risk was completed.

1740 **15.7 Live Grenade Court**

1741 The Live Grenade Court is located in the southeast corner of the site. The location is only
1742 known from a War Department map, circa 1945. A visual reconnaissance was completed during
1743 the SI and no surface features were identified that could be related to the court. The only
1744 indication that the area was once cleared was that the forest trees were primarily alder and fir
1745 while the surrounding forest was fir, hemlock, and cedar (older growth forest). Munitions used
1746 at the Live Grenade Court included Mk II fragmentation hand grenades and M21 practice hand
1747 grenades. No evidence of MEC or MD was located. However, because of the heavy vegetation,
1748 the presence of MEC may have been undetected. The risk associated with potential MEC is low.

1749 One soil sample was collected from the Live Grenade Court. There were no sediment samples
1750 collected from the Live Grenade Court. Chromium and nickel were detected above their
1751 respective background concentration. These results were compared to human health risk

1752 screening values and were below the screening values. Based on this, there is no risk to human
1753 health at the Live Grenade Court. These results were also compared to ecological risk screening
1754 values. The detected chromium concentration was below the ecological risk screening value, but
1755 the nickel concentration was above. A SLERA was completed for the elevated nickel
1756 concentration in soil. The evaluation concluded that while the sample concentration exceeded
1757 the most conservative screening level (plants), the site background concentration also exceeded
1758 the screening level by a nearly equal amount. This suggests that the screening value is not
1759 appropriate for this site. The soil invertebrate and wildlife screening values are higher than the
1760 background and sample concentrations. Based on this evaluation the nickel concentration in soil
1761 is not an ecological concern.

1762 **15.8 Practice Grenade Court**

1763 The Practice Grenade Court is located in the southeast corner of the site. The location is only
1764 known from a War Department map, circa 1945. A visual reconnaissance was completed during
1765 the SI and no surface features were identified that could be related to the court. The only
1766 indication that the area was once cleared was that the forest trees were primarily alder and fir
1767 while the surrounding forest was fir, hemlock, and cedar (older growth forest). Munitions used
1768 at the Practice Grenade Court consisted of M21 practice hand grenades and MK 1 1A1 practice
1769 hand grenade. Both have explosive charges. No evidence of MEC or MD was located. The risk
1770 associated with potential MEC is low.

1771 As agreed to during the TPP process no soil or sediment samples were collected from the
1772 Practice Grenade Court, due to the low risk of MC constituents (black powder and iron from
1773 grenade bodies.

1774 **15.9 Rifle Range**

1775 The Rifle Range is located in the northeast corner of the FUDS and was used for training troops
1776 in the use of small arms. Only small arms were used at the AOC. No evidence of MEC or MD
1777 was located during a visual reconnaissance of the AOC. The risk associated with potential MEC
1778 is low.

1779 Two soil samples and one sediment sample was collected from in front of the target berm at the
1780 AOC and analyzed for lead only. The lead concentration in both soil samples exceeded the
1781 background concentration for lead. One soil sample exceeded the human health risk screening
1782 value and both soil samples exceeded the ecological risk screening value. A SLERA was
1783 completed for the elevated lead concentration in soil. The SLERA concluded that the lead
1784 concentration exceeded both the plant, soil invertebrate, and wildlife ecological screening values
1785 and that the elevated lead concentration is a concern at the Rifle Range.

1786 The lead concentration in the sediment sample significantly exceeded the background
1787 concentration. The sediment sample lead concentration was below the human health risk
1788 screening value and the ecological risk screening value.

1789 *15.10 Demolition Area*

1790 The Demolition Area is located in the northwest corner of the FUDS near the lower camping
1791 area. The AOC is known only from a War Department map, circa 1945. The War Department
1792 map indicated the area was within a tidal zone that flooded at each high tide. The area has since
1793 been backfilled with gravel and soil to create a picnic and camping area that is several feet above
1794 the high tide mark. The grass is mowed regularly during the growing season. The depth to the
1795 demolition area may be as much as 10 ft. All that is known of this area is from the War
1796 Department Map and the notation "Demolition Area." The area is thought to have been an
1797 OB/OD area, where munitions that were no longer useful or damaged were destroyed.

1798 A visual reconnaissance was completed during the SI field activities. No MEC, evidence of
1799 MEC, or MD was identified. The risk associated with potential MEC at the surface is low.
1800 However, the potential for subsurface MEC is unknown.

1801 As agreed to during the TPP process no soil or sediment sample were to be collected from this
1802 AOC. This was based on the assumption that the demolition area was buried under several feet
1803 to as much as 10 feet of soil. As with MEC, the potential for MC in subsurface soils is unknown.

1804 *15.11 Quartermaster Wharf Disposal Area*

1805 This AOC is on the beach located south of the old Quartermaster Wharf. It is suspected that the
1806 beach was used to dispose of damaged or unwanted supplies. Several rounds of .30 caliber
1807 ammunition was recovered from this area by a park volunteer.

1808 A visual reconnaissance of the AOC was completed during the SI field work, no evidence of
1809 MEC or MD was identified. The risk associated with potential MEC at the surface is low.

1810 One sample from the beach was collected and analyzed for explosives only. Metals were not
1811 analyzed for, as disposal of non-munitions items that may also have contained metals would also
1812 likely be present. There were no explosive compounds detected in the sample.

1813 **16.0 Recommendations**

1814 Results of the SI provide the basis for conclusions and/or recommendations for further actions at
1815 each of the AOCs. This section is organized to provide recommendations for the three ranges
1816 identified in the ARC (DoD, 2006). Additional recommendations are made for other areas
1817 identified during the TPP process that should be identified as MRS.

1818 **16.1 Range Complex**

1819 The Range Complex consists of the nine artillery batteries, Transition Range 1, and the Gas
1820 Chamber. Based on historical evidence including the configuration, and limited use of the
1821 batteries, it is unlikely that munitions would have been discarded. Results from the SI field
1822 reconnaissance activities indicate there is no evidence of MEC on land areas of the Range
1823 Complex. The beach and offshore areas of the Range were not evaluated due to the limited MEC
1824 exposure potential and accessibility. Therefore, a recommendation for NDAI with respect to
1825 MEC is made for the Range Complex

1826 No sampling was conducted at the nine artillery batteries or Gas Chamber within the Range
1827 Complex. Significant MC from firing the artillery guns is unlikely because of infrequent use and
1828 the extended time period since use stopped. No sampling was conducted from the beach and
1829 offshore areas of the Range Complex because of the unlikely presence of MC on the beach and
1830 inaccessibility of the offshore target areas. Residue from the gas used (CN-1) at the gas chamber
1831 is not expected as well. Soil and sediment sampling for lead was completed within Transition
1832 Range 1. Analytical results show that lead concentrations in soil and sediment were below
1833 background concentrations or human health and ecological screening values. Therefore, a
1834 recommendation for NDAI for MC is made for the Range Complex.

1835 **16.2 Rocket Range**

1836 Based on historical use of the Rocket Range (Rifle Grenade/Anti-Tank Rocket Range, previous
1837 clearance activities, and results of the SI field activities, there is evidence of MEC at this range
1838 and a moderate risk to park users. Therefore, a recommendation for RI/FS for MEC is made for
1839 the Rocket Range.

1840 Analytical results from three soil samples and one sediment sample did not exceed background.
1841 Therefore, a recommendation for NDAI for MC is made for the Rocket Range.

1842 **16.3 Transition Range 2**

1843 Based on historical use of the range and results of the SI field activities, there is no evidence of
1844 MEC or MD (other than small arms use) at the Transition Range 2. Analytical results from soil
1845 and sediment sampling indicated that lead concentrations were below background

1846 concentrations. A recommendation for NDAI for both MEC and MC is made for Transition
1847 Range 2.

1848 **16.4 Removal Actions**

1849 Section 1.3 identified as one of the decision rules, evaluation of whether a TCRA is warranted.
1850 A TCRA would be warranted if a high MEC hazard or elevated MC risk was identified. There is
1851 no indication that a high MEC risk is present at Ft. Flagler. No MEC was identified during the
1852 SI or ASR field activities and there have been no reports of MEC since the TCRA completed in
1853 1992.

1854 **16.5 Munitions Response Areas**

1855 Results of the SI field activities provide the basis for identifying MRSs and, as appropriate,
1856 munitions response areas (MRAs) and for scoring each MRS using the MRSPP. A MRA is any
1857 area on a defense site that is known or suspected to contain MEC or MC, and may contain one or
1858 more MRS.

1859 Based on the use and physical distribution of the AOCs at Ft. Flagler, three MRSs are identified
1860 (Figure 16-1):

- 1861 • MRS No. 1 – Range Complex,
- 1862 • MRS No. 2 – Rocket Range, and
- 1863 • MRS No. 3 – Transition Range 2.

1864 MRSPP scoring is provided in Appendix K.

1865 For the purposes of scoring, the Range Inventory list is used, as per USACE direction. MRS No.
1866 1 – Range Complex consists of those sub-ranges listed in Section 1.2, including all artillery
1867 batteries and associated offshore target areas, Transition Range 1, and the Gas Chamber. MRS
1868 No. 2 is the Rocket Range, and MRS No. 3 is Transition Range 2.

1869 **16.6 Other AOCs**

1870 Based on USACE guidance, only those ranges identified in the ARC (DoD, 2006) are assigned
1871 to an MRA/MRS and scored using the MRSPP protocols until DoD can determine the eligibility
1872 of the other AOCs. Recommendations for identification for those remaining AOC are made
1873 below.

1874 **16.6.1 Ammunition Bunker**

1875 The Ammunition Bunker is not recommended to be identified as an MRS. The Ammunition
1876 Bunker is also located within the boundaries of MRS No.1 - Range Complex. While the AOC
1877 was shown on a War Department map from 1945, no evidence of the bunker could be found at
1878 the location indicated on the map. There is no evidence that the Ammunition Bunker has any
1879 MEC or MC associated with it.

1880 **16.6.2 Live Grenade Court**

1881 The Live Grenade Court is recommended to be identified as an MRS. The Live Grenade Court
1882 is not within one of the existing MRSs. While no evidence of the court (throwing bays, impact
1883 area) was identified in the field due to very heavy vegetation growth, the trees at the reported
1884 location indicate that it was once cleared (younger growth forest than surrounding forest). In
1885 addition, the reported former use as a live grenade court suggests a potential for MEC and MC
1886 risk. If the Live Grenade Court is identified as an MRS, additional investigations for MEC and
1887 MC are recommended.

1888 **16.6.3 Practice Grenade Court**

1889 The Practice Grenade Court is recommended to be identified as an MRS. The Practice Grenade
1890 Court is not within one of the existing MRSs. While no evidence of the court (throwing bays,
1891 impact area) was identified in the field due to very heavy vegetation growth, the trees at the
1892 reported location indicate that it was once cleared (younger growth forest than surrounding
1893 forest). In addition, the reported former use as a practice grenade court suggests a potential for
1894 MEC and MC risk. If the Practice Grenade Court is identified as an MRS, additional
1895 investigations for MEC and MC are recommended.

1896 **16.6.4 Rifle Range**

1897 The Rifle Range is recommended to be identified as an MRS. The Rifle Range is within the
1898 boundary of the MRS No. 1 - Range Complex. There is direct evidence that this range was used
1899 as a rifle range and the MC risk is present based on lead concentrations above site background,
1900 human health, and ecological screening values. If the Rifle Range is identified as an MRS,
1901 additional investigations for MC are recommended.

1902 **16.6.5 Demolition Area**

1903 The Demolition Area is recommended to be identified as an MRS. The Demolition Area is not
1904 within one of the existing MRSs. The War Department map (Appendix L) identified this area as
1905 a "Demolition Area Rifle Grenade", and it appears that the location was a beach area that has
1906 been backfilled. There is no apparent surface MEC risk at this location. However, there may be
1907 a subsurface MEC or MC risk. If the Demolition Area is identified as an MRS, additional
1908 investigations for MEC and MC are recommended.

1909 **16.6.6 Quartermaster Wharf Disposal Area**

1910 The Quartermaster Wharf Disposal Area is recommended to be identified as an MRS. The
1911 Quartermaster Wharf Area is within MRS No.1 the Range Complex. The area is thought to have
1912 been used for disposal of unwanted materials. Small arms ammunition has been found on the
1913 beach and other munitions may have been discarded there as well. There is a potential risk for

1914 MEC and MC from disposal of munitions. If the Quartermaster Wharf Disposal Area is
1915 identified as an MRS, additional investigations for MEC and MC are recommended.

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Figures



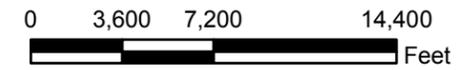
OFFICE: MNRVL
 DRAWN BY: K. Masterson
 DRAWING NUMBER: 05/08/07
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Legend

 Ft. Flagler Military Reservation FUDS Boundary

NOTES:

- 1) FUDS boundary was derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Topographic maps (Jefferson and Island Counties) obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



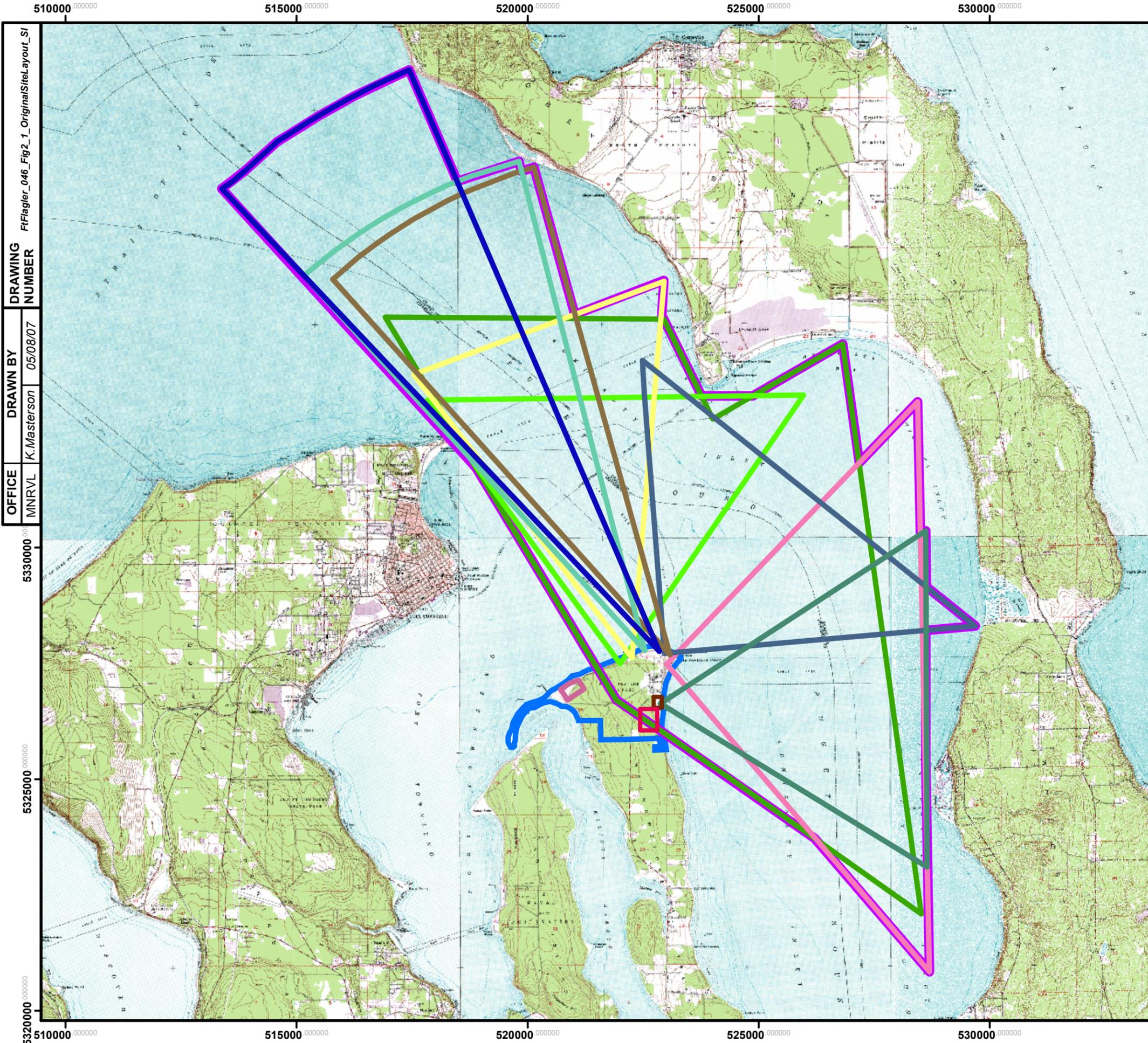
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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OMAHA DESIGN CENTER

FIGURE 1-1
SITE LOCATION
FORT FLAGLER MILITARY RESERVATION





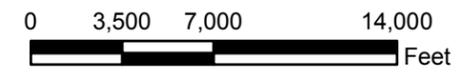
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 532000 000000 5325000 000000 5330000 000000 5335000 000000 5340000 000000
 F:\Flagler_046_Fig2_1_OriginalSiteLayout_S1
 DRAWING NUMBER
 DRAWN BY K. Masterson 05/08/07
 OFFICE MNRVL

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Ranges Identified in the MMRP Range Inventory**
- Range Complex No. 1
- Battery Bankhead
- Battery Calwell
- Battery Downes
- Battery Gratton
- Battery Lee
- Battery Rawlins
- Battery Revere
- Battery Wansboro
- Battery Wilhelm
- Gas Chamber
- Rocket Range
- Transition Range 1

NOTES:

- 1) FUDS boundary and range boundaries were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo obtained from the U.S. Geological Survey and is dated 1967.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 1-2
RANGE CONFIGURATION FROM THE
MMRP RANGE INVENTORY
 FORT FLAGLER MILITARY RESERVATION

519850 000000 520800 000000 521750 000000 522700 000000 523650 000000



Legend

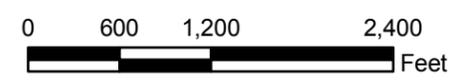
- Ft. Flagler Military Reservation FUDS Boundary
- 1992 UXO Clearance Area
- Ranges Included in the MMRP Range Inventory**
- Range Complex No. 1
- Gas Chamber
- Rocket Range
- Transition Range 1

NOTES:

- 1) FUDS boundary and range boundaries were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

5328000 000000
5327200 000000
5326400 000000
5325600 000000

F:\Flagler_047_Fig2_2_CurrentAerial_SI
DRAWING NUMBER
 K.Masterson 06/21/07
OFFICE
 MNRVL



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



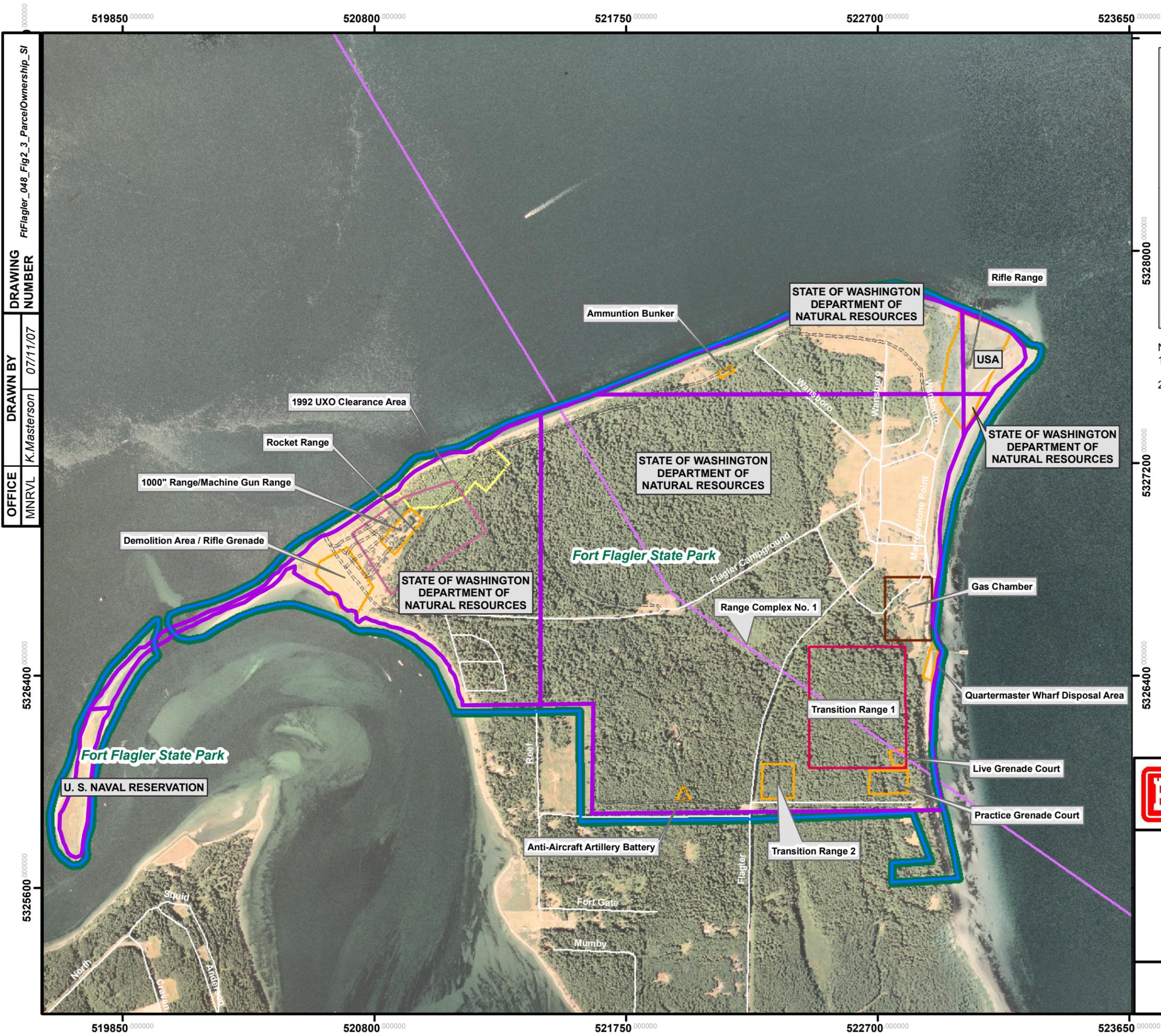
U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 2-1
CURRENT LAND USE

FORT FLAGLER MILITARY RESERVATION



519850 000000 520800 000000 521750 000000 522700 000000 523650 000000



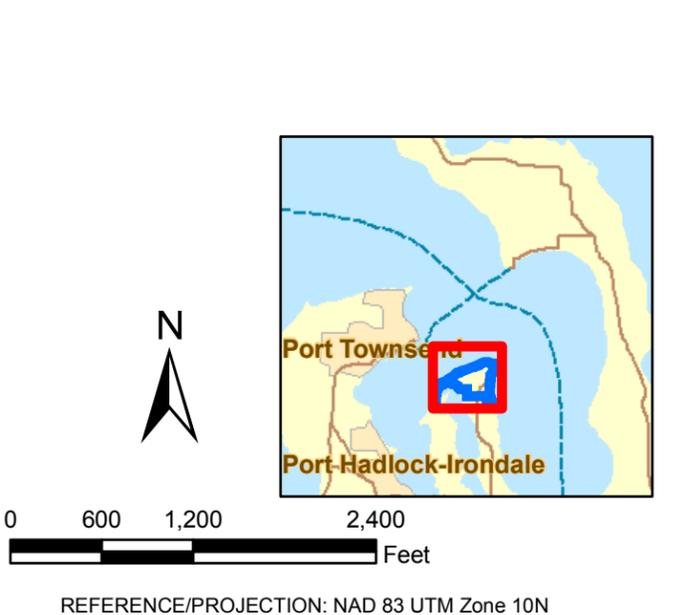
DRAWING NUMBER: FtFlagler_048_Fig2_3_ParcelOwnership_SI
 DRAWN BY: K.Masterson
 OFFICE: MNRVL
 DATE: 07/11/07

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Parcel Ownership Boundary
- Ranges Identified in the MMRP Range Inventory**
- Range Complex No. 1
- Gas Chamber
- Rocket Range
- Transition Range 1
- Additional Areas of Interest Identified During the Technical Planning Process
- 1992 UXO Clearance Area
- Fort Flagler State Park

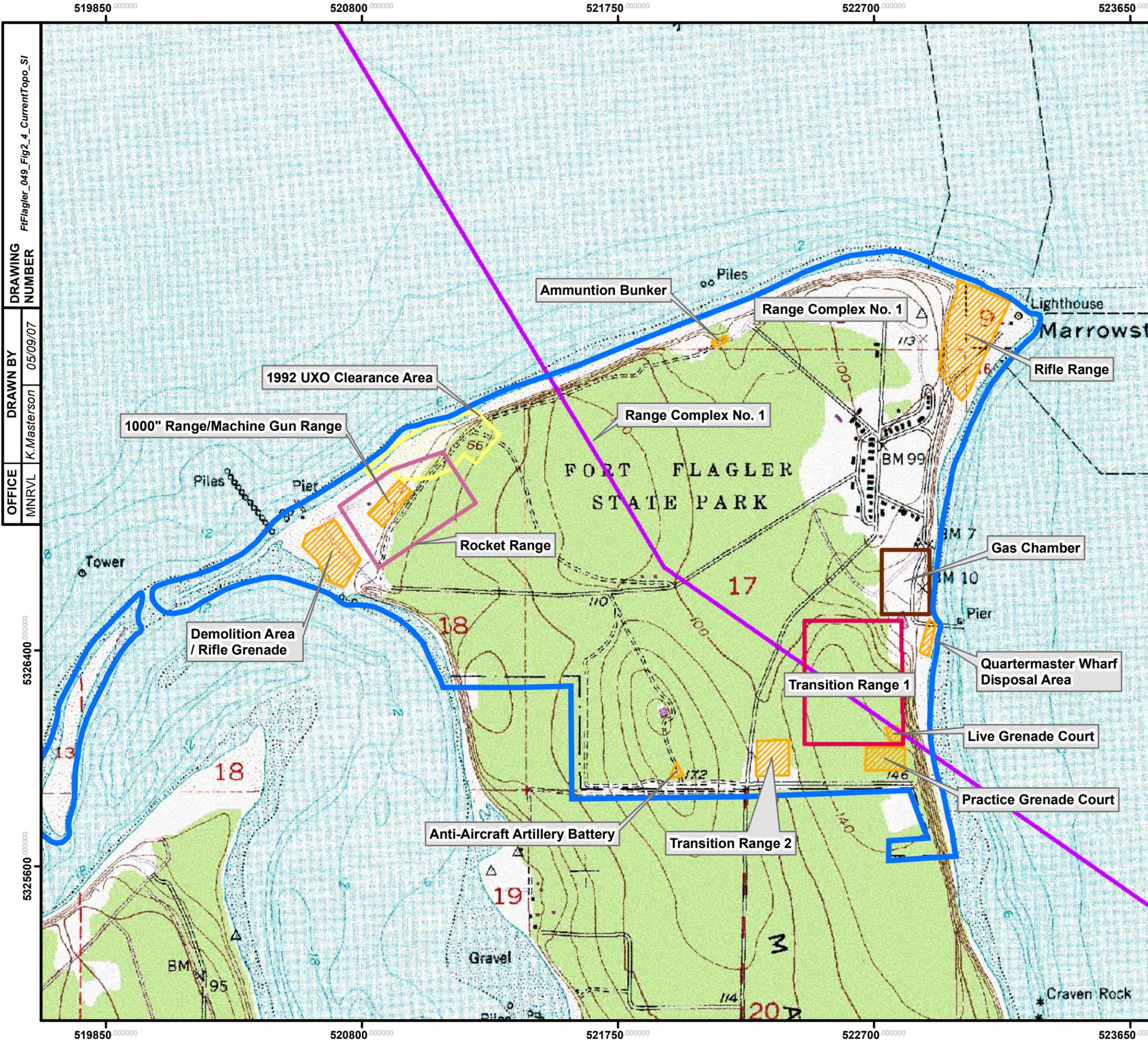
NOTES:

- 1) FUDS boundary and range boundaries were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



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FIGURE 2-2
PARCEL OWNERSHIP
 FORT FLAGLER MILITARY RESERVATION

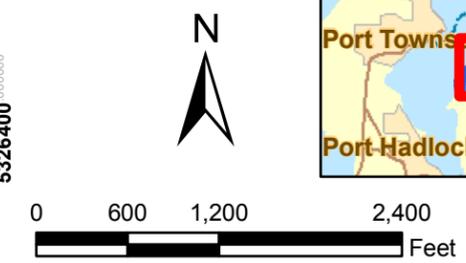
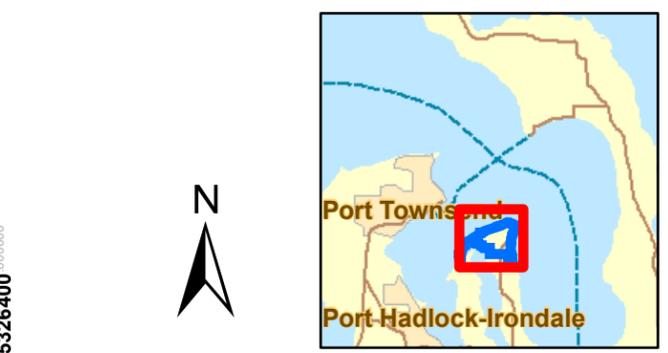


Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Ranges Identified in the MMRP Range Inventory**
- Range Complex No. 1
- Gas Chamber
- Rocket Range
- Transition Range 1
- Additional Areas of Interest Identified During the Technical Planning Process
- 1992 UXO Clearance Area

NOTES:

- 1) FUDS boundary and range boundaries were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Topographic map (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 2-3
CURRENT TOPOGRAPHIC MAP
FORT FLAGLER MILITARY RESERVATION

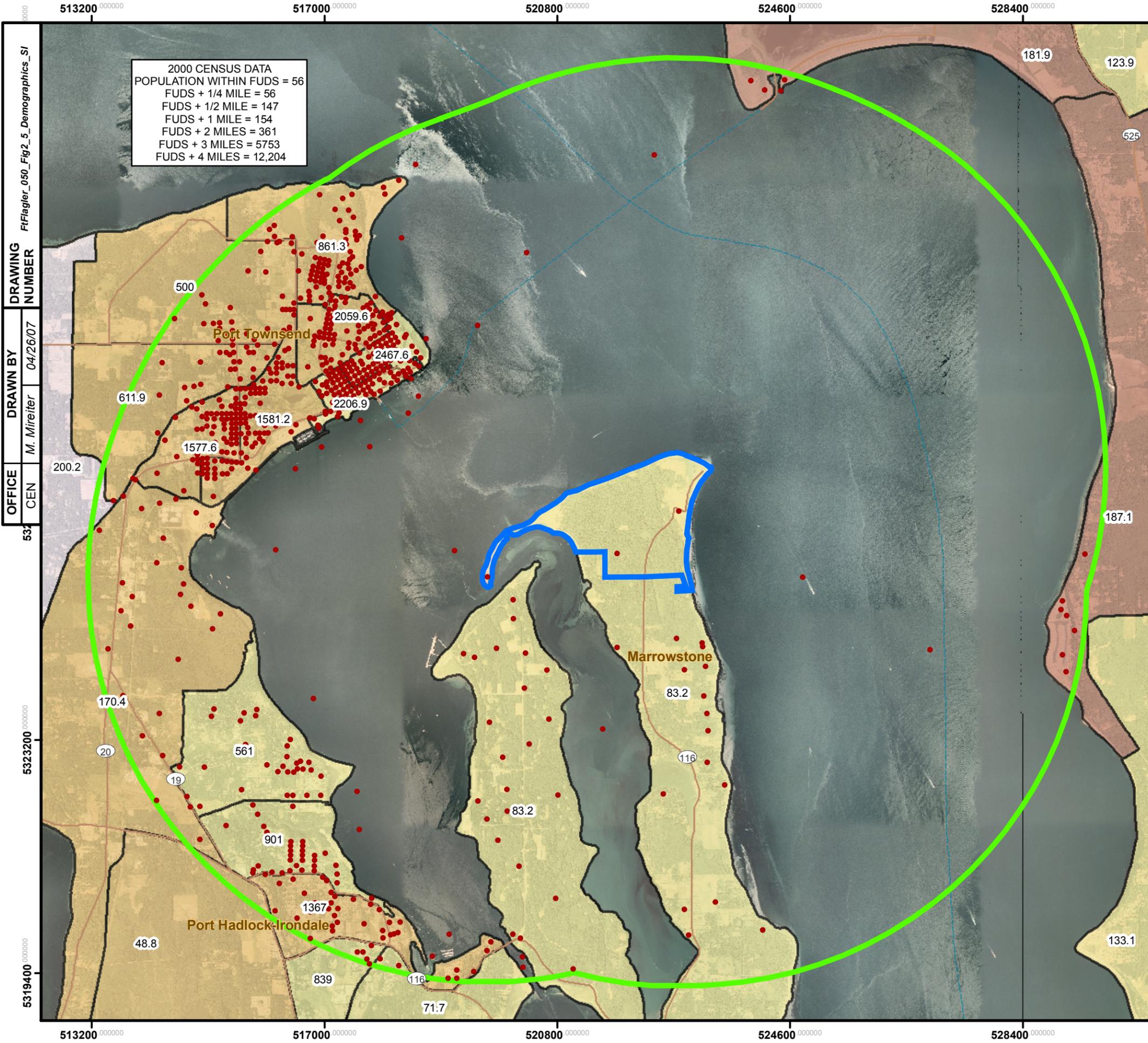
DRAWING NUMBER: FFlagler_049_Fig2_4_CurrentTopo_SI
DRAWN BY: K.Masterson
OFFICE: MNRVL
DATE: 05/09/07

5326400
5325600

5328000
5327200
5326400
5325600

519850 520800 521750 522700 523650

519850 520800 521750 522700 523650



2000 CENSUS DATA
 POPULATION WITHIN FUDS = 56
 FUDS + 1/4 MILE = 56
 FUDS + 1/2 MILE = 147
 FUDS + 1 MILE = 154
 FUDS + 2 MILES = 361
 FUDS + 3 MILES = 5753
 FUDS + 4 MILES = 12,204

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- 4-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary

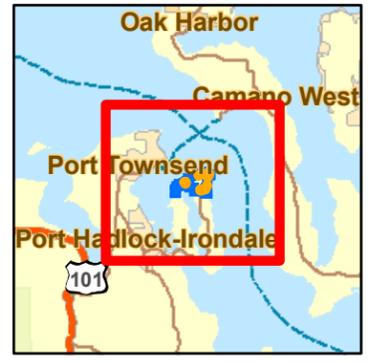
2004 Census Block Group Population

- 0 - 500
- 501 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 2200

- Census Block Centroid Unit
- Number of People Per Square Mile

NOTES:

- 1) FUDS boundary was derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Census data obtained from StreetMap, ESRI, 2005.
- 3) Aerial photos (Jefferson and Island Counties) obtained from the U.S. Department of Agriculture, Service Center Agencies; photos are from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 2-4
CENSUS DATA WITHIN 4-MILE RADIUS
 FORT FLAGLER MILITARY RESERVATION

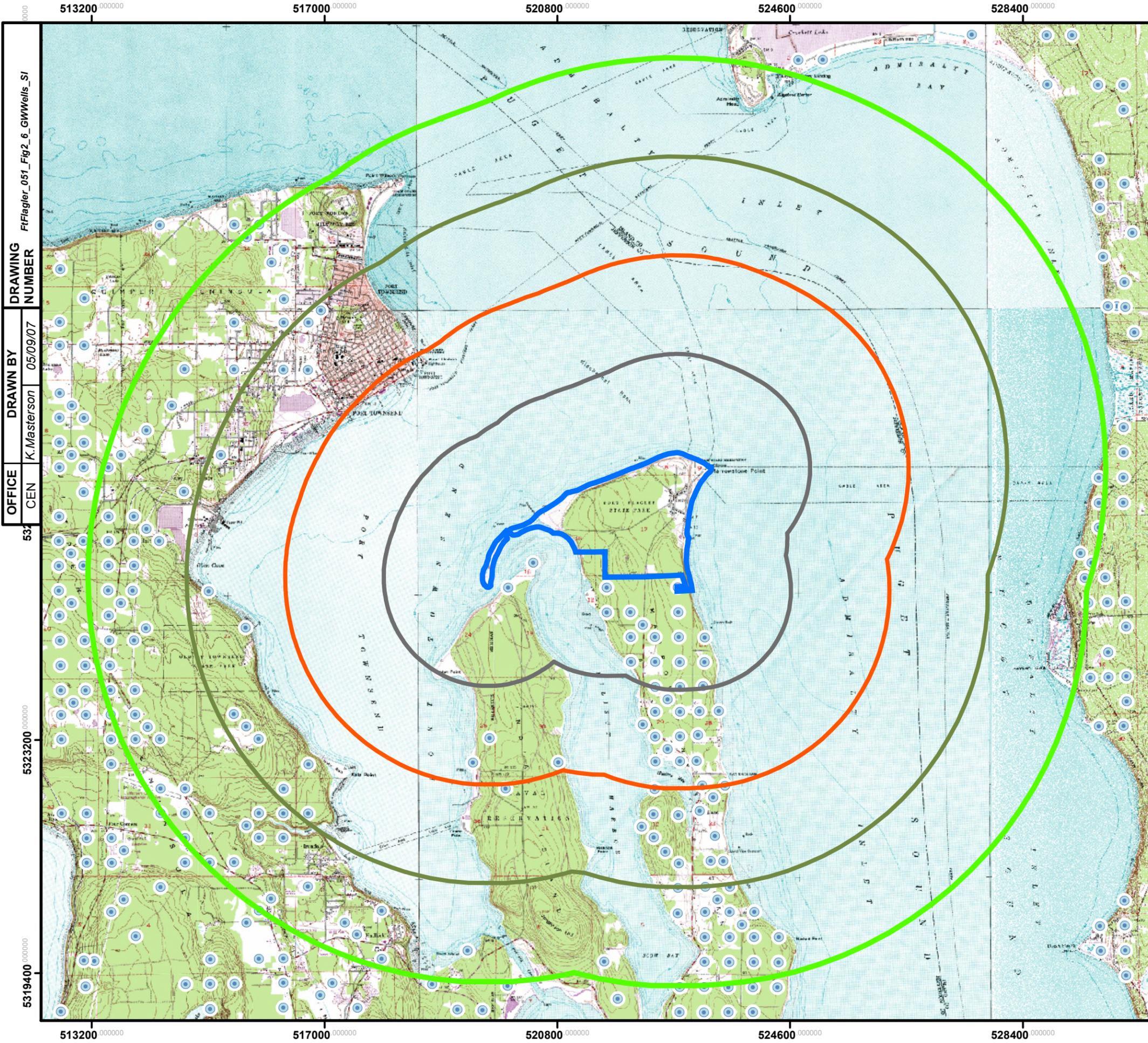


DRAWING NUMBER: FFlagler_050_Fig2_5_Demographics_SI

DRAWN BY: M. Mireiter

OFFICE: CEN

DATE: 04/26/07



DRAWING NUMBER: FIFlagler_051_Fig2_6_GWwells_SI
 DRAWN BY: K. Masterson
 DATE: 05/09/07
 OFFICE: CEN

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- 4-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- 3-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- 2-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- 1-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- Groundwater Well

NOTES:

- 1) FUDS boundary was derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Groundwater well data obtained from the State of Washington, Department of Ecology.
- 3) Topographic maps (Jefferson and Island Counties) obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



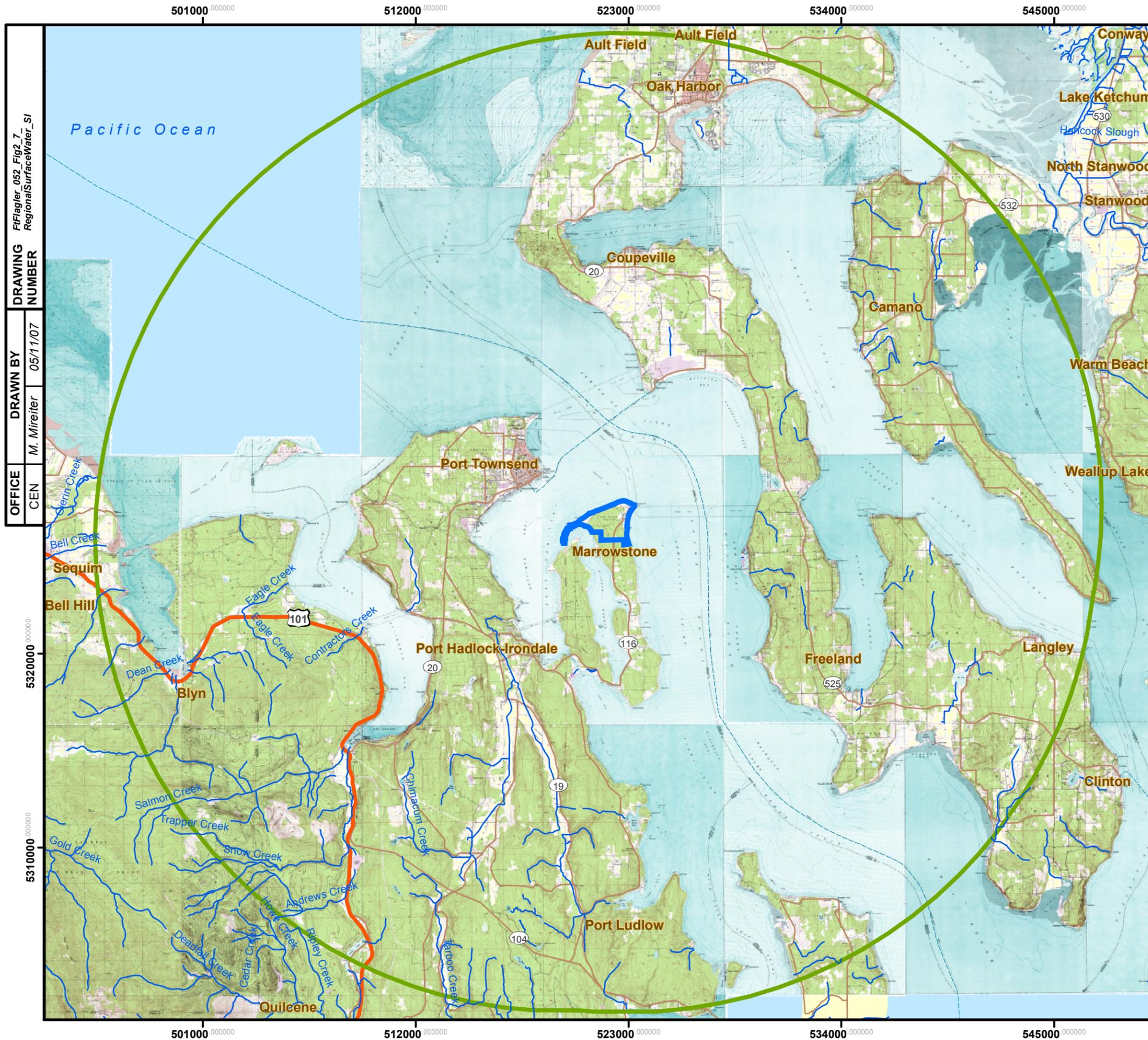
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 2-5
GROUNDWATER WELL LOCATIONS
 FORT FLAGLER MILITARY RESERVATION



513200.000000 517000.000000 520800.000000 524600.000000 528400.000000
 5319400.000000 5323200.000000 5330800.000000 5334600.000000



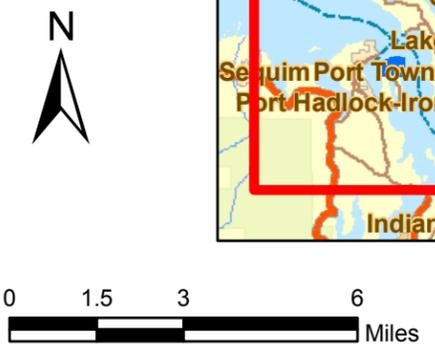
OFFICE: CEN
 DRAWN BY: M. Mireiter
 DATE: 05/11/07
 DRAWING NUMBER: FFlagler_052_Fig2_7_RegionalSurfaceWater_SI

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- 15 Mile Radius from the FUDS Boundary

NOTES:

- 1) FUDS boundary was derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Topographic maps (Jefferson, Island, Clallam, and Kitsap Counties) obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 2-6
SURFACE WATER DRAINAGE
 FORT FLAGLER MILITARY RESERVATION



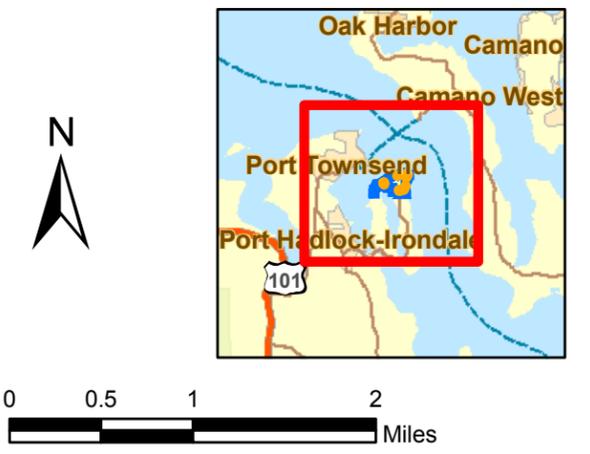
DRAWING NUMBER: FtFlagler_053_Fig2_8_SensRec_SI
 DRAWN BY: K.Masterson
 DATE: 05/09/07
 OFFICE: MNRVL

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- 4-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- 2-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- Wetland Area
- Park
- Golf Course
- School
- Hospital

NOTES:

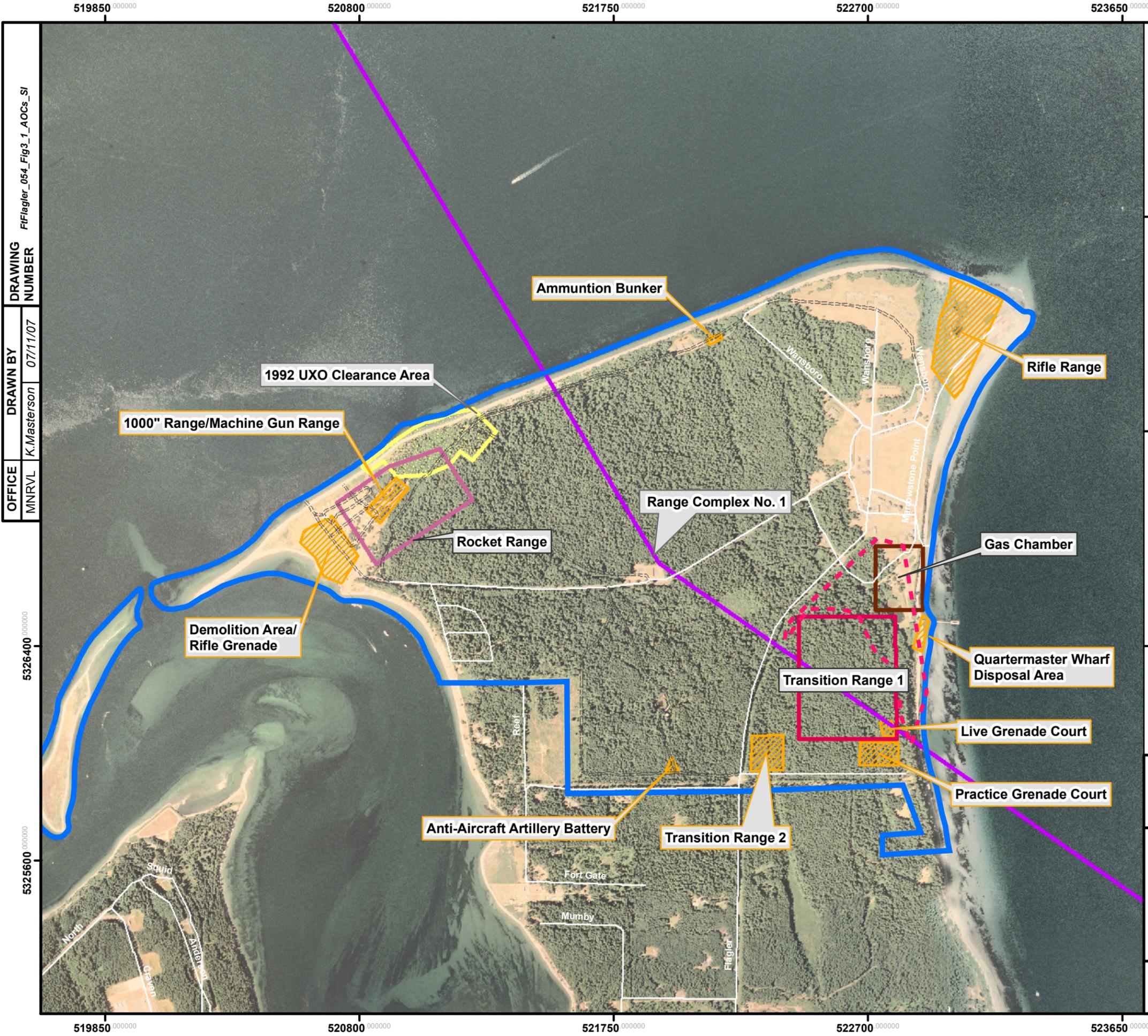
- 1) FUDS boundary was derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Wetlands data obtained from the U.S. Fish and Wildlife Service, 200605, NWIDBA.CONUS_wet_poly: Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31., U.S. Fish and Wildlife Service, Branch of Habitat Assessment, Washington, D.C.
- 3) Topographic maps (Jefferson and Island Counties) obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 2-7
SENSITIVE RECEPTOR LOCATIONS
FORT FLAGLER MILITARY RESERVATION



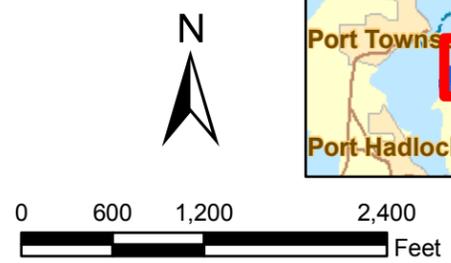
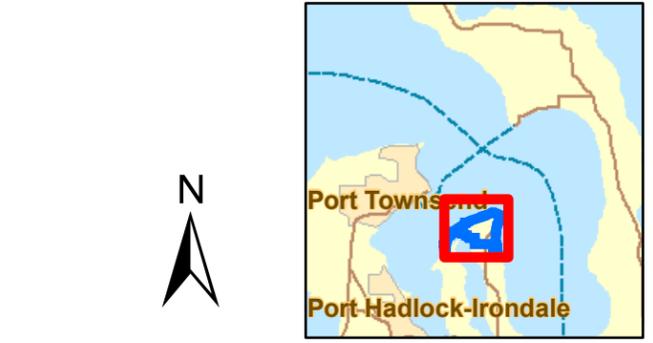
DRAWING NUMBER: FtFlagler_054_Fig3_1_AOCs_SI
 DRAWN BY: K.Masterson 07/11/07
 OFFICE: MNRVL

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Ranges Identified in the MMRP Range Inventory
- Range Complex No. 1
- Gas Chamber (Range Complex No. 1 Subrange)
- Transition Range 1 (Range Complex No. 1 Subrange)
- Rocket Range
- Range Boundary Identified in the ASR
- Transition Range 1 (Adjusted Location)
- Additional Areas
- Additional Areas of Interest Identified During the Technical Planning Process
- 1992 UXO Clearance Area

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Dashed lines indicate adjustments to INPR Supplement Locations
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 3-1
SITE INSPECTION
AREAS OF CONCERN
 FORT FLAGLER MILITARY RESERVATION



DRAWING NUMBER: FFlagler_055_Fig3_2_BkgrndSampleLocs_S1
 DRAWN BY: K. Masterson
 DATE: 07/11/07
 OFFICE: MNRVL
 ID: 53

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Range Complex No. 1
- Gas Chamber
- Rocket Range (Adjusted Location)
- Transition Range 1 (Adjusted Location)
- Additional Areas of Interest Identified During the Technical Planning Process
- 1992 UXO Clearance Area
- Background Soil Sample Location
- ◆ Background Sediment Sample Location

NOTES:

- 1) FUDS boundary and range boundaries were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

N

0 500 1,000 2,000 Feet

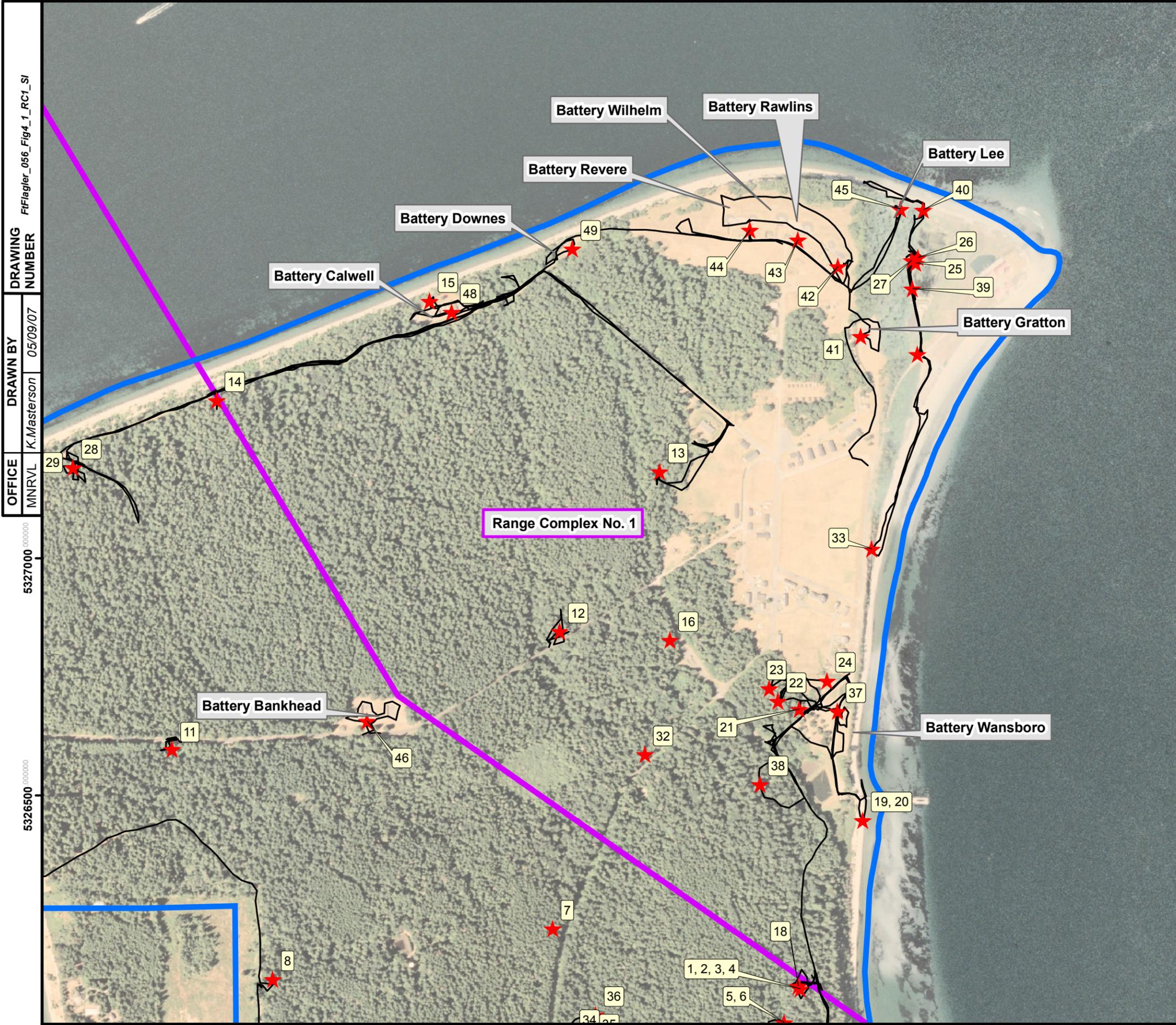
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

Port Townsend
Port Hadlock-Irondale

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FIGURE 3-2
BACKGROUND SAMPLE LOCATIONS
 FORT FLAGLER MILITARY RESERVATION

521500 522000 522500 523000 523500



Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Reconnaissance Tracks
- Photograph Location

NOTES:
 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

5328000
5327500
5327000
5326500

DRAWING NUMBER: FtFlagler_056_Fig4_1_RC1_SI
 DRAWN BY: K.Masterson 05/09/07
 OFFICE: MNRVL



0 350 700 1,400 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



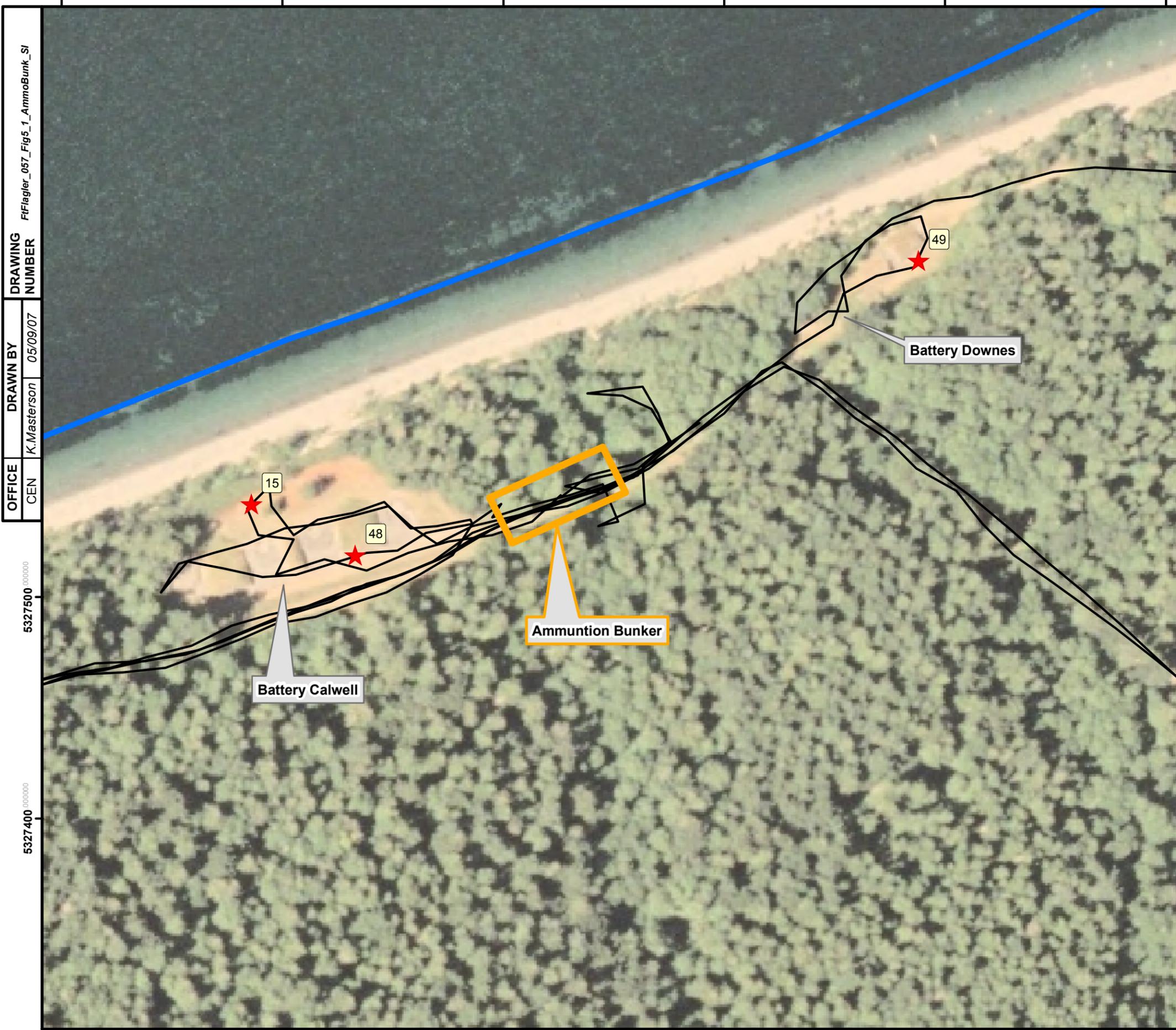
U.S. ARMY CORPS OF ENGINEERS
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FIGURE 4-1
RANGE COMPLEX NO. 1
RECONNAISSANCE
 FORT FLAGLER MILITARY RESERVATION



521500 522000 522500 523000 523500

521900 522000 522100 522200 522300 522400



F:\Flagler_057_Fig5_1_AmmoBunk_SI
 DRAWING NUMBER
 DRAWN BY
 OFFICE
 CEN
 K.Masterson
 05/09/07

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Ammunition Bunker
- Reconnaissance Tracks
- Photograph Location

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

5327700
5327600
5327500
5327400



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

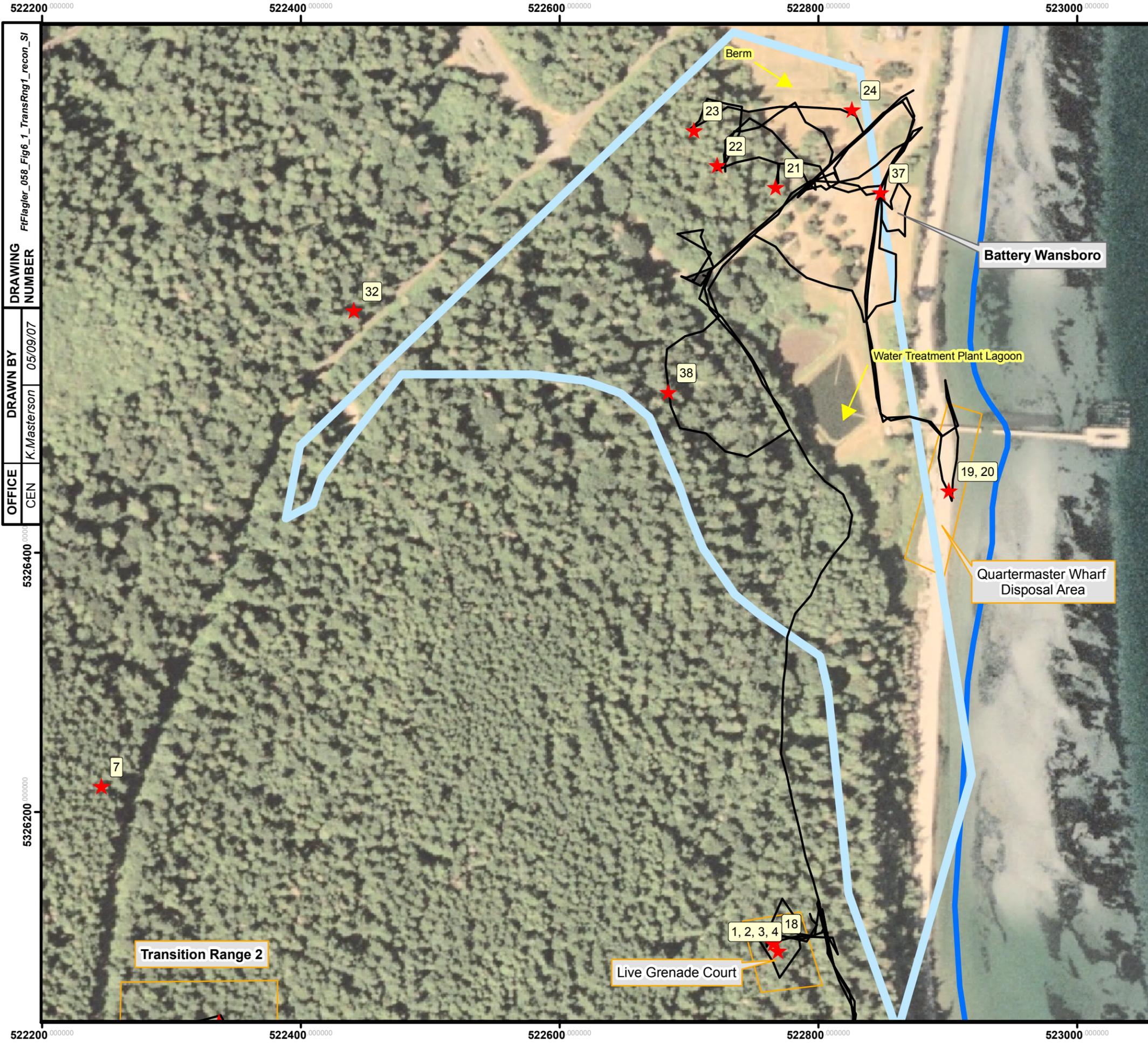


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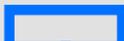
FIGURE 5-1
AMMUNITION BUNKER
RECONNAISSANCE
 FORT FLAGLER MILITARY RESERVATION



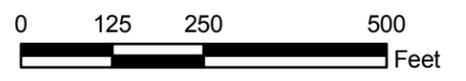
521900 522000 522100 522200 522300 522400



Legend

-  Ft. Flagler Military Reservation FUDS Boundary
-  Transition Range 1
-  Reconnaissance Tracks
-  Photograph Location

NOTES:
 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 6-1
TRANSITION RANGE 1
RECONNAISSANCE
 FORT FLAGLER MILITARY RESERVATION

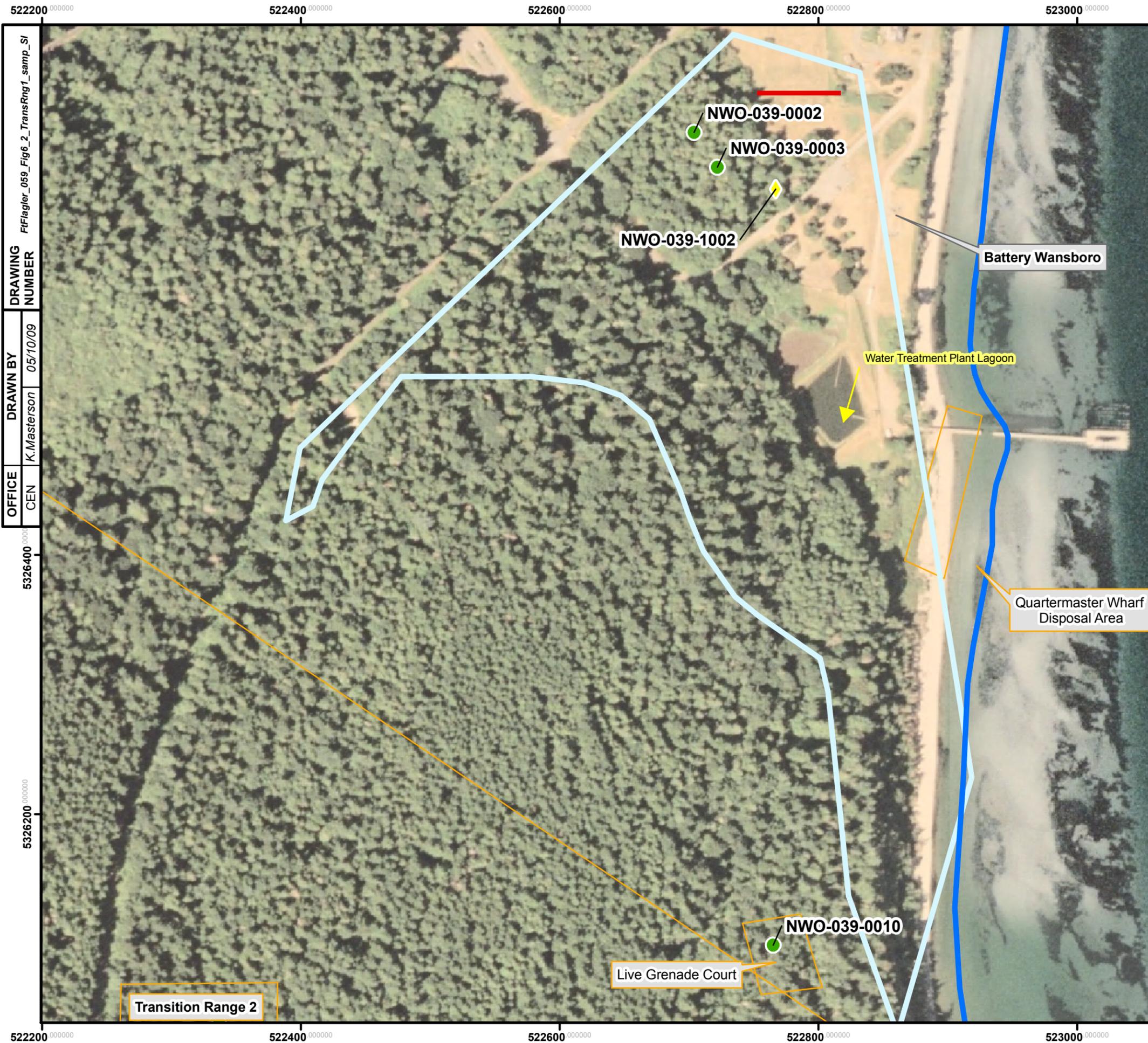
 Shaw Environmental, Inc.

522200 000000 522400 000000 522600 000000 522800 000000 523000 000000

5326400 000000 5326600 000000 5326800 000000

FtFlagler_058_Fig6_1_TransRng1_recon_SI
 DRAWING NUMBER
 DRAWN BY K.Masterson 05/09/07
 OFFICE CEN

5326400 000000 5326200 000000 522200 000000 522400 000000 522600 000000 522800 000000 523000 000000



522200 000000 522400 000000 522600 000000 522800 000000 523000 000000
 5326400 000000 5326600 000000 5326800 000000
 F:\Flagler_059_Fig6_2_TransRng1_samp_SI
 DRAWING NUMBER
 DRAWN BY K.Masterson 05/10/09
 OFFICE CEN


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FIGURE 6-2
TRANSITION RANGE 1
SAMPLE LOCATIONS AND LEAD RESULTS
 FORT FLAGLER MILITARY RESERVATION


Shaw Shaw Environmental, Inc.



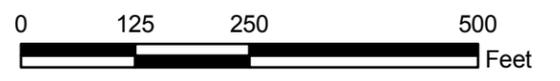
52200 000000 522100 000000 522200 000000 522300 000000 522400 000000 522500 000000 522600 000000
 5325700 000000 5325800 000000 5325900 000000 5326000 000000 5326100 000000 5326200 000000 5326300 000000
 FFlagler_060_Fig7_1_TransRng2_recon_SI
 DRAWING NUMBER
 DRAWN BY
 OFFICE
 K.Masterson 07/10/09
 CEN

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Transition Range 2
- Reconnaissance Tracks

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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FIGURE 7-1
TRANSITION RANGE 2
RECONNAISSANCE
 FORT FLAGLER MILITARY RESERVATION

Shaw Shaw Environmental, Inc.



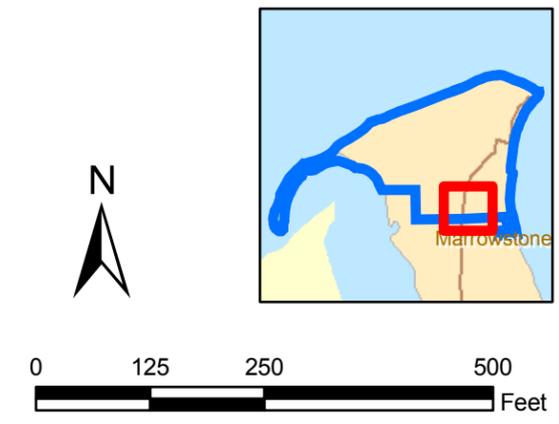
522000 000000 522100 000000 522200 000000 522300 000000 522400 000000 522500 000000 522600 000000
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 FtFlagler_061_Fig7_2_TransRng2_samps_SI
 DRAWING NUMBER
 DRAWN BY K.Masterson 07/11/07
 OFFICE CEN

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Transition Range 2
- Soil Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

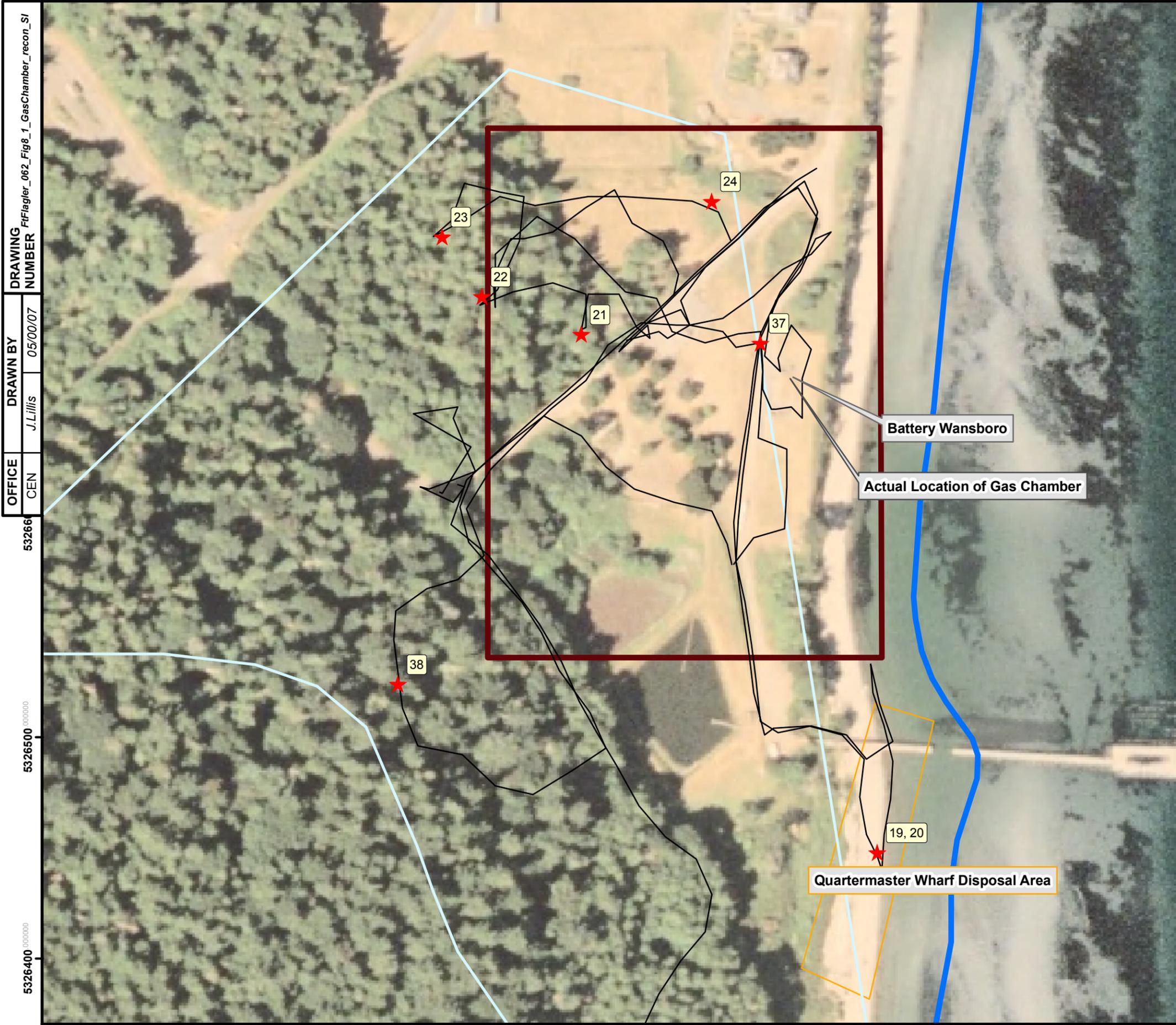


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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 OMAHA DESIGN CENTER

FIGURE 7-2
TRANSITION RANGE 2
SAMPLE LOCATIONS AND LEAD RESULTS
 FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.



Legend

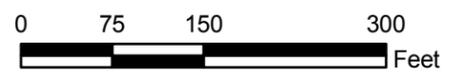
- Ft. Flagler Military Reservation FUDS Boundary
- Gas Chamber
- Transition Range 1
- Reconnaissance Tracks
- Photograph Location

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

DRAWING NUMBER: FtFlagler_062_Fig8_1_GasChamber_recon_SI
 DRAWN BY: J.Lillis
 DATE: 05/00/07
 OFFICE: CEN
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532680
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 532660
 532650
 532640



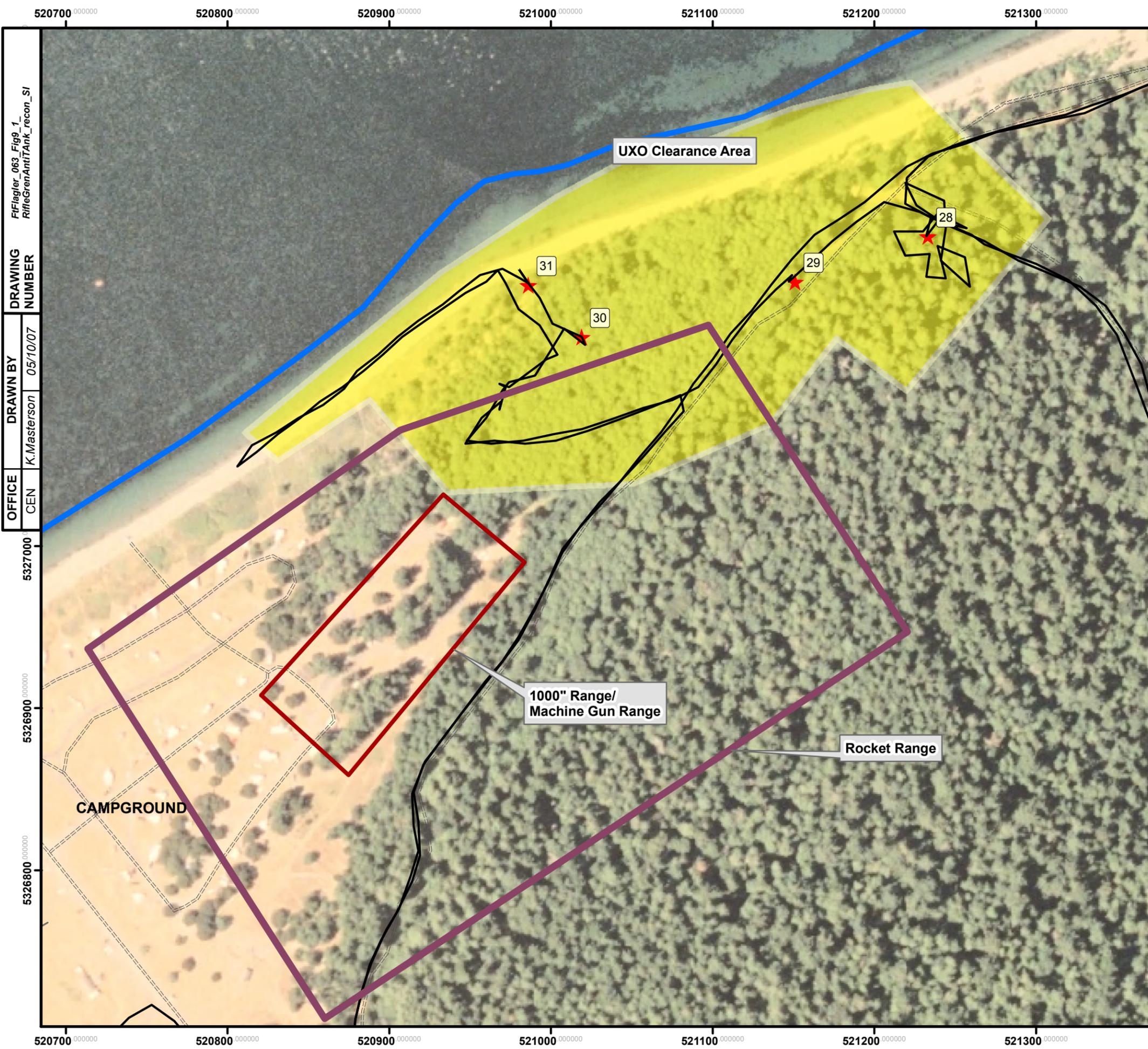
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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OMAHA DESIGN CENTER

FIGURE 8-1
GAS CHAMBER
RECONNAISSANCE
 FORT FLAGLER MILITARY RESERVATION



522600 522700 522800 522900 523000

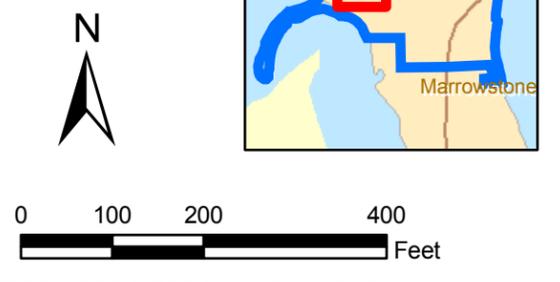


Legend

-  Ft. Flagler Military Reservation FUDS Boundary
-  Rocket Range
-  1992 UXO Clearance Area/TCRA Area
-  Reconnaissance Tracks
-  Photograph Location

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



0 100 200 400 Feet



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



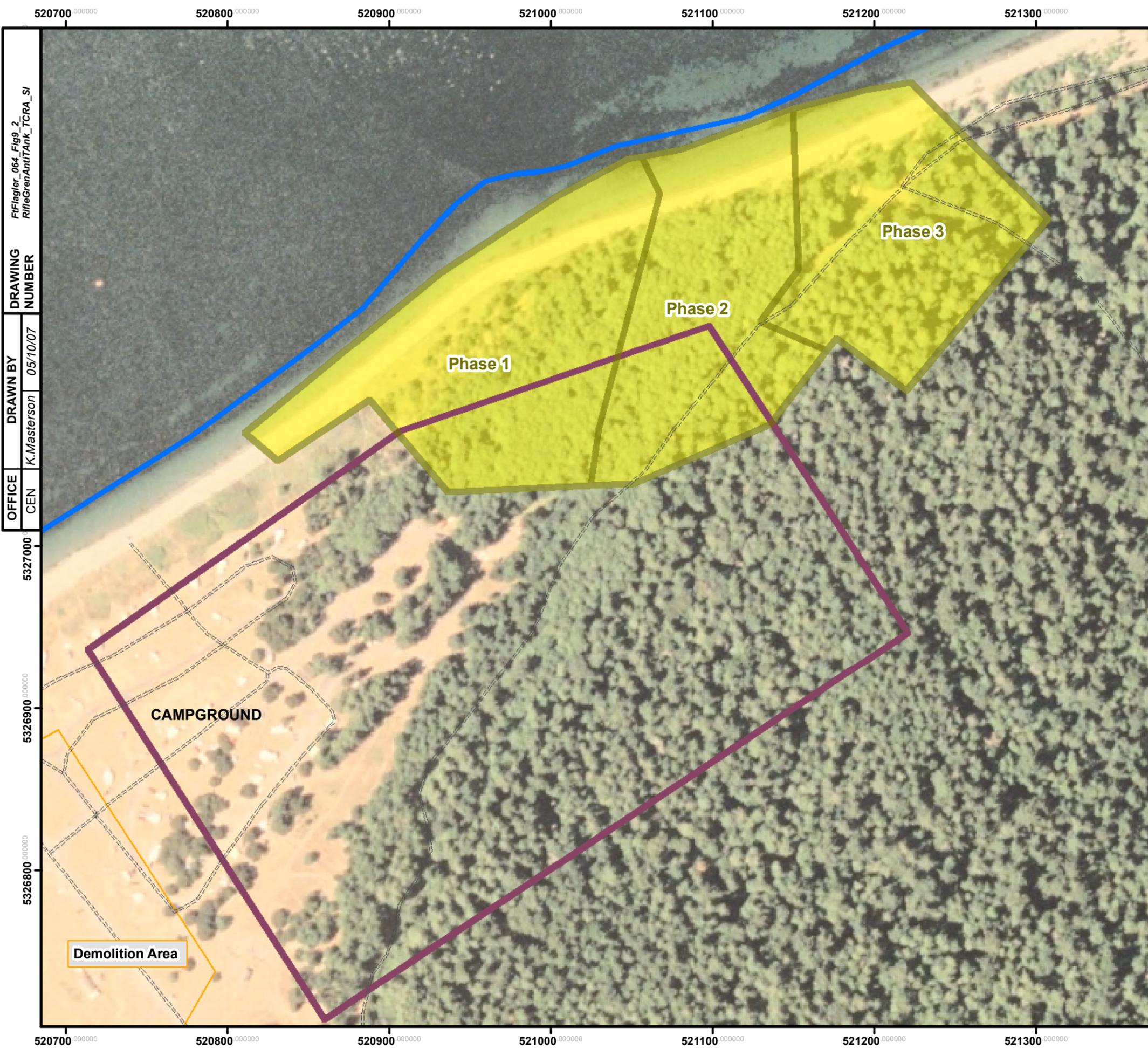
U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 9-1
ROCKET RANGE
RECONNAISSANCE
FORT FLAGLER MILITARY RESERVATION

520700.000000 520800.000000 520900.000000 521000.000000 521100.000000 521200.000000 521300.000000

FFlagler_063_Fig9_1_RifleGrenAntiTank_recon_SI
 DRAWING NUMBER
 DRAWN BY K.Masterson 05/10/07
 OFFICE CEN

520700.000000 520800.000000 520900.000000 521000.000000 521100.000000 521200.000000 521300.000000



520700.000000 520800.000000 520900.000000 521000.000000 521100.000000 521200.000000 521300.000000

5327000 5326900 5326800

Ft. Flagler 064 Fig 9-2
Rifle Gren Anti Tank TCRA SI

DRAWING
NUMBER

DRAWN BY
K. Masterson 05/10/07

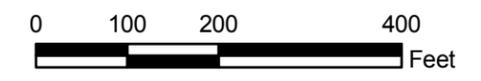
OFFICE
CEN

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Rocket Range
- 1992 UXO Clearance Area/TCRA Area

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



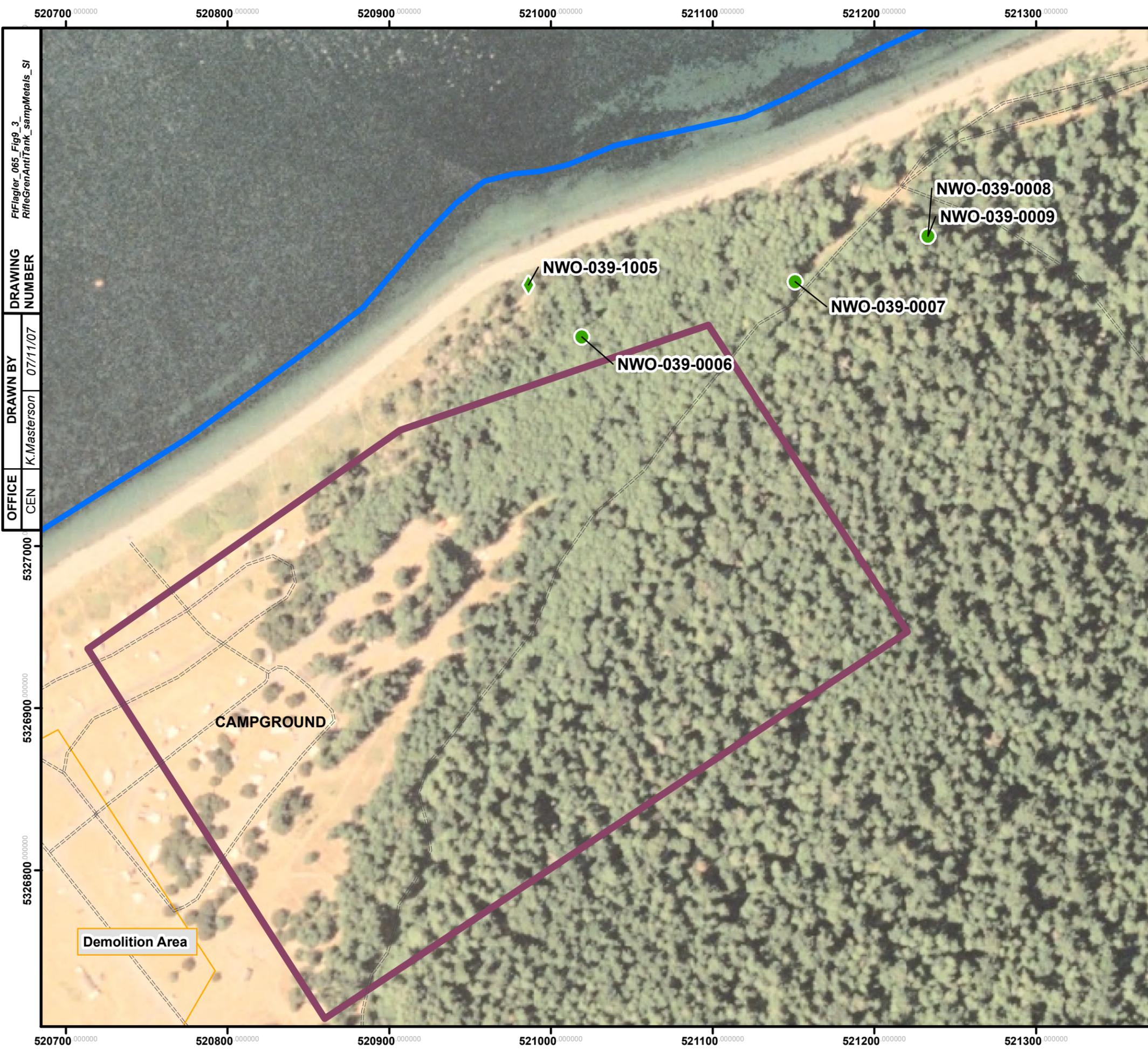
U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 9-2
ROCKET RANGE
TCRA AREA

FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.

520700.000000 520800.000000 520900.000000 521000.000000 521100.000000 521200.000000 521300.000000



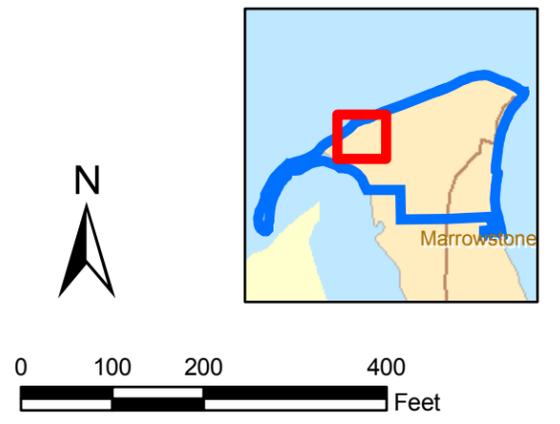
FFlagler_065_Fig9_3
 RifleGrenAntiTank_sampMetals_SI
 DRAWING NUMBER
 DRAWN BY
 OFFICE
 K.Masterson
 07/11/07
 CEN

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Rocket Range
- Soil Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values

NOTES:

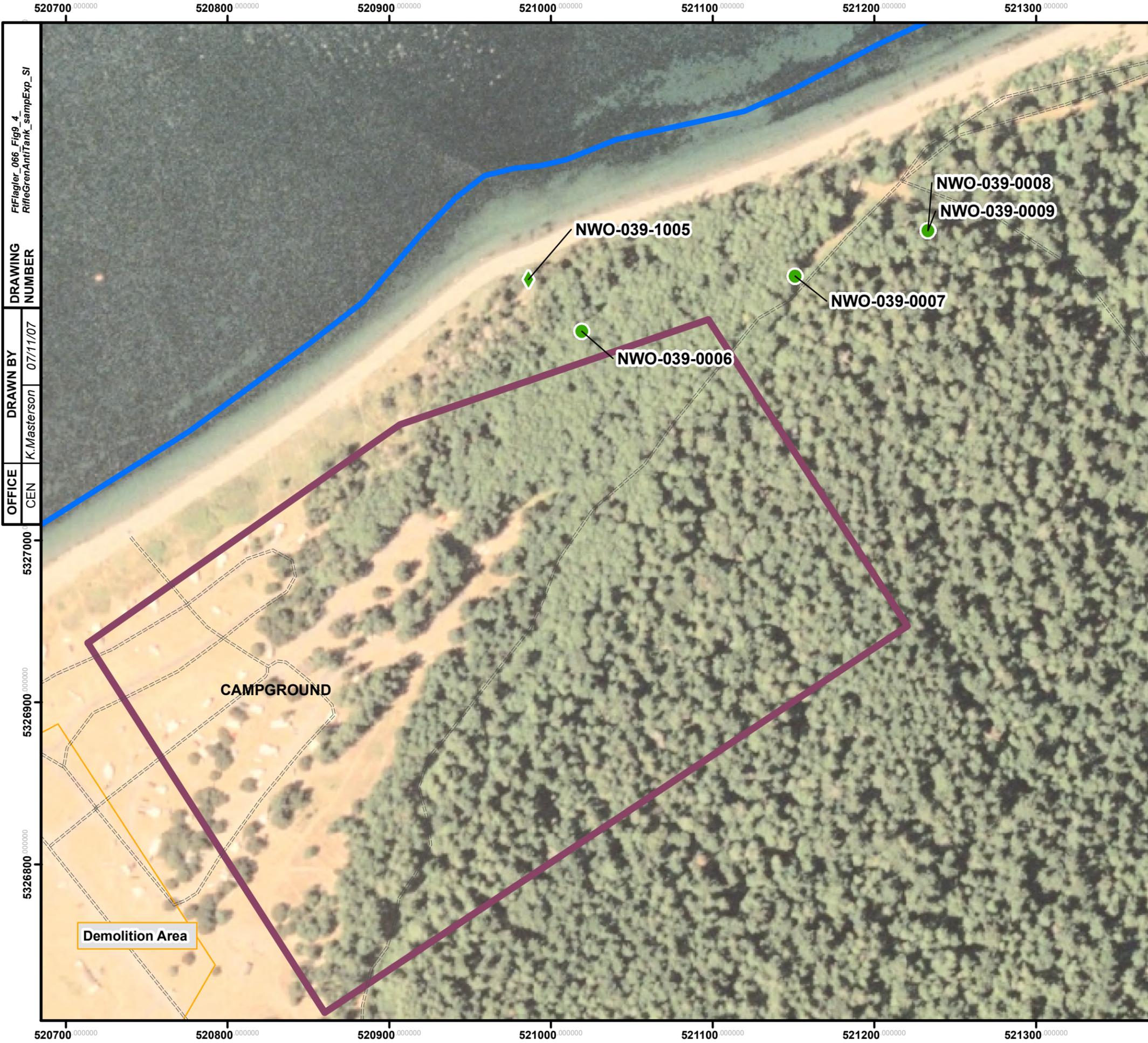
- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 9-3
ROCKET RANGE
SAMPLE LOCATIONS AND METALS RESULTS
 FORT FLAGLER MILITARY RESERVATION



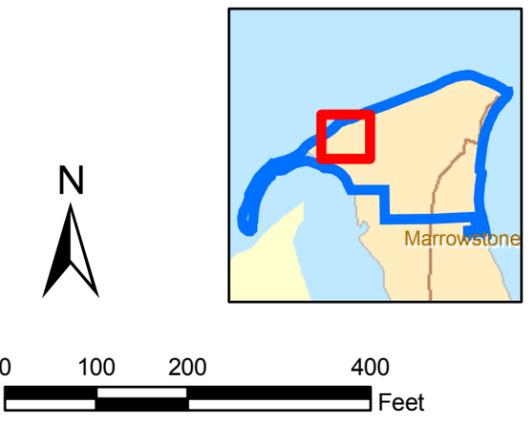
FFlagler_066_Fig9_4
 RifleGrenAntiTank_sampExp_SI
 DRAWING NUMBER
 DRAWN BY
 OFFICE
 K.Masterson
 07/11/07
 CEN

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Rocket Range
- Soil Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values

NOTES:

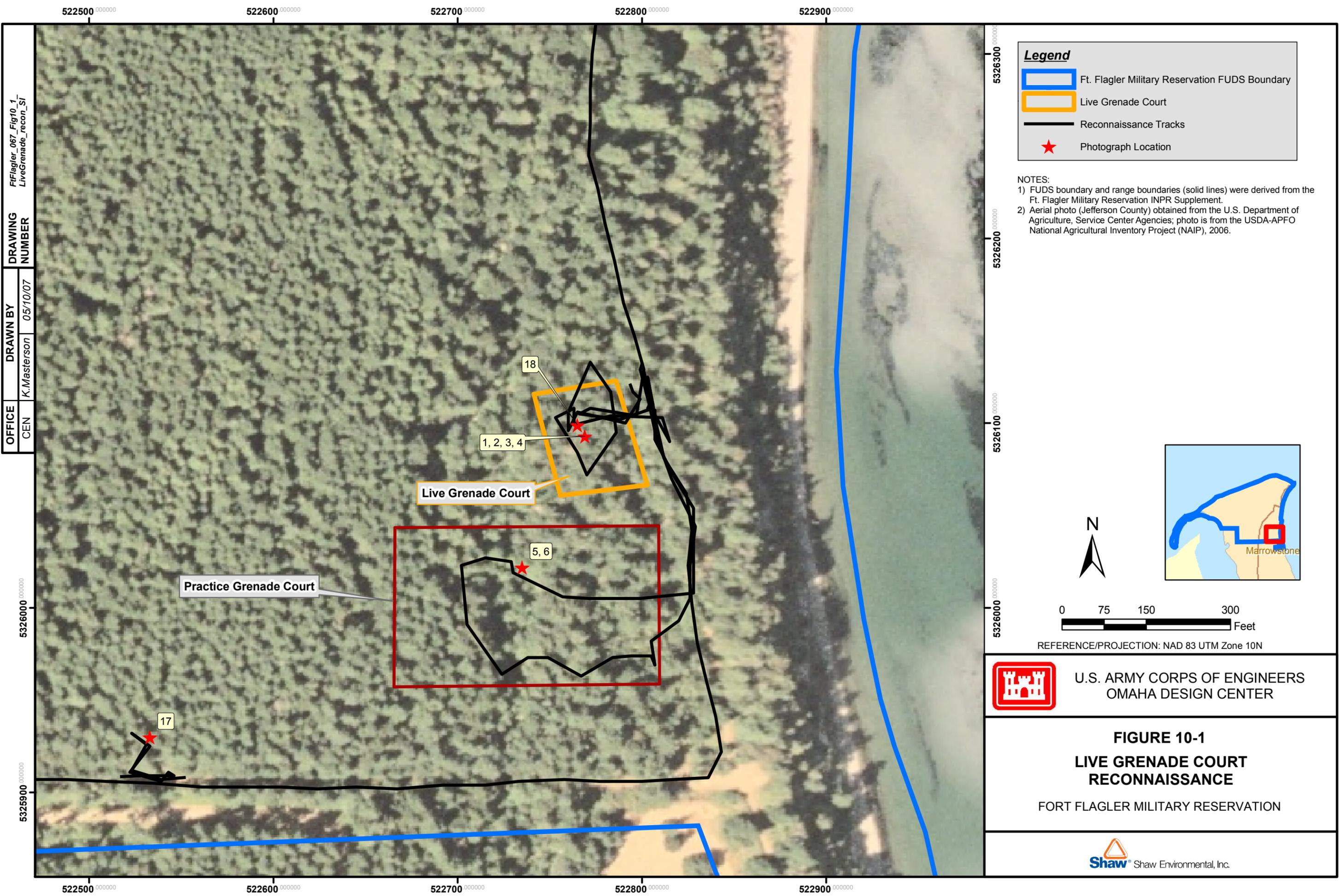
- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 9-4
ROCKET RANGE
SAMPLE LOCATIONS AND
EXPLOSIVE RESULTS
 FORT FLAGLER MILITARY RESERVATION



OFFICE: CEN
 DRAWN BY: K. Masterson
 DRAWING NUMBER: 05/10/07
 Ft. Flagler 067 Fig10_1
 Live Grenade Recon_S1

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Live Grenade Court
- Reconnaissance Tracks
- ★ Photograph Location

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

N

0 75 150 300
Feet

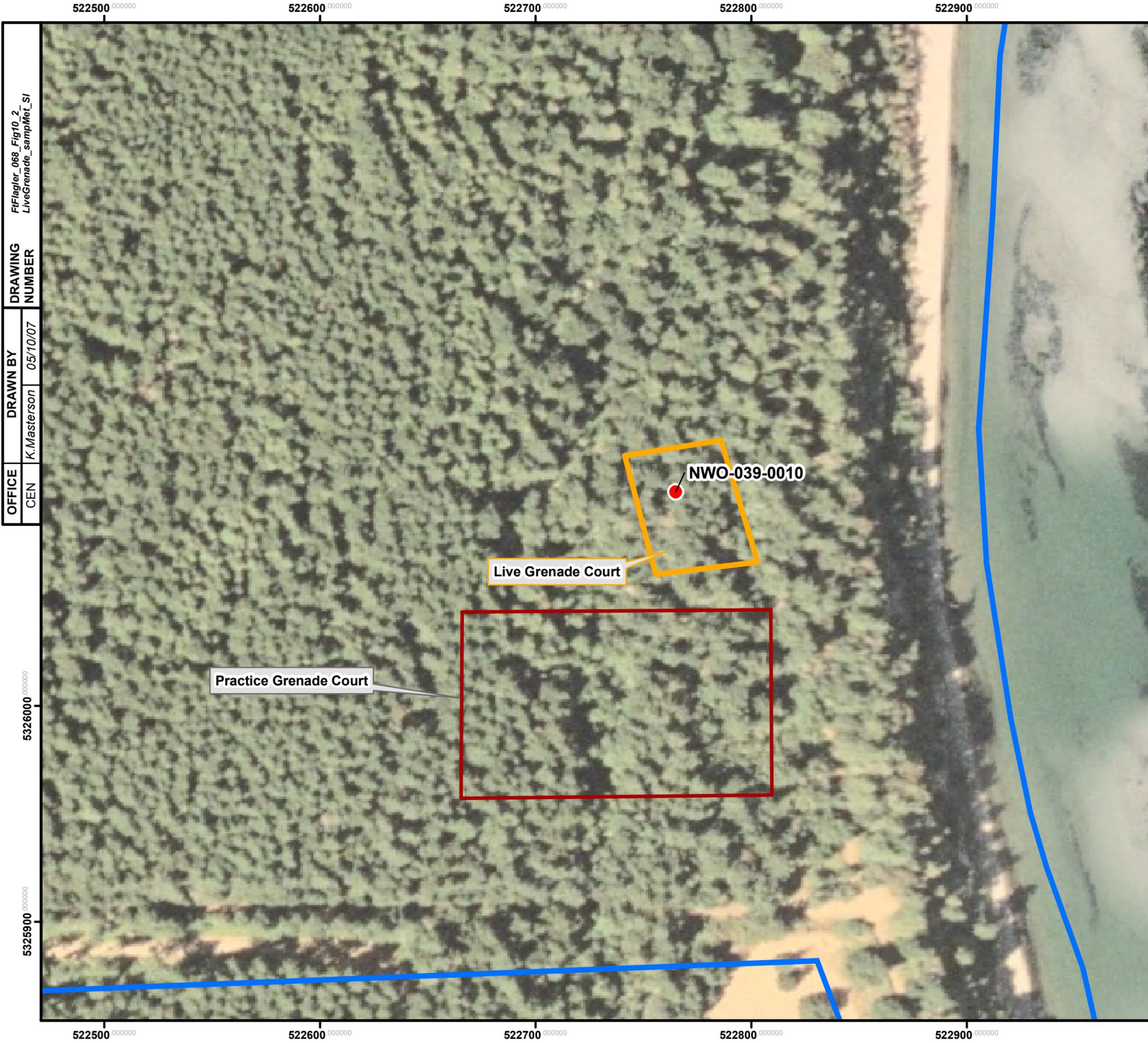


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 10-1
LIVE GRENADE COURT
RECONNAISSANCE
 FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.



OFFICE
 CEN

DRAWN BY
 K.Masterson

DRAWING NUMBER
 05/10/07

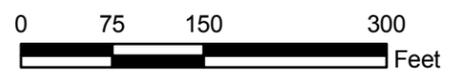
FtFlagler_068_Fig10_2_LiveGrenade_sampMet_SI

Legend

-  Ft. Flagler Military Reservation FUDS Boundary
-  Live Grenade Court
-  Soil Sample Results Were Greater Than Background and Greater Than Eco or Human Health Screening Values

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

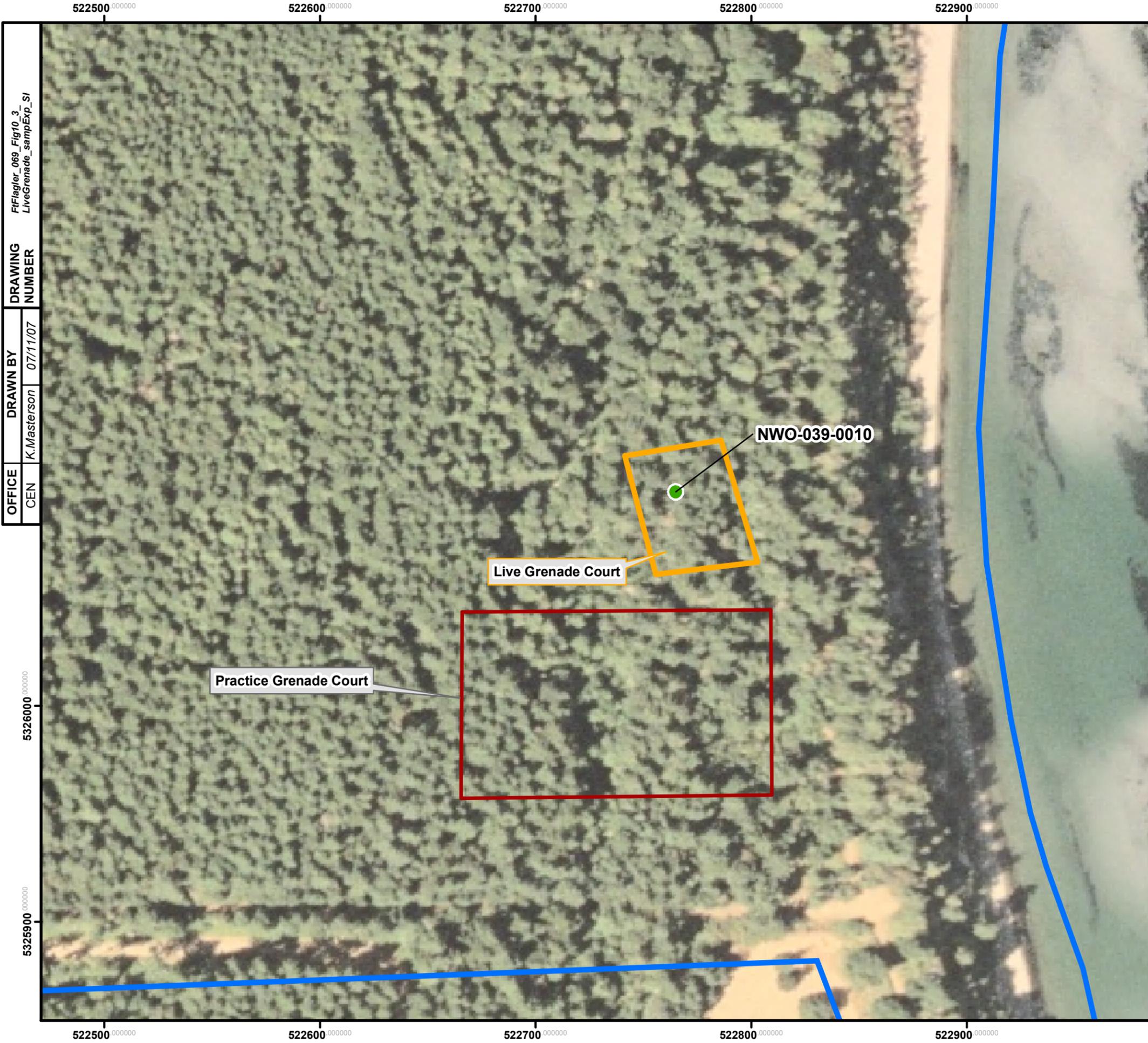


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N


 U.S. ARMY CORPS OF ENGINEERS
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FIGURE 10-2
LIVE GRENADE COURT
SAMPLE LOCATIONS AND
METALS RESULTS
 FORT FLAGLER MILITARY RESERVATION


 Shaw Environmental, Inc.



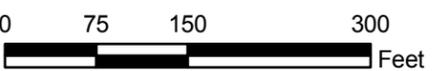
OFFICE: CEN
 DRAWN BY: K. Masterson
 DRAWING NUMBER: FFlagler_069_Fig10_3_LiveGrenade_sampExp_SI
 DATE: 07/11/07

Legend

-  Ft. Flagler Military Reservation FUDS Boundary
-  Live Grenade Court
-  Soil Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



 REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

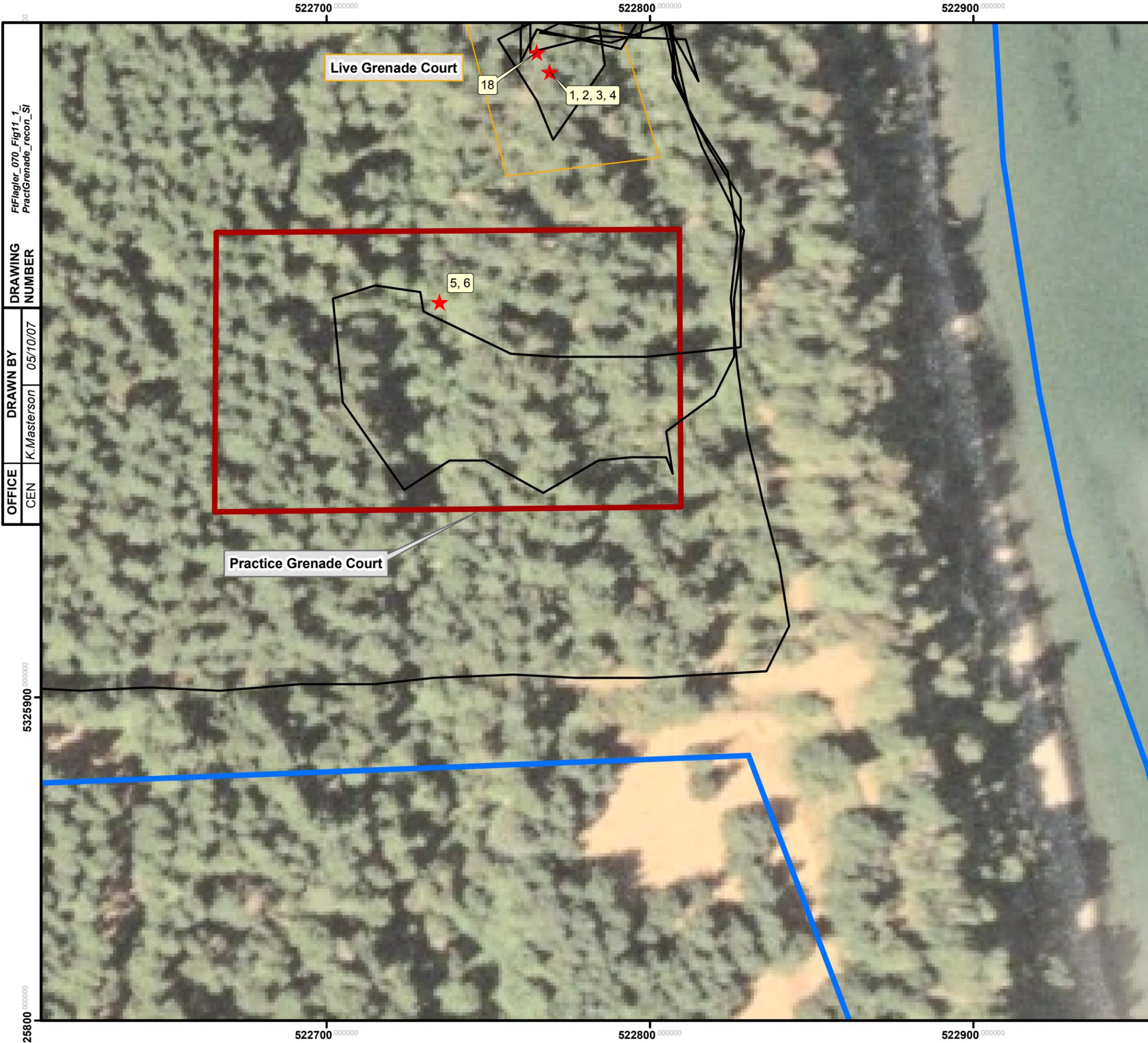


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FIGURE 10-3
LIVE GRENADE COURT
SAMPLE LOCATIONS AND
EXPLOSIVE RESULTS
 FORT FLAGLER MILITARY RESERVATION


 Shaw Environmental, Inc.

OFFICE: CEN
 DRAWN BY: K. Masterson
 DATE: 05/10/07
 DRAWING NUMBER:
 Ft. Flagler_070_Fig11_1
 PractGrenade_recon_Si



Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Practice Grenade Court
- Reconnaissance Tracks
- Photograph Location

NOTES:

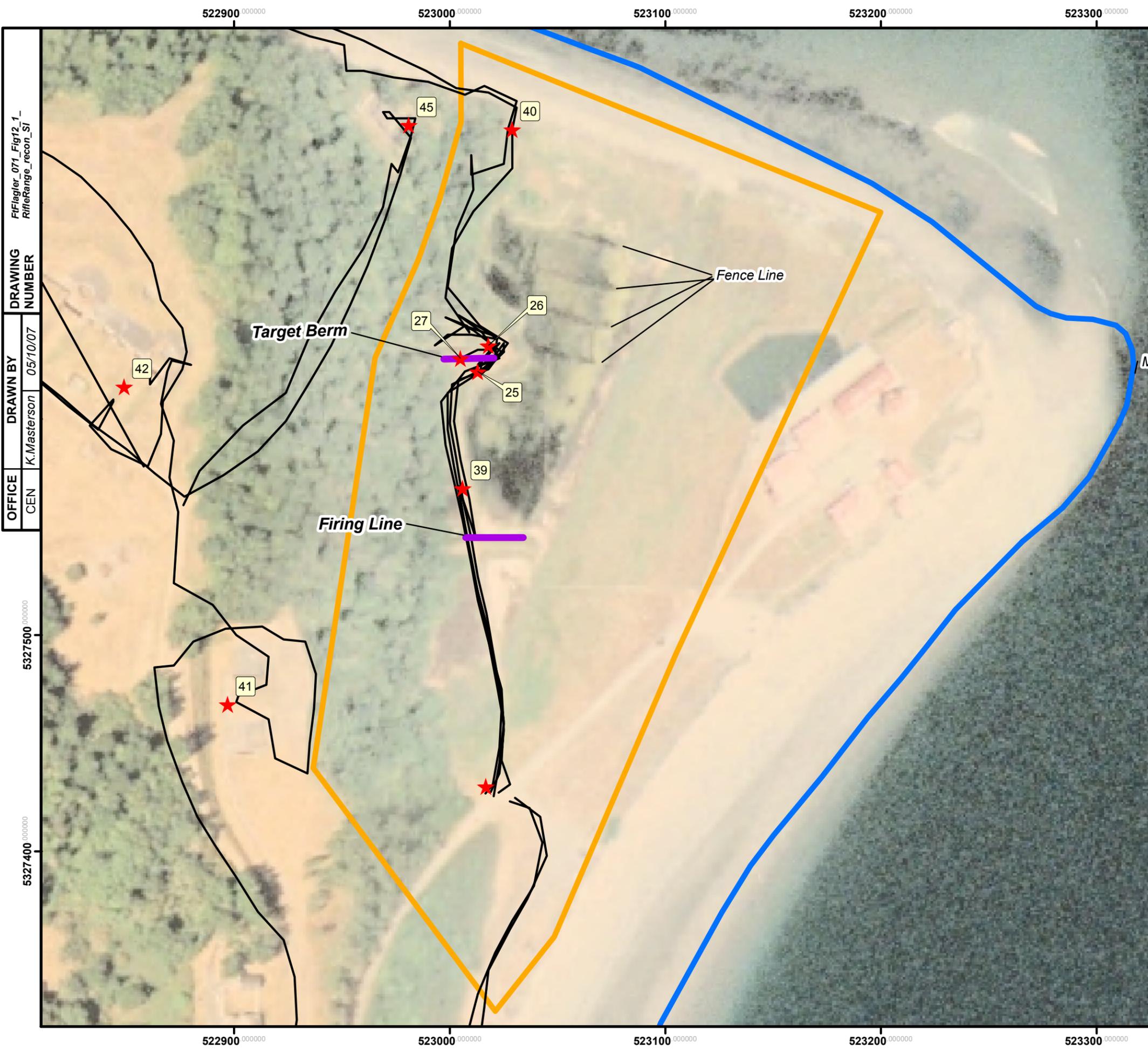
- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 11-1
PRACTICE GRENADE COURT
RECONNAISSANCE
 FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.



Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Rifle Range
- Reconnaissance Tracks

NOTES:
 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

Map Elements:
 North Arrow
 Scale: 0, 75, 150, 300 Feet
 Reference/Projection: NAD 83 UTM Zone 10N
 Inset Map: Shows location within Marrowstone area

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FIGURE 12-1
RIFLE RANGE
RECONNAISSANCE

FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.



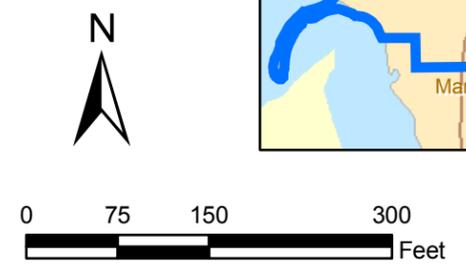
OFFICE: CEN
 DRAWN BY: J.Lillis
 DATE: 05/10/07
 DRAWING NUMBER: FFlagler_072_Fig12_2_RifleRange_sampLead_SI

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Rifle Range
- Soil Sample Results Were Greater Than Background and Greater than Eco or Human Health Screening Values
- Sediment Sample Results Were Greater Than Background and Greater than Eco or Human Health Screening Values

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

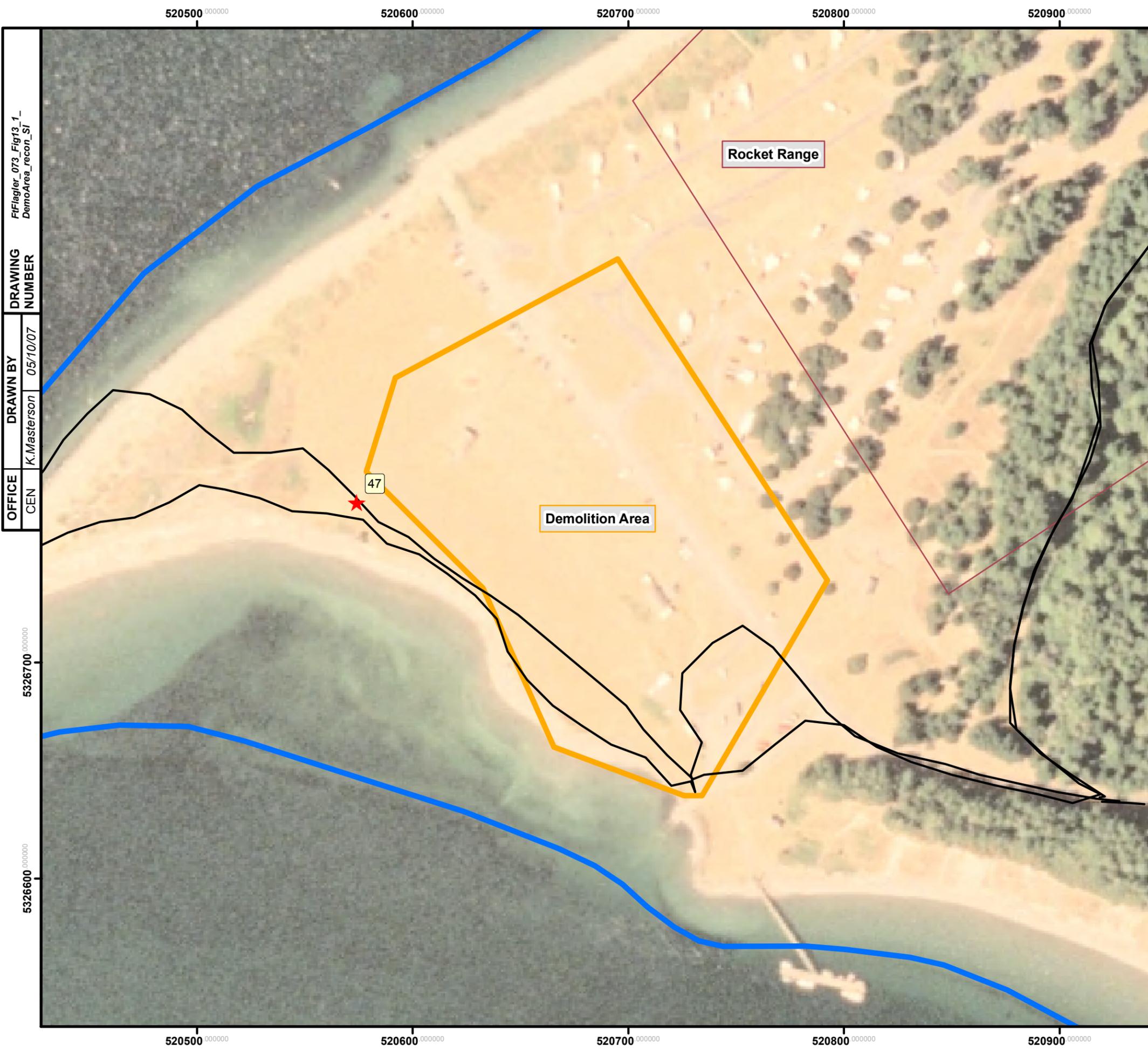


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OMAHA DESIGN CENTER

FIGURE 12-2
RIFLE RANGE
SAMPLE LOCATIONS AND
LEAD RESULTS

FORT FLAGLER MILITARY RESERVATION





OFFICE: CEN
 DRAWN BY: K. Masterson
 DRAWING NUMBER: 05/10/07
 F:\Flagler_073_Fig13_1_DemoArea_recon_Si_

Legend

-  Ft. Flagler Military Reservation FUDS Boundary
-  Demolition Area
-  Rocket Range
-  Reconnaissance Tracks

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

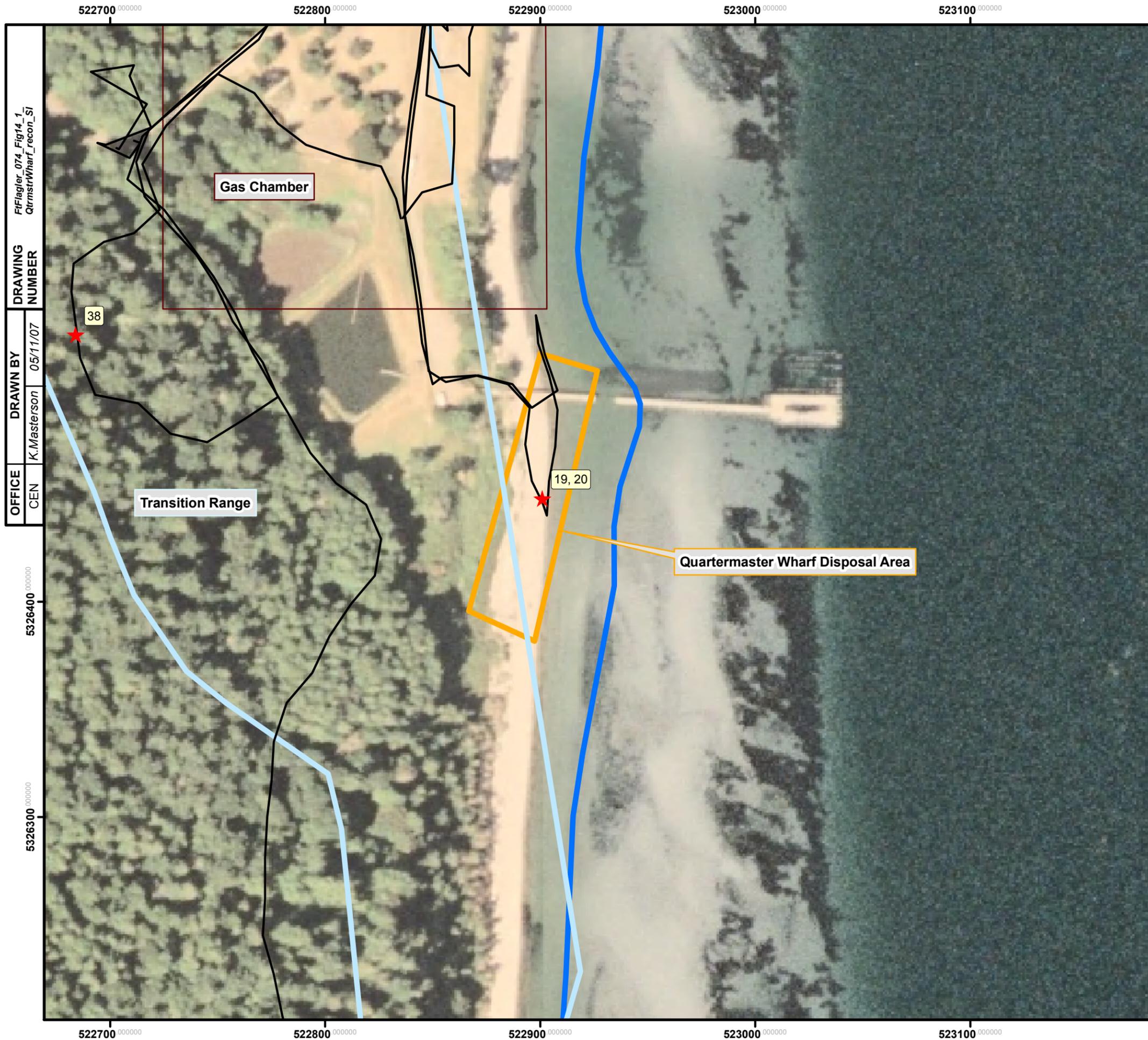


U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 13-1
DEMOLITION AREA
RECONNAISSANCE

FORT FLAGLER MILITARY RESERVATION





FIFlagler_074_Fig14_1
 QtrmstrWharf_recon_Si
DRAWING NUMBER
DRAWN BY K.Masterson 05/11/07
OFFICE CEN

Legend

-  Ft. Flagler Military Reservation FUDS Boundary
-  Quatermaster Wharf Disposal Area
-  Transition Range 1 Adjusted Location
-  Gas Chamber
-  Reconnaissance Tracks

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

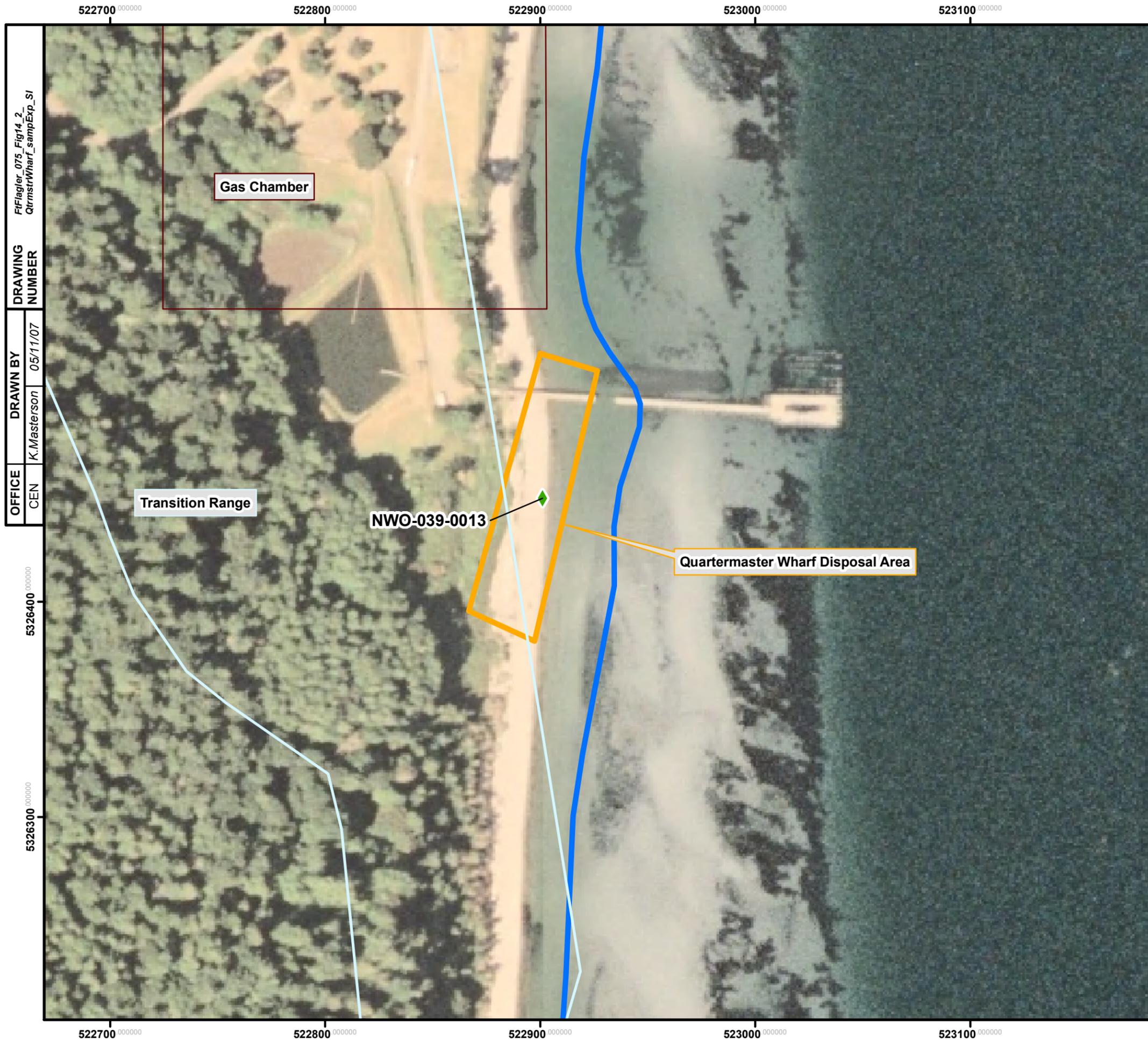


U.S. ARMY CORPS OF ENGINEERS
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FIGURE 14-1
QUATERMASTER WHARF DISPOSAL AREA
RECONNAISSANCE

FORT FLAGLER MILITARY RESERVATION





Ft. Flagler 075 Fig14 2
QtrmstrWharf_sampExp_SI

DRAWING
NUMBER

DRAWN BY
K. Masterson 05/11/07

OFFICE
CEN

Legend

- Ft. Flagler Military Reservation FUDS Boundary
- Quatermaster Wharf Disposal Area
- Transition Range 1
- Gas Chamber
- Sediment Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



U.S. ARMY CORPS OF ENGINEERS
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FIGURE 14-2
QUATERMASTER WHARF DISPOSAL AREA
SAMPLE LOCATIONS AND EXPLOSIVE RESULTS
FORT FLAGLER MILITARY RESERVATION



519850 000000

520800 000000

521750 000000

522700 000000

523650 000000

5326400 000000

5325600 000000

5328800 000000

5328000 000000

5327200 000000

5326400 000000

5325600 000000

519850 000000

520800 000000

521750 000000

522700 000000

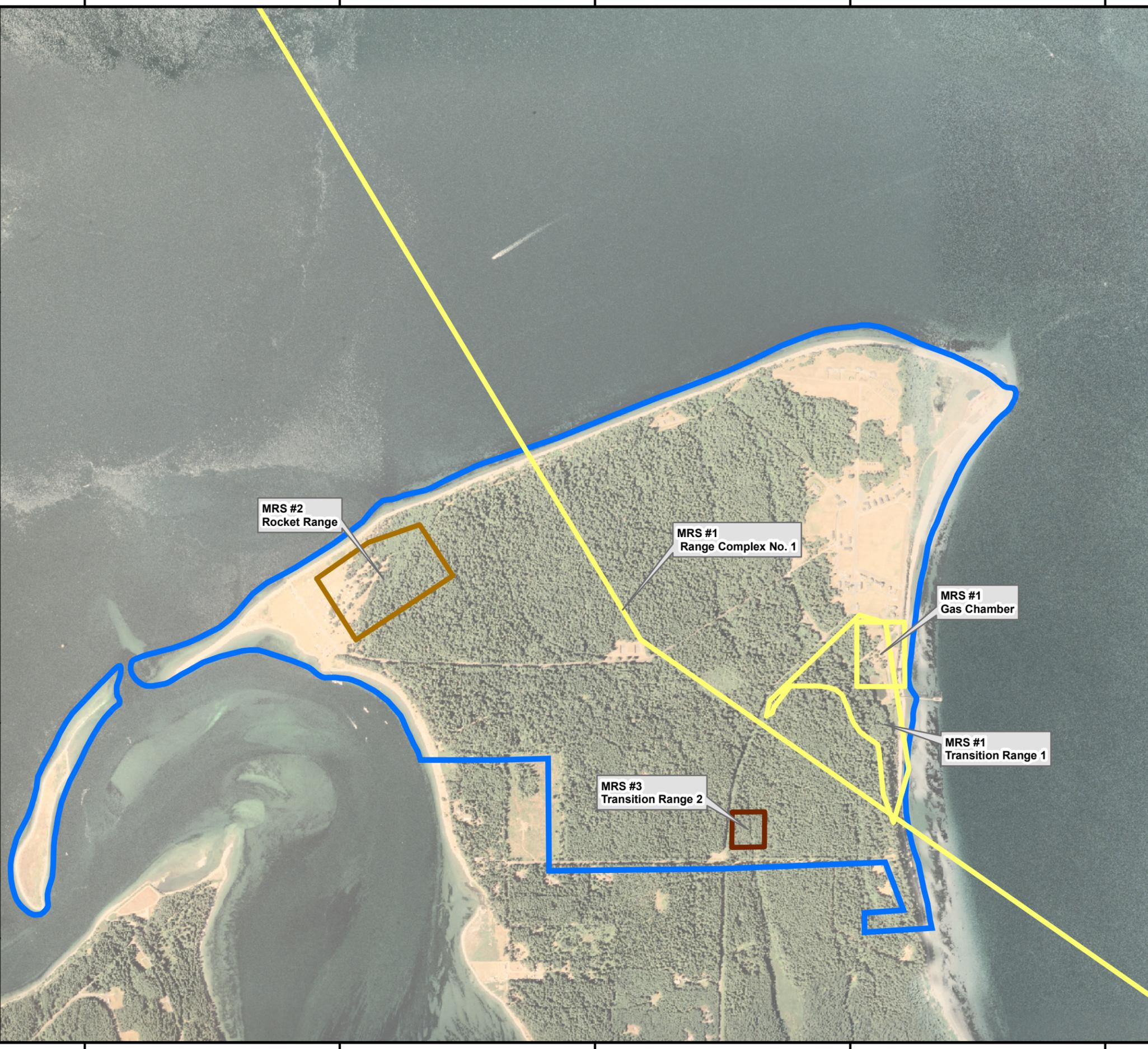
523650 000000

OFFICE CEN

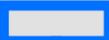
DRAWN BY K.Masterson

DRAWING NUMBER 05/11/07

FtFlagler_075_Fig16_1_MRS_SI



Legend

-  Ft. Flagler Military Reservation FUDS Boundary
-  MRS #1
-  MRS #2
-  MRS #3

NOTES:

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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FIGURE 16-1
MUNITIONS RESPONSE SITES
FORT FLAGLER MILITARY RESERVATION



Tables

**Table 2-1
Munitions Information
Fort Flagler Military Reservation**

AOC	Subrange /Battery	Munitions	Munitions Constituents
Range Complex	Battery Bankhead	12-inch Mortar, M1889 MI	Propellant – single-base (nitrocellulose) or triple-base (nitrocellulose, NG, and nitroguanidine); HE Projectile – Explosive D (ammonium picrate). Projectile cast iron or steel
	Battery Calwell	6-inch Rapid Fire, M1903	Propellant – single-base (nitrocellulose) double-base (nitrocellulose and NG, or triple base (nitrocellulose, NG, and nitroguanidine); Practice Projectile – spotting charge; HE Projectile – TNT. Projectile cast iron or steel
	Battery Downes	3-inch Rapid Fire, M1903	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); HE Projectile – TNT. Projectile cast iron or steel
	Battery Gratton	6-inch Rapid Fire, M1903	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Practice Projectile – spotting charge; HE Projectile – Explosive D (ammonium picrate). Projectile cast iron or steel
	Battery Lee	5-inch Rapid Fire, M1897	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Projectile explosive– unknown. Projectile cast iron or steel
	Battery Rawlins	10-inch Rifle, MII	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Projectile explosive – unknown. Projectile cast iron or steel
	Battery Revere	10-inch Rifle, MII	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Projectile explosive– unknown. Projectile cast iron or steel
	Battery Wansboro	3-inch Rapid Fire, M1903	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Practice Projectile – spotting charge; HE Projectile – TNT. Projectile cast iron or steel
	Battery Wilhelm	12-inch Rifle, M1888 MII	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); HE Projectile – Explosive D (ammonium picrate). Projectile cast iron or steel
	Anti-Torpedo Boat Battery	90-mm M1	Propellant – single-base (nitrocellulose), double-base (nitrocellulose and NG, or triple base (nitrocellulose, NG, and nitroguanidine) Projectile explosive - unknown Projectile cast iron or steel
	Anti-Aircraft Artillery Battery	3-inch, M1917M1A2	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Practice Projectile – spotting charge; HE Projectile – Explosive D (Ammonium picrate). Projectile cast iron or steel

Table 2-1 (Continued)

AOC	Munitions	Munitions Constituents
Ammunition Bunker	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG).
	Riot Hand Grenade, ABC-M25A1	CN, steel
	Candle	CN
	Rocket, M28, 3.5-inch	NG, nitrocellulose, potassium perchlorate, RDX, TNT, steel
	Practice Rocket, M29, 3.5-inch	NG, nitrocellulose, potassium perchlorate, steel
	Rocket, M6A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine); Pentolite (TNT & PETN), steel
	Practice Rocket, M7A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine), steel
	Mk II Fragment Hand Grenade	TNT, flaked or granular, older models used E.C. blank fire smokeless powder, perchlorate in fuze, cast iron
	M21 Practice Hand Grenade	Black powder (potassium nitrate, sulfur, charcoal), perchlorate in fuze.
	Mk 1A1 Practice Hand Grenade	Spotting charge, steel
	Anti-Tank, Anti-Vehicle Mine	Inert, steel
Transition Range 1	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG).
Transition Range 2	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG).
Gas Chamber	Riot Hand Grenade, ABC-M25A1	CN, steel
	Candle	CN
Rifle Grenade/ Anti-Tank Rocket Range	Rocket, M28, 3.5-inch	NG, nitrocellulose, potassium perchlorate, RDX, TNT, steel.
	Practice Rocket, M29, 3.5-inch	NG, nitrocellulose, potassium perchlorate, steel.
	Rocket, M6A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine); Pentolite (TNT & PETN), steel
	Practice Rocket, M7A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine), steel
	Anti-Tank/Anti-Vehicle Mine.	Inert, steel

Table 2-1 (Continued)

AOC	Munitions	Munitions Constituents
Live Grenade Court	Mk II Fragment Hand Grenade	TNT, flaked or granular, older models used E.C. blank fire smokeless powder, perchlorate in fuze, cast iron
	M21 Practice Hand Grenade	Black powder (potassium nitrate, sulfur, charcoal), perchlorate in fuze, steel
Practice Grenade Court	M21 Practice Hand Grenade	Black powder (potassium nitrate, sulfur, charcoal), perchlorate in fuze, steel
	Mk 1A1 Practice Hand Grenade	Spotting charge, steel
Rifle Range	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG).
Demolition Area	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG).
	Riot Hand Grenade, ABC-M25A1	CN, steel
	Rocket, M28, 3.5-inch	NG, nitrocellulose, potassium perchlorate, RDX, TNT, steel
	Practice Rocket, M29, 3.5-inch	NG, nitrocellulose, potassium perchlorate, steel
	Rocket, M6A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine); Pentolite (TNT & PETN), steel
	Practice Rocket, M7A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine), steel
	Mk II Fragment Hand Grenade	TNT, flaked or granular, older models used E.C. blank fire smokeless powder, perchlorate in fuze, cast iron.
	M21 Practice Hand grenade	Black powder (potassium nitrate, sulfur, charcoal), perchlorate in fuze, steel
	Mk 1A1 Practice Hand Grenade	Spotting charge, steel

Table 2-1 (Continued)

AOC	Munitions	Munitions Constituents
Quarter Master Wharf	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG)
	Riot Hand Grenade, ABC-M25A1	CN, steel
	Rocket, M28, 3.5-inch	NG, nitrocellulose, potassium perchlorate, RDX, TNT, steel
	Practice Rocket, M29, 3.5-inch	NG, nitrocellulose, potassium perchlorate, steel
	Rocket M6A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine); Pentolite (TNT & PETN), steel
	Rocket Practice M7A1, 2.36-inch Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine), steel
	Mk II Fragment Hand Grenade	TNT, flaked or granular, older models used E.C. blank fire smokeless powder, perchlorate in fuze, cast iron
	M21 Practice Hand Grenade	Black powder (potassium nitrate, sulfur, charcoal), perchlorate in fuze, steel
	Mk 1A1 Practice Hand Grenade	Spotting charge, steel

Notes:

AOC – area of concern

CN – chloroacetophenone

HE – high explosive

mm – millimeter

NG – nitroglycerin

PETN – pentaerythritol tetranitrate

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

TNT – 2,4,6-Trinitrotoluene

**Table 2-2
Army Checklist for Important Ecological Places ^a
Fort Flagler, Washington**

		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 checked="" type="checkbox"/> / <input type="checkbox"/>	Site shoreline on Puget Sound and is in one of the 15 State counties identified under the CZMA.
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"/>	Occasional transient bald eagle Site use.
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"/>	
22	National river reach designated as Recreational	<input type="checkbox"/> / <input checked="" type="checkbox"/>	

Table 2-2 (Cont.)

		Yes / No	Comments
23	Habitat known to be used by state designated endangered or threatened species	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Occasional transient bald eagle Site use.
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 type="checkbox"/> / <input checked="" type="checkbox"/>	
27	State land designated for wildlife or game management	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Site is State Park, and Washington State Parks and Recreation Commission is assumed to manage state park lands for wildlife and/or game species.
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 checked="" type="checkbox"/> / <input type="checkbox"/>	Site is State Park, and Washington State Parks and Recreation Commission has statutory responsibility to conserve Washington's seashore.
32	Wetlands	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
33	Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes	<input type="checkbox"/> / <input checked="" type="checkbox"/>	

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

Table 3-1

Summary of Samples Collected
Fort Flagler Military Reservation

Location ID	Sample Number	Sample Purpose	Sample Type	Date Collected	Sample Depth (ft)	Laboratory SDG Number	Lead by SW-846 6020A	Select Metals* by SW-846 6020A	TAL Metals (including Molybdenum) by SW-846 6020A	Mercury by SW-846 7471A	Explosives by SW-846 8330A	Nitroglycerine and PETN by SW-846 8330A (Modified)
Transition Range 1												
039A003	NWO-039-0002	REG	SS	21-Feb-07	0 - 0.5	702114-001	X					
039A004	NWO-039-0003	REG	SS	21-Feb-07	0 - 0.5	702114-002	X					
039A005	NWO-039-1002	REG	SD	21-Feb-07	0 - 0.5	702114-003	X					
Transition Range 2												
039A006	NWO-039-0004	REG	SS	21-Feb-07	0 - 0.5	702114-004	X					
039A007	NWO-039-0005	REG	SS	21-Feb-07	0 - 0.5	702114-005	X					
039A008	NWO-039-1003	REG	SD	21-Feb-07	0 - 0.5	702114-006	X					
	NWO-039-1004	FD	SD	21-Feb-07	0 - 0.5	702114-007	X					
Rifle Grenade / Anti-Tank Rocket Range												
039A009	NWO-039-0006	REG	SS	21-Feb-07	0 - 0.5	702113-001		X			X	X
	NWO-039-0006-MS	MS	SS	21-Feb-07	0 - 0.5	702113-001MS		X			X	X
	NWO-039-0006-MSD	MSD	SS	21-Feb-07	0 - 0.5	702113-001MSD		X			X	X
039A010	NWO-039-0007	REG	SS	21-Feb-07	0 - 0.5	702113-002		X			X	X
039A011	NWO-039-0008	REG	SS	21-Feb-07	0 - 0.5	702113-003		X			X	X
	NWO-039-0009	FD	SS	21-Feb-07	0 - 0.5	702113-004		X			X	X
039A012	NWO-039-1005	REG	SD	21-Feb-07	0 - 0.5	702113-005		X			X	X
Live Grenade Range												
039A013	NWO-039-0010	REG	SS	21-Feb-07	0 - 0.5	702113-006		X			X	X
Rifle Range												
039A014	NWO-039-0011	REG	SS	21-Feb-07	0 - 0.5	702114-008		X				
039A015	NWO-039-0012	REG	SS	21-Feb-07	0 - 0.5	702114-009		X				
039A016	NWO-039-1006	REG	SD	21-Feb-07	0 - 0.5	702114-010		X				
Quartermaster's Wharf												
039A017	NWO-039-0013	REG	SD**	21-Feb-07	0 - 0.5	702113-007					X	X
Background												
039A018	NWO-039-5001	REG	SS	21-Feb-07	0 - 0.5	702112-001			X	X		
	NWO-039-5001-MS	MS	SS	21-Feb-07	0 - 0.5	702112-001MS			X	X		
	NWO-039-5001-MSD	MSD	SS	21-Feb-07	0 - 0.5	702112-001MSD			X	X		
039A019	NWO-039-5002	REG	SS	20-Feb-07	0 - 0.5	702112-002			X	X		
039A020	NWO-039-5003	REG	SS	20-Feb-07	0 - 0.5	702112-003			X	X		
039A021	NWO-039-5004	REG	SS	20-Feb-07	0 - 0.5	702112-004			X	X		
039A022	NWO-039-5005	REG	SS	20-Feb-07	0 - 0.5	702112-005			X	X		
039A023	NWO-039-5006	REG	SS	20-Feb-07	0 - 0.5	702112-006			X	X		
039A024	NWO-039-5007	REG	SS	20-Feb-07	0 - 0.5	702112-007			X	X		
039A025	NWO-039-5008	REG	SS	21-Feb-07	0 - 0.5	702112-008			X	X		
039A026	NWO-039-5009	REG	SS	20-Feb-07	0 - 0.5	702112-009			X	X		
039A027	NWO-039-5010	REG	SS	20-Feb-07	0 - 0.5	702112-010			X	X		
	NWO-039-5011	FD	SS	20-Feb-07	0 - 0.5	702112-011			X	X		
039A028	NWO-039-5012	REG	SD	20-Feb-07	0 - 0.5	702112-012			X	X		
039A029	NWO-039-5013	REG	SD**	21-Feb-07	0 - 0.5	702112-013			X	X		

Notes:

- X - Indicates a sample was collected and analyzed for the given parameter
- * Select metals are aluminum, chromium, copper, iron, lead, manganese, molybdenum, and nickel.
- ** Sediment - beach sand

ft - feet
 SDG - sample delivery group
 TAL - target analyte list
 PETN - pentaerythritol tetranitrate
 REG - regular field sample
 FD - field duplicate
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MS - matrix spike
 MSD - matrix spike duplicate
 SS - surface soil (< 0.5ft below ground surface)
 SD - sediment

**Table 3-2
Summary of Fort Flagler Military Reservation Background Values**

Element	Soil Background Concentration 95th UTL/95th Percentile ^a (Based on 10 Samples) (mg/kg)	Sediment Background Concentration (Based on 1 Sample ^b) (mg/kg)
Aluminum	12,300	10,800
Antimony	< 0.75	<0.13
Arsenic	11.5	3.9
Barium	426	131
Beryllium	0.25	0.19
Cadmium	0.35	0.19
Calcium	12,300	6,410
Chromium	35.2	28.5
Cobalt	10.4	8.4
Copper	13.2	11.1
Iron	17,800	15,600
Lead	32.6	12.8
Magnesium	5,830	5,660
Manganese	4,250	590
Mercury	0.23	0.082
Molybdenum	< 3.8	0.22
Nickel	80.2	46.9
Potassium	1,020	979
Selenium	< 3.8	0.73
Silver	< 0.23	0.11
Sodium	265	301
Thallium	< 1.5	0.13
Vanadium	42.6	33.9
Zinc	101	45.3

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

UTL - upper tolerance limit

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

^b Background sample analytical results provided in Appendix G

**Table 3-3
Human Health Soil and Sediment Screening Criteria
Fort Flagler Military Reservation**

Analyte	USEPA Region 9 ^a		Washington Department of Ecology - Soil Cleanup Levels ^b					Final Screening Value ^b (mg/kg)
	Residential PRGs (mg/kg)	Industrial PRGs (mg/kg)	Method B Level - Unrestricted ^c (mg/kg)	Leaching - Phase 3 Model - Unrestricted ^d (mg/kg)	Method B Level - Industrial ^e (mg/kg)	Leaching - Phase 3 Model - Industrial ^f (mg/kg)	Natural Background Level ^g (mg/kg)	
Explosives								
Hexahydro-1,3,5-trinitro-1,3,5-triazine	4.4	16	NVA	NVA	NVA	NVA	NA	4.4
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	3,100	31,000	NVA	NVA	NVA	NVA	NA	3,100
2,4,6-Trinitrotoluene	16	57	NVA	NVA	NVA	NVA	NA	16
1,3,5-Trinitrobenzene	1,800	18,000	NVA	NVA	NVA	NVA	NA	1,800
1,3-Dinitrobenzene	6.1	62	NVA	NVA	NVA	NVA	NA	6.1
2,4-Dinitrotoluene ¹	0.72	2.5	NVA	NVA	NVA	NVA	NA	0.72
2,6-Dinitrotoluene ¹	0.72	2.5	NVA	NVA	NVA	NVA	NA	0.72
2-Amino-4,6-dinitrotoluene	12	120	NVA	NVA	NVA	NVA	NA	12
2-Nitrotoluene	0.88	2.2	NVA	NVA	NVA	NVA	NA	0.88
3-Nitrotoluene	730	1,000	NVA	NVA	NVA	NVA	NA	730
4-Amino-2,6-dinitrotoluene	12	120	NVA	NVA	NVA	NVA	NA	12
4-Nitrotoluene	12	30	NVA	NVA	NVA	NVA	NA	12
Nitrobenzene	20	100	NVA	NVA	NVA	NVA	NA	20
Nitroglycerin	35	120	NVA	NVA	NVA	NVA	NA	35
Methyl-2,4,6-trinitrophenylnitramine	610	6,200	NVA	NVA	NVA	NVA	NA	610
Pentaerythritol tetranitrate	NVA	NVA	NVA	NVA	NVA	NVA	NA	0.5 ¹
Metals								
Chromium (Total)	210	450	NVA	NVA	NVA	NVA	48	210
Copper	3,100	41,000	NVA	NVA	NVA	NVA	36	3,100
Iron	23,000	100,000	NVA	NVA	NVA	NVA	58,700	23,000
Lead	400	800	NVA	3,000	NVA	3,000	24	400
Molybdenum	390	5,100	NVA	NVA	NVA	NVA	NVA	390
Nickel	1,600	20,000	NVA	NVA	NVA	NVA	48	1,600

CLARC = Cleanup Level and Risk Calculation
WAC = Washington Administrative Code
NVA = no value available
mg/kg = milligrams per kilogram.

C = Value for carcinogen
N = Value for noncarcinogen
NA = not applicable, compound considered not present in natural soils
USEPA = U.S. Environmental Protection Agency

^a Region 9 Preliminary Remediation Goals (PRG) table; October 2004. Values are based on residential and industrial exposure to single chemicals.

Table 3-3
Human Health Soil and Sediment Screening Criteria
Fort Flagler Military Reservation

^b Cleanup levels are established under the Model Toxics Control Act (MCTA) Cleanup Regulation. Chapter 173-340 WAC.

^c Values from Notes on Method A Cleanup Levels WAC 173-340-720, 740, and 745, Table 740-1, Table 5: Method B Calculations for Carcinogens for Soil Ingestion Plus Dermal Contact and Table 6: Method B Calculation for Soil Ingestion Plus Dermal Contact. Based on Unrestricted land use. From CLARC Notes undated on November 23, 2004.

^d Values from Notes on Method A Cleanup Levels WAC 173-340-720, 740, and 745, Table 740-1, Table 7: 3-Phase Model Assumptions and Results. Based on protection of groundwater. From CLARC Notes updated on November 23, 2004.

^e Values from Notes on Method A Cleanup Levels WAC 173-340-720, 740, and 745, Table 745-1, Table 5: Method C Industrial Calculations for Carcinogens for Soil Injection Plus Dermal Contact and Table 6: Method C Industrial Calculations for Carcinogens for Soil Ingestion Plus Dermal Contact. Based on industrial land use. From CLARC Notes updated on November 23, 2004.

^f Values from Notes on Method A Cleanup Levels WAC 173-340-720, 740, and 745, Table 745-1, Table 7: 3-Phase Model Assumptions and Results. Based on protection of groundwater. From CLARC Notes updated on November 23, 2004.

^g Values from "Natural Background Soil Metals Concentrations in Washington State", Publication #94-115, October 1994. Based on data for Puget Sound.

^h Final Screening Value selected based on the lowest value listed for chemical between USEPA Region 9 PRG and Washington Department of Ecology – Soil Cleanup Levels.

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

^j Value is laboratory practical quantitation limit.

**Table 3-4
Ecological Soil Screening Values
Fort Flagler Military Reservation**

Analyte	Proposed Benchmarks										Potential Bioaccumulative Constituent? ^h	Final Proposed Ecological Screening Value Soil ⁱ (mg/kg)
	Washington Department of Ecology Lowest Value for Plants/ Soil Biota/Wildlife ^a (mg/kg)	USEPA Region 5 ESLs ^b (2003) (mg/kg)	USEPA Region 7 ^c (mg/kg)	USEPA Region 8 ^d (mg/kg)	USEPA Region 10 ^e (mg/kg)	Other Values: Talmage et al. (1999) ^f or LANL (2005) ^g (mg/kg)						
Explosives												
1,3,5-Trinitrobenzene	NVA	0.376	0.376	EPA-R4	NVA	0.376	EPA-R4	6.6	LANL			0.376
1,3-Dinitrobenzene	NVA	0.655	0.655	EPA-R4	NVA	0.655	EPA-R4	0.073	LANL			0.655
2,4,6-Trinitrotoluene	NVA	NVA	NVA		NVA	NVA		6.4	LANL			6.4
2,4-Dinitrotoluene	NVA	1.28	1.28	EPA-R4	NVA	1.28	EPA-R4	0.52	LANL			1.28
2,6-Dinitrotoluene	NVA	0.0328	0.0328	EPA-R4	NVA	0.0328	EPA-R4	0.37	LANL			0.0328
2-Amino-4,6-Dinitrotoluene	NVA	NVA	NVA		NVA	NVA		2.1	LANL			2.1
2-Nitrotoluene	NVA	NVA	NVA		NVA	NVA		2.0	LANL			2.0
3-Nitrotoluene	NVA	NVA	NVA		NVA	NVA		2.4	LANL			2.4
4-Amino-2,6-Dinitrotoluene	NVA	NVA	NVA		NVA	NVA		0.73	LANL			0.73
4-Nitrotoluene	NVA	NVA	NVA		NVA	NVA		4.4	LANL			4.4
HMX	NVA	NVA	NVA		NVA	NVA		27	LANL			27
Nitrobenzene	40	1.31	1.31	EPA-R4	NVA	1.31	EPA-R4	2.2	LANL			40
Nitroglycerin	NVA	NVA	NVA		NVA	NVA		71	LANL			71
PETN	NVA	NVA	NVA		NVA	NVA		8600	LANL			8600
RDX	NVA	NVA	NVA		NVA	NVA		7.5	LANL			7.5
Tetryl	NVA	NVA	NVA		NVA	NVA		0.99	LANL			0.99
Metals/Inorganics												
Chromium (total)	42	0.4	26	SSL	26	SSL	26	SSL	2.3	LANL	Yes	42
Copper	50	5.4	60	ORNL	190	Dutch	60	ORNL	10	LANL	Yes	50
Iron	NVA	NVA	200	EPA-R4	NVA		200	EPA-R4	NVA			200
Lead	50	0.0537	11	SSL	11	SSL	11	SSL	14	LANL	Yes	50
Molybdenum	2	NVA	2	ORNL	2	ORNL	2	ORNL	NVA			2
Nickel	30	13.6	30	ORNL	30	ORNL	30	ORNL	20	LANL	Yes	30

Acronyms and Abbreviations:

EPA-R4 = USEPA Region 4

Dutch = Dutch Intervention Values

HMX - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine

LANL = Los Alamos National Laboratory

mg/kg = milligrams per kilogram

NVA: No value available

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

PETN - pentaerythritol tetranitrate

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

SSL = USEPA Eco Soil Screening Levels

USEPA = U. S. Environmental Protection Agency

Notes:

^a Washington Department of Ecology, Toxics Cleanup Program, Table 749-3, Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals. Developed under WAC 173-340-7493 (2)(a)(i).

^b Ecological Screening Levels (ESLs), USEPA Region V, August 2003.

^c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: USEPA EcoSSLs; ORNL Efroymsen values; USEPA Region 4 values; other published values.

^d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: USEPA SSLs; Dutch Intervention Values or ORNL Efroymsen values.

^e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.

^f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel, 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values, Rev. Environ. Contam. Toxicol.

Table 3-4
Ecological Soil Screening Values
Fort Flagler Military Reservation

^g Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005.

^h Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation.

Potential bioaccumulative potential from: *Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs* (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).

ⁱ Final Screening Value selected using the following hierarchy:

1. State Value (Washington)
2. USEPA Region State Located In (USEPA Region 10)
3. Lower of Talmage et al. (1999) or LANL (2005) values.

Other References:

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

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

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

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

The Netherlands Ministry of Housing, Spatial Planning and Environment's Circular on target values and intervention values for soil remediation http://www2.minvrom.nl/Docs/internationaal/S_I2000.pdf and Annex A:

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

**Table 3-5
Ecological Sediment Screening Values
Fort Flagler Military Reservation**

Analyte	Proposed Benchmarks										Potential Bioaccumulative Constituent? ^g	Final Ecological Screening Value Sediment ^h (mg/kg)
	Washington Department of Ecology Screening Level Values Freshwater ^a (mg/kg)	USEPA Region 5 Ecological Screening Levels ^b (mg/kg)	USEPA Region 7 ^c (mg/kg)	USEPA Region 8 ^d (mg/kg)	USEPA Region 10 ^e (mg/kg)	Other Ecological Screening Levels ^f (mg/kg)						
Explosives												
1,3,5-Trinitrobenzene	NVA	NVA	NVA		NVA		NVA		2.40E-02	TAL		2.40E-02
1,3-Dinitrobenzene	NVA	8.61E-03	NVA		NVA		NVA		6.70E-02	TAL		6.70E-02
2,4,6-Trinitrotoluene	NVA	NVA	NVA		NVA		NVA		9.20E-01	TAL		9.20E-01
2,4-Dinitrotoluene	NVA	1.44E-03	NVA		NVA		NVA		2.90E-01	LANL		2.90E-01
2,6-Dinitrotoluene	NVA	3.98E-03	NVA		NVA		NVA		1.90E+00	LANL		1.90E+00
2-Amino-4,6,-Dintrotoluene	NVA	NVA	NVA		NVA		NVA		7.00E+00	LANL		7.00E+00
2-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		5.60E+00	LANL		5.60E+00
3-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		4.90E+00	LANL		4.90E+00
4-Amino-2,6,-Dintrotoluene	NVA	NVA	NVA		NVA		NVA		1.90E+00	LANL		1.90E+00
4-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		1.00E+01	LANL		1.00E+01
HMX	NVA	NVA	NVA		NVA		NVA		4.70E-02	TAL		4.70E-02
Nitrobenzene	NVA	1.45E-01	NVA		NVA		NVA		3.20E+01	LANL		3.20E+01
Nitroglycerin	NVA	NVA	NVA		NVA		NVA		1.70E+03	LANL		1.70E+03
PETN	NVA	NVA	NVA		NVA		NVA		1.20E+05	LANL		1.20E+05
RDX	NVA	NVA	NVA		NVA		NVA		1.30E-01	TAL		1.30E-01
Tetryl	NVA	NVA	NVA		NVA		NVA		1.00E+02	LANL		1.00E+02
Metals/Inorganics												
Chromium	2.60E+02	4.34E+01	4.34E+01	MAC	4.34E+01	MAC	4.34E+01	MAC	5.60E+01	LANL	Yes	2.60E+02
Copper	3.90E+02	3.16E+01	3.16E+01	MAC	3.16E+01	MAC	3.16E+01	MAC	1.70E+01	LANL	Yes	3.90E+02
Iron	NVA	NVA	NVA		NVA		NVA		2.00E+01	LANL		2.00E+01
Lead	2.60E+02	3.58E+01	3.58E+01	MAC	3.58E+01	MAC	3.58E+01	MAC	2.70E+01	LANL	Yes	2.60E+02
Molybdenum	NVA	NVA	NVA		NVA		NVA		NVA			NVA
Nickel	4.60E+02	2.27E+01	2.27E+01	MAC	2.27E+01	MAC	2.27E+01	MAC	3.90E+01	LANL	Yes	4.60E+02

Acronyms and Abbreviations:

EPRGs = Oak Ridge National Laboratory Ecological PRGs
 HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
 ISQGs = Canadian Interim Sediment Quality Guidelines
 LANL = Los Alamos National Laboratory
 MAC = MacDonal Consensus Values
 mg/kg = milligram per kilogram
 NVA = No Value Available
 PETN - pentaerythritol tetranitrate
 RDX - Hexahydro-1,3,5-trinitro-1,3,5-triazine
 TAL = Talmage et al (1999)
 USEPA = U. S. Environmental Protection Agency

Table 3-5
Ecological Sediment Screening Values
Fort Flagler Military Reservation

Notes:

^a Washington Department of Ecology, Creation and Analysis of Freshwater Sediment Quality Values in Washington State, July, 1997, Pub. No. 97-323a (Table 11).

^b Ecological Screening Levels (ESLs), USEPA Region V, August 2003.

^c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: MacDonald Consensus Values (MacDonald, 2000); ORNL Efroymsen values (ORNL, 1977).

^d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: MacDonald Consensus Values (MacDonald, 2000); Canadian ISQG values (CCME, 2003) or ORNL Efroymsen values (ORNL, 1977).

^e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.

^f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel (TAL), 1999, *Nitroaromatic Munition Compounds: Environmental Effects and Screening Values*, Rev. Environ. Contam. Toxicol. or Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005; the Talmage [TAL] screening values assume 10% organic carbon in the sediment.

^g Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation. Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).

^h Final Screening Value selected using the following hierarchy:

1. State Value (Washington)
2. USEPA Region State Located In (USEPA Region 10)
3. Lower of Talmage et al. [TAL] (1999) or LANL (2005) values.

Other References:

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

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

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

**Table 6-1
Comparison of Transition Range 1 Surface Soil Detected Analytical Results to Site Background,
Human Health and Ecological Screening Values
Fort Flagler Military Reservation**

Location						039A003		039A004	
Sample Date						21-Feb-07		21-Feb-07	
Sample Number						NWO-039-0002		NWO-039-0003	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ
Metals	Lead	mg/kg	32.6	50	400	13.8		18.6	

Notes:

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

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

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

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States 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.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

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.

**Table 6-2
Comparison of Transition Range 1 Sediment Detected Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Fort Flagler Military Reservation**

Location							039A005	
Sample Date							21-Feb-07	
Sample Number							NWO-039-1002	
Sample Depth (bgs) (ft)							0 to 0.5	
Sample Purpose							REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ
Metals	Lead	mg/kg	12.8	38.4	260	400	40.4	

Notes:

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

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

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

ft - feet

bgs - below ground surface

REG - regular sample

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

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.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be

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.

**Table 7-1
Comparison of Transition Range 2 Surface Soil Detected Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Ft. Flagler Military Reservation**

Location						039A006		039A007	
Sample Date						21-Feb-07		21-Feb-07	
Sample Number						NWO-039-0004		NWO-039-0005	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ
Metals	Lead	mg/kg	32.6	50	400	6.7		8.5	

Notes:

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

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

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

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States 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.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

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.

**Table 7-2
Comparison of Transition Range 2 Sediment Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Fort Flagler Military Reservation**

Location							039A008	039A008			
Sample Date							21-Feb-07	21-Feb-07			
Sample Number							NWO-039-1003	NWO-039-1004			
Sample Depth (bgs) (ft)							0 to 0.5	0 to 0.5			
Sample Purpose							REG	FD			
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	
Metals	Lead	mg/kg	12.8	38.4	260	400	28.4		22		

Notes:

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

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

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

ft - feet
 bgs - below ground surface
 USEPA - United States Environmental Protection Agency
 PRG - Preliminary Remediation Goal
 mg/kg - milligram per kilogram
 VQ - validation qualifier

REG - regular sample
 FD - field duplicate

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.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

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.

**Table 9-1
Comparison of Rocket Range Surface Soil Detected Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Fort Flagler Military Reservation**

Location						039A009		039A010		039A011		039A011	
Sample Date						21-Feb-07		21-Feb-07		21-Feb-07		21-Feb-07	
Sample Number						NWO-039-0006		NWO-039-0007		NWO-039-0008		NWO-039-0009	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5		0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG		REG		FD	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Metals	Chromium	mg/kg	35.2	42	210	25.9		23.4		17.9		19.9	
Metals	Copper	mg/kg	13.2	50	3100	9.3		7.9		10.8		10.3	
Metals	Iron	mg/kg	17800	200	23000	<i>13200</i>		<i>13600</i>		<i>11500</i>		<i>11600</i>	
Metals	Lead	mg/kg	32.6	50	400	4.3		3		17.3		15.9	
Metals	Molybdenum	mg/kg	3.8	2	390	0.47	J	0.23	U	0.28	J	0.28	J
Metals	Nickel	mg/kg	80.2	30	1600	<i>38.3</i>		<i>42.2</i>		27.9		<i>27.2</i>	

Notes:

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

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

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

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States 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.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

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.

**Table 9-2
Comparison of Rocket Range Sediment Detected Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Fort Flagler Military Reservation**

Location							039A012	
Sample Date							21-Feb-07	
Sample Number							NWO-039-1005	
Sample Depth (bgs) (ft)							0 to 0.5	
Sample Purpose							REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ
Metals	Chromium	mg/kg	28.5	85.5	260	210	25.5	
Metals	Copper	mg/kg	11.1	33.3	390	3100	8	
Metals	Iron	mg/kg	15600	46800	20	23000	<i>13100</i>	
Metals	Lead	mg/kg	12.8	38.4	260	400	3.6	
Metals	Molybdenum	mg/kg	0.22	.66	No criteria	390	0.25	J
Metals	Nickel	mg/kg	46.9	140.7	460	1600	37.7	

Notes:

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

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

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

ft - feet

bgs - below ground surface

REG - regular sample

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

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.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

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.

Table 10-1
Comparison of the Live Grenade Court Surface Soil Detected Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Fort Flagler Military Reservation

Location						039A013	
Sample Date						21-Feb-07	
Sample Number						NWO-039-0010	
Sample Depth (bgs) (ft)						0 to 0.5	
Sample Purpose						REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ
Metals	Chromium	mg/kg	35.2	42	210	36.3	
Metals	Copper	mg/kg	13.2	50	3100	7.6	
Metals	Iron	mg/kg	17800	200	23000	<i>16700</i>	
Metals	Lead	mg/kg	32.6	50	400	10	
Metals	Molybdenum	mg/kg	3.8	2	390	0.24	U
Metals	Nickel	mg/kg	80.2	30	1600	85.8	

Notes:

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

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

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

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States 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.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

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.

Table 12-1
Comparison of the Rifle Range Surface Soil Detected Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Fort Flagler Military Reservation

Location						039A014		039A015	
Sample Date						21-Feb-07		21-Feb-07	
Sample Number						NWO-039-0011		NWO-039-0012	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ
Metals	Lead	mg/kg	32.6	50	400	235		587	

Notes:

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

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

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

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States 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.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

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.

**Table 12-2
Comparison of the Rifle Range Sediment Detected Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Fort Flagler Military Reservation**

Location							039A016	
Sample Date							21-Feb-07	
Sample Number							NWO-039-1006	
Sample Depth (bgs) (ft)							0 to 0.5	
Sample Purpose							REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ
Metals	Lead	mg/kg	12.8	38.4	260	400	219	

Notes:

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

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

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

ft - feet

bgs - below ground surface

REG - regular sample

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

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.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

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.