



Explosives Safety Submission

Munitions Response Action

Installation Restoration Site 05 and Dredge Pond 7S

Former Mare Island Naval Shipyard Vallejo, California

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1. PROJECT SUMMARY

The proposed project involves the geophysical survey of two munitions areas of concern and the investigation of suspected MEC anomalies. Installation Restoration Site 5 (IR05) and the adjacent former Dredge Pond 7S (DP 7S) are located on the former Mare Island Naval Shipyard located in Vallejo, California as shown in Figure 2-1. Both areas have already been the subject of separate survey and removal actions as described in the following sections.

1.1 INSTALLATION RESTORATION SITE 5

IR05 is located on the southern end of Mare Island between a hilly upland area to the east, San Pablo Bay wetlands to the west, Dredge Pond 7 to the north, and Carquinez Strait to the south as shown on Figure 2-2. The site covers approximately 60.8 acres and is comprised of IR05 and the adjacent former dredge pond DP 7S. IR05 was operated between 1947 and 1975 as an inert munitions storage site and munitions disposal facility for the adjacent Mare Island Ammunition Depot established in 1857. DP 7S was used during the 1940's, 50's, and 60's for the deposition of dredge sediments that originated from Carquinez Strait and lower Mare Island Strait berth and pier areas. Dredge outfall locations at Mare Island have typically been found to contain small caliber (20 mm, 40 mm, and 1.1 inch) anti-aircraft munitions discarded overboard in the period following the end of World War II.

IR05 was identified as a munitions area of concern by a series of investigative actions that began with an initial assessment study in 1982, followed by a 1991 Phase I Remedial Investigation and two separate geophysical surveys completed in 1993 and 1994. Those investigations formed the basis for a 1995-97 time critical munitions removal action completed by Mare Island Naval Shipyard and Superintendent of Shipbuilding, Conversion, and Repair, Portsmouth, Virginia (SSPORTS) Environmental Detachment Vallejo. DDESB approval of the 21 month project was obtained in February 1995 (NOC, 1995). All detectable anomalies were investigated, evaluated, and removed during the time critical removal action that was performed on a grid-by-grid basis utilizing handheld survey instruments (MK 26 Ordnance Locators, MK 29 All Metals Locators, and AN-19/2 Mine Detecting Sets) to locate and verify clearance of anomalies. A total of 116 *munitions and explosives of concern* (MEC) items were recovered, including: 20 mm and 40 mm



anti-aircraft rounds; 3 inch, 5 inch, and 6 pounder projectiles; and various projectile/bomb/rocket fuzes. Careful examination by UXO Technicians revealed that all of the recovered projectiles were unfired (i.e., they had no rifling marks on their rotating bands) and that none of the fuzes showed any discernable indication of having been armed. Table 3-1 contains a complete listing of MEC recovered at IR05. No explosives contamination of soil or groundwater was encountered during the removal action; a small quantity (~270 cubic yards) of lead contaminated soil was removed for disposal from the location of several former propellant burn pads. Since all detectable anomalies were excavated and removed during the removal action, no additional MEC is known or suspected to remain at the site. Details of the removal action are described in the Final Summary Report for the Unexploded Ordnance Time Critical Removal Action for Installation Restoration Site 05 at Mare Island (SSPORTS, 1998a).

The removal of buried munitions during the intrusive investigation, completed between November 1995 and September 1997, was intended to satisfy the minimum clearance requirements of the Department of Defense Explosives Safety Board (DDESB) as outlined in Section 2.1.14 of NAVSEA OP 5 (Ammunition and Explosives Ashore) for the planned reuses of the site. "Public Access" (recreational) and "Limited Public Access" (wildlife preserve) reuses are planned the site as described in the Mare Island Final Reuse Plan (City of Vallejo, 1995). A minimum clearance depth of 4 feet was implemented during the project approved by the DDESB in their February 1995 letter (NOC, 1995). Clearance depth was based on the planned reuses of the site, in order to maintain public safety in accordance with Chapter 12 of Department of Defense Standard 6055.9 (DOD, 1999).

1.2 DREDGE POND 7S

The Ordnance Preliminary Assessment of Mare Island Ordnance Sites (PA) completed in 1995 by PRC Environmental, Inc. (PRC, 1995) led to the geophysical survey and subsequent intrusive investigation of DP 7S. The PA described the history of munitions activities at Mare Island, including the potential for munitions discarded overboard in Mare Island Strait to be present in dredge spoils ponds. The PA concluded that the dredge ponds were an area of potential concern and recommended further investigation to determine if buried munitions were present. A geophysical survey of the active dredge ponds was subsequently completed during the 1995-



96 Unexploded Ordnance (UXO) Site Investigation (SI) completed by Mare Island Naval Shipyard/Superintendent of Shipbuilding, Conversion, and Repair, Portsmouth, Virginia (SSPORTS) Environmental Detachment Vallejo. The SI survey of the ponds was performed using handheld MK 26 magnetometers. A total of 390 dredge pond magnetic anomalies were identified by the SI survey, including several located at a historic outfall site in the northwest corner of DP 7S (SSPORTS, 1997a). The bottom of DP 7S was not surveyed due to environmental concerns and a lack of evidence indicating that munitions items might be present. The subsequent intrusive investigation of the dredge ponds, completed by SSSPORTS, excavated and evaluated all of the SI anomalies to determine if they posed a munitions hazard.

All 390 documented SI anomalies were investigated, evaluated, and removed during the 1998-2000 dredge pond intrusive investigation. DDESB approval of the project was obtained in August 1998 (NOC, 1998). A total of 121 MEC items were recovered from the DP 7S outfall location, including: 20 mm, 40 mm, and 1.1 inch anti-aircraft rounds/projectiles; 3 inch and 6 pounder projectiles; and a projectile proximity fuze (see Table 3-2 for a complete listing. Most of the recovered MEC gun ammunition consisted of an integrated cartridge case and projectile assembly. Those few separate projectiles that were recovered were unfired (i.e., they had no rifling marks on their rotating bands or other indication of having been fired). They are believed to have been separated from their associated cartridge cases because of the deteriorated condition of the cases and by handling received during their disposal, deposition, and subsequent recovery. Various scrap metal objects (welding rods, angle iron, etc.) associated with sediments dredged from waterfront area of the Shipyard along Mare Island Strait, accounted for the remainder of the anomalies investigated.

No discernable evidence of explosives contamination in soil or groundwater was noted during the intrusive investigation. The recovered MEC items were substantially intact and no bulk explosives materials were encountered or suspected. Because the approved investigation work plan required sampling only where contamination was known or suspected to exist, no sampling of soil or groundwater for explosives was performed.

Since all known anomalies were excavated and removed during the removal action, no additional MEC is known or suspected to remain in DP 7S. Details of the removal action are described in the



Final Summary Report for the Unexploded Ordnance Intrusive Investigation of the Dredge Ponds at Mare Island (Weston, 2001). A subsequent second dredge pond survey, incorporating a survey of berms and outfall locations utilizing an EM-61 system, was completed in 2001. That survey did not include DP 7S (with the exception of the common berm with Dredge Pond 7). A Final Summary Report for the Ordnance and Explosives Confirmation Survey and Removal Action of the Mare Island Dredge Ponds was completed in March 2002 (Weston, 2002).

The removal of dredge pond buried munitions during the intrusive investigation and subsequent confirmation survey and removal, was intended to satisfy the minimum clearance requirements of the DDESB as outlined in Section 2.1.14 of NAVSEA OP 5 (Ammunition and Explosives Ashore) for the planned reuse of the site. A “Limited Public Access” (wildlife preserve) reuse is planned the site as described in the Mare Island Final Reuse Plan (City of Vallejo, 1995). A minimum clearance depth of 4 feet was specified by the DDESB in their August 1998 approval letter for the dredge spoils ponds ordnance intrusive investigation (NOC, 1998). Clearance depths were based on the planned reuses of the dredge ponds, in order to maintain public safety in accordance with Chapter 12 of Department of Defense Standard 6055.9 (DOD, 1999).

1.3 CURRENT SITE STATUS

All munitions response actions completed to date for both sites have been planned in consultation with regulatory agency representatives to effectively address the various environmental concerns (including the presence of buried munitions) posed by the closure of Mare Island Naval Shipyard. The response actions have been performed utilizing the best available technology and techniques to meet existing DoD, Navy, and regulatory agency requirements to support the ultimate transfer and reuse of the property.

The property is currently in the Remedial Investigation phase of the CERCLA process. A second survey and clearance of the site, termed a “*munitions confirmation survey*” is required by regulatory agencies to support completion of the Remedial Investigation and the ultimate transfer of the property. The confirmation survey will also provide an opportunity to address previous munitions actions, advances in quality control (QC) methodology, and the availability of new



survey techniques to address perceived shortcomings in past survey efforts. Specifically the confirmation survey will focus on the following areas:

- *DP 7S Bottom*—A dredge outfall site in the northwest corner of the pond was identified during the SI and was subsequently excavated during the Dredge Pond Intrusive Investigation. A quantity of discarded MEC was identified and removed from the outfall location during the intrusive investigation. The pond bottom was never surveyed due to environmental concerns (SSPORTS, 1997a and Weston, 2001), and since no MEC has been observed in the pond bottoms away from outfall locations.
- *Quality Control Measures*—Although the QC measures implemented during the previous survey and investigation activities were adequate, documentation supporting the measures is not available.
- *Use of “Real-Time” Survey Instruments*—All geophysical surveys associated with the previous survey actions of both IR05 and DP 7S were performed using handheld “real time” survey instruments (MK 26, MK 29, and AN-19/2) that did not provide a permanent record of anomaly parameters or verification of adequate search coverage. This lack of verifiable survey data prevents effective QC confirmation of the previous removal action and necessitates a resurvey of the site.

The current munitions confirmation survey will: resurvey IR05 to confirm the removal of munitions anomalies; and survey the berm, outfall, and pond bottom areas of DP 7S. Anomalies identified by the data reassessment and resurvey will be excavated and removed to a minimum depth of 4 feet.

The site has been divided into four discrete subareas (shown on Figure 2-3) based on their history and potential mode of munitions placement:

- *Open Storage Area*—The 14.3-acre portion of IR05 includes those areas of the site used primarily for the open storage of inert munitions following World War II.
- *Detonation/Burn Area*—The 17.3-acre portion of IR05 was used between 1948 and 1975 for the open burning and detonation of unwanted munitions and propellant. The area was the primary munitions disposal area for the Mare Island ammunition facility during that time period.



- Pond Berms/Outfall Area—The 4.4-acre area includes the outfall site previously identified by the SI and cleared during the subsequent munitions intrusive investigation. The berms and outfall constitute the portions of DP 7S most likely to contain munitions based on the established Mare Island dredge pond “outfall model” characterizing munitions deposition. The northwest berm (common with Dredge Pond 7 to the north) was excluded from this confirmation survey since it was included in the second Dredge Pond Ordnance and Explosives Confirmation Survey and Removal Action completed in 2002 (Weston, 2002).
- Pond Bottom—The 24.8-acre dredge pond bottom area was not surveyed during the SI because of its status as endangered species habitat and a low probability of containing discarded munitions. Since the pond bottom is considered to have a very low probability of containing MEC, it will be surveyed only along 100 foot grid lines to yield approximately a 10% sampling of the total area. This is the same survey method, rationale, and coverage applied to all the other dredge pond bottoms.



2. MAPS/FIGURES

2.1 REGIONAL MAP

Figure 2-1 shows the location of Mare Island relative to the San Francisco Bay Area and IR05/DP 7S in relation to Mare Island.

2.2 SITE MAP

Figure 2-2 shows the 401 foot exclusion zone distance from all potential IR05/DP 7S excavation sites and the nearest inhabited buildings. A 401 foot exclusion zone around each work area will be invoked, as described in Section 7, during all site work that may involve the excavation, handling, or evaluation of recovered MEC.

The figure also shows the 1,250-foot Inhabited Building Distance (IBD) arc from the MEC storage site (Magazine A180) and the 1,250-foot exclusion zone established around the MEC treatment site (Disposal Range #2) during MEC treatment events.

2.3 MUNITIONS RESPONSE AREA MAP

Figure 2-3 shows the four Munitions Response Areas located within IR05/DP 7S.

2.4 PROPOSED GEOPHYSICAL PROVE-OUT AREA

Figure 2-4 shows the layout of the proposed Geophysical Prove-Out (GPO) area.

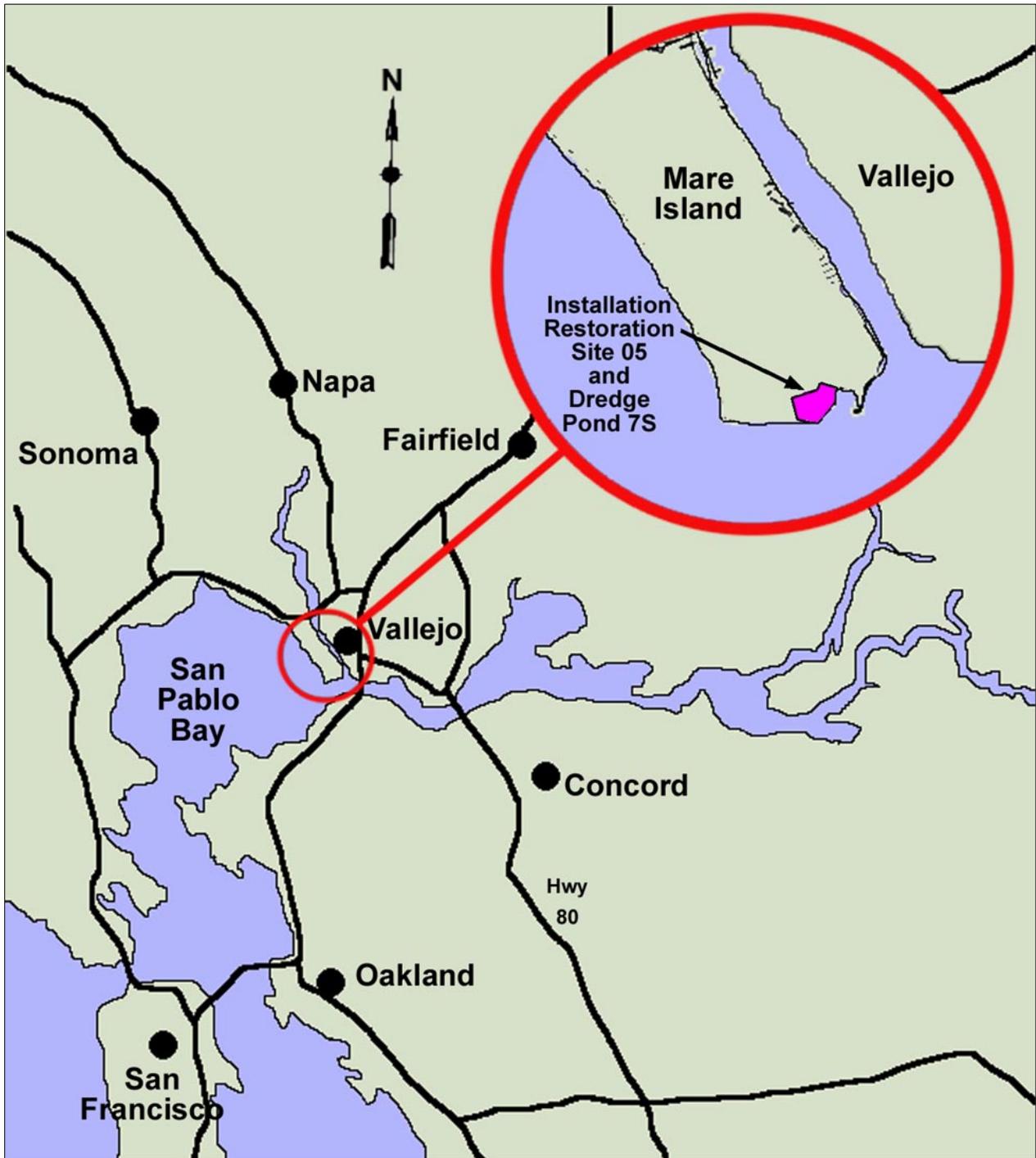
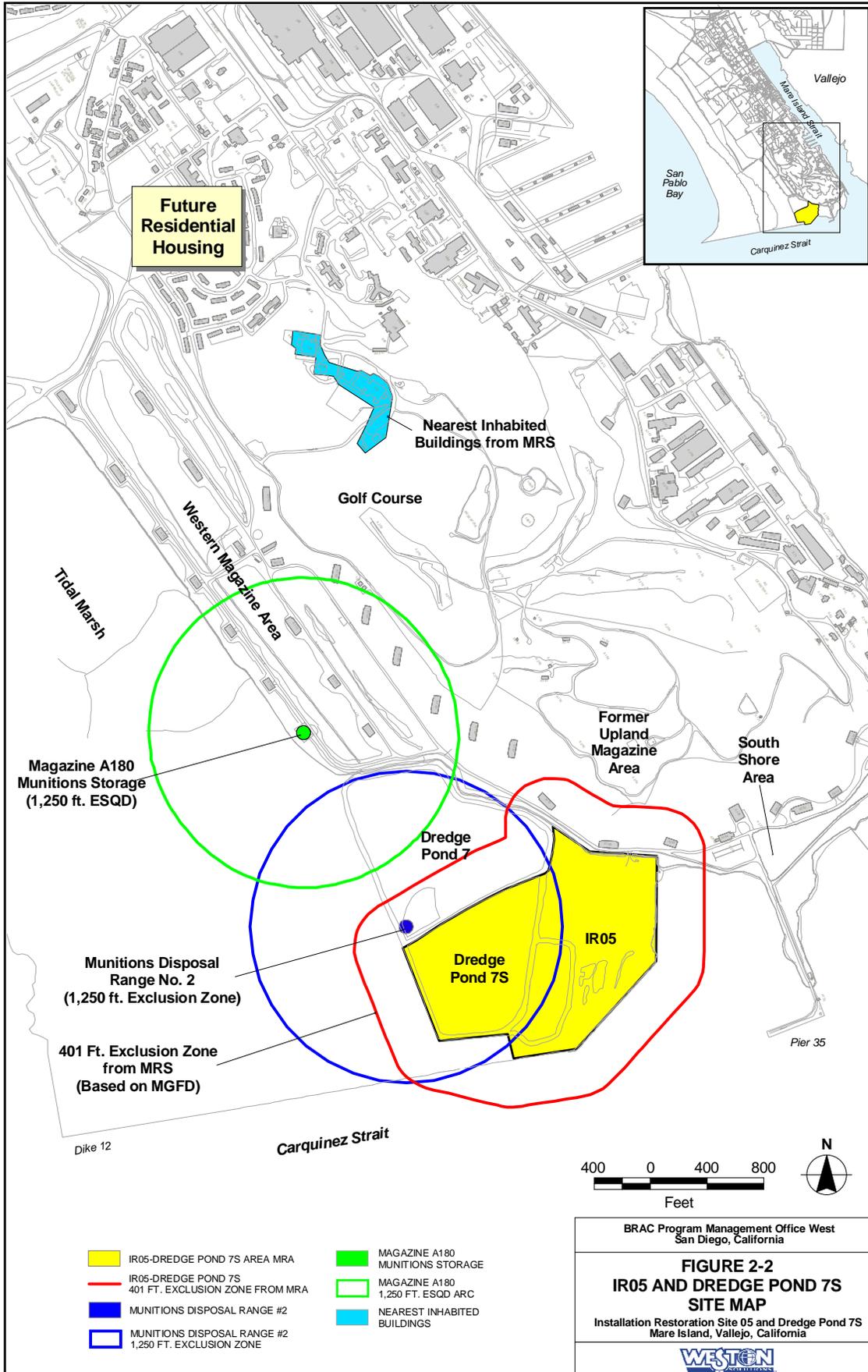


Figure 2-1 Mare Island and IR05/DP 7S Location Map



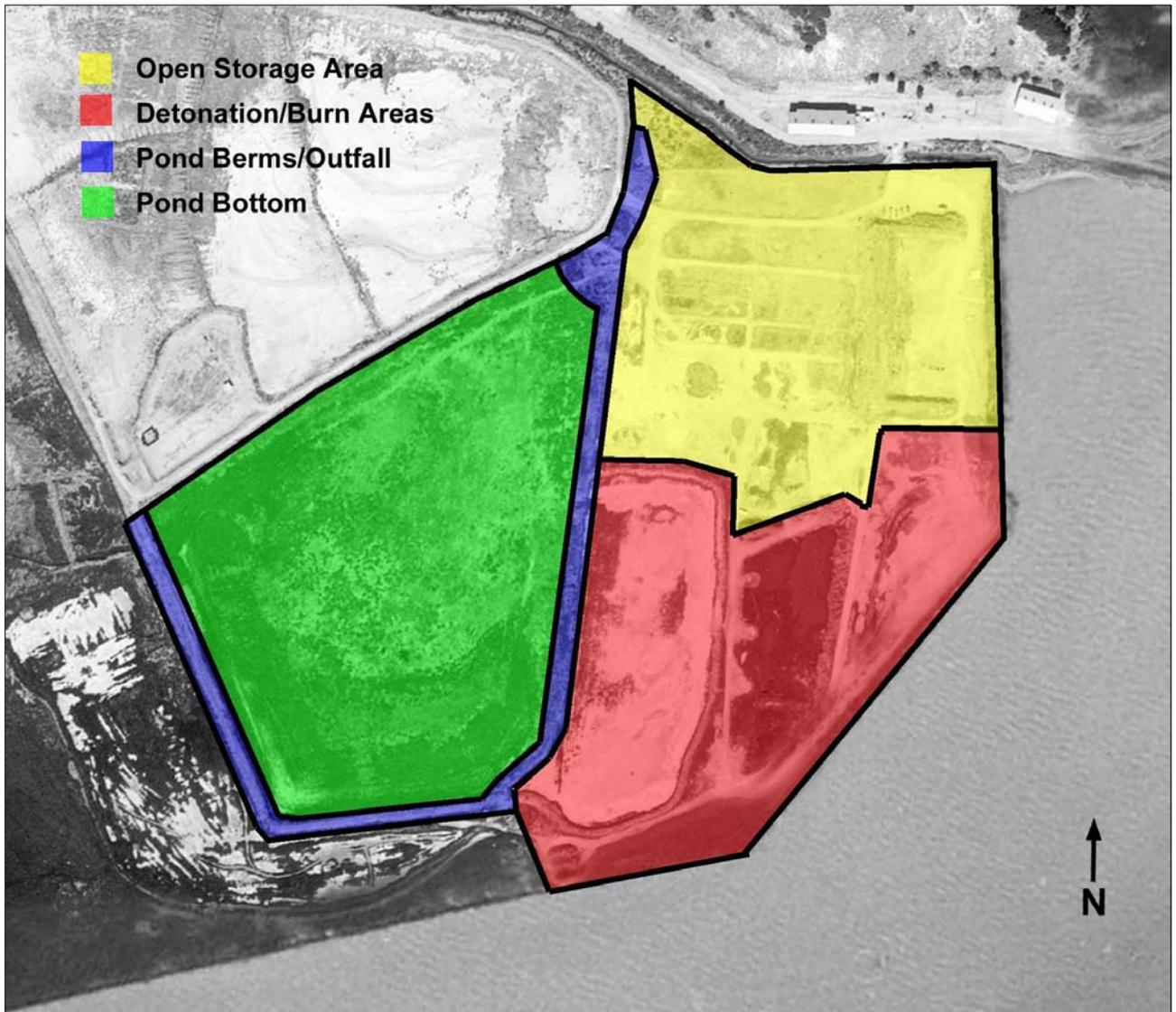


Figure 2-3 IR05/DP 7S Munitions Response Areas

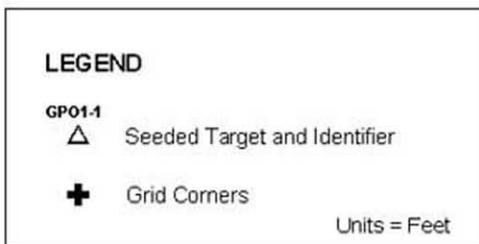
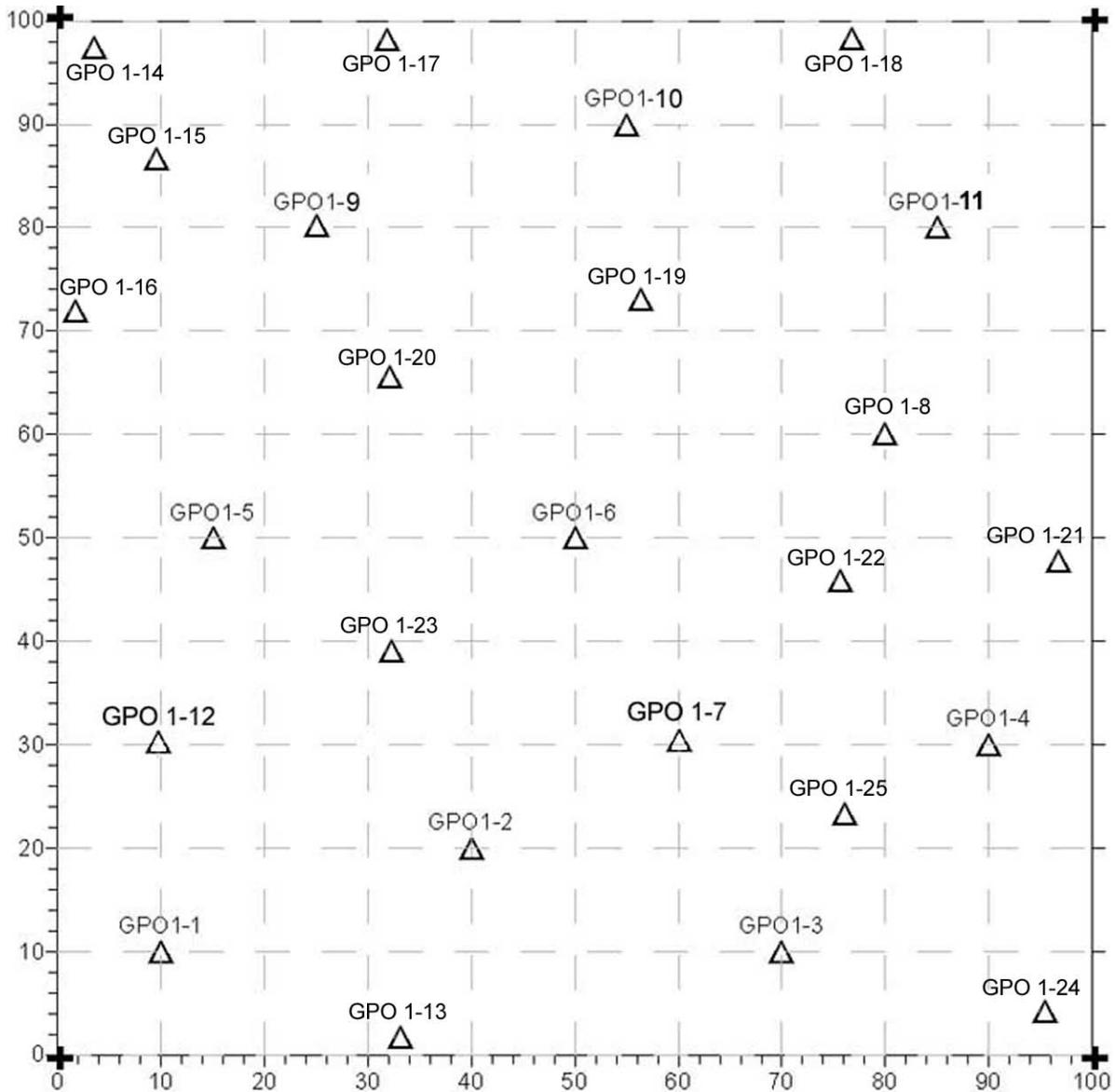


Figure 2-4 Proposed Geophysical Prove-Out Area



3. AMOUNT AND TYPE OF MEC

Although numerous MEC items were recovered from the site during the prior investigation and removal of geophysical anomalies (see Tables 3-1 and 3-2 below), none are known to remain. The prevalent munitions types encountered during previous actions were small/medium caliber gun projectiles and associated fuzes dating to the World War II era. Based on the MEC items already recovered from the site, the most probable *munition with the greatest fragmentation distance* (MGFD) is the 5 inch/38 caliber MK 32 or MK 46 armor piercing projectile (having a filler comprised of 2.04 to 2.58 lbs of Explosive D).

**TABLE 3-1
IR05 RECOVERED MEC (1995-97 TIME CRITICAL REMOVAL ACTION)**

MEC Item	Quantity
MK 15 Primer	4
40 mm High Explosive Projectile	1
MK 5 Practice Bomb (w/black powder spotting charge)	1
MK 18 Mechanical Time Fuze (projectile)	1
MK 21 (series) Base Detonating Fuze	1
20 mm High Explosive Projectile	7
MK 23 Base Detonating Fuze (projectile)	15
MK 158 Nose Fuze (5 inch rocket)	10
M 103 Nose Fuze (bomb)	1
MK 31 Base Detonating Fuze (projectile)	36
6 pounder High Explosive Projectile	1
3 inch MK 29 Armor Piercing Projectile	1
5 inch "Armor Piercing" Projectile	1
Bomb Fuze Booster	28
3 inch MK 27 MOD 3 Anti-Aircraft High Explosive Projectile	7
3 inch Common (High Explosive) Projectile	1



**TABLE 3-2
DP 7S RECOVERED MEC (1998-2001 INTRUSIVE INVESTIGATION ACTION)**

MEC Item	Quantity
Projectile proximity fuze (VT fuze)	1
1.1 inch anti-aircraft projectiles	4
20 mm anti-aircraft rounds/projectiles	112
40 mm anti-aircraft rounds/projectiles	2
3 inch/50 caliber anti-aircraft projectile	1
6 pounder projectile	1

No explosives contaminated soil or buildings are known to exist at the site. There are no occupied structures located at or near the site and access into the area is restricted by fencing and locked gates maintained by the Navy.

The IR05/DP 7S site is located adjacent to three other Mare Island Munitions Response Sites shown in Figure 2-2:

- The former Upland Magazine Area to the east was initially identified as a potential munitions area of concern but subsequent geophysical survey and investigation actions revealed no evidence of discarded munitions (SSPORTS, 1997b).
- The South Shore Area was a former munitions storage and handling area where munitions were discarded by dumping/burial along the historic shoreline. This area has also been previously surveyed and all anomalies removed; a munitions confirmation survey will likely be required to facilitate transfer (Weston, 2003).
- The Western Magazine Area was the location of a former munitions storage area operated from 1939 through 1975. All detectable munitions material was removed from the site during a 1997-98 intrusive investigation action; a munitions confirmation survey will likely be required to facilitate transfer (SSPORTS, 1998b).



4. PROJECT START DATE

Project work, including surveys and anomaly investigation, is scheduled to begin in October of 2005.



5. FROST LINE

There are no known potential phenomena that would cause movement of MEC. Mare Island is located in a temperate region where frost heave is not a concern. The site is predominantly flat and vegetated such that erosion is not a realistic concern.

6. RESPONSE TECHNIQUES

The proposed munitions confirmation survey consists of a preliminary visual surface search (to remove metallic surface debris), a geophysical survey, and a removal of all identified anomalies. The four munitions response sites within the MRS referred to in this section are shown on Figure 2-3.

Two separate instruments, both of which are standard systems commonly used for munitions surveys and provide geo-referenced data via an integrated GPS receiver, will be used to perform the survey:

- Since non-ferrous MEC items may be encountered, a Geonics EM-61 inductive time domain electro-magnetic (TDEM) instrument will be used to survey the Open Storage Area, Detonation/Burn Areas, and Pond Bottom Area (Figure 2-3).
- A Geometrics G-858 cesium vertical gradiometer will be used to survey the Pond Berms/Outfall Area (Figure 2-3) since expected MEC includes small to medium caliber gun ammunition and other munitions items constructed largely of ferrous materials. Possible anomalies also include dredge outfall debris that may be buried at depths exceeding 10 feet.

The proposed survey instruments were evaluated by the Naval Surface Warfare Center at Dahlgren Virginia (NOSSA, 2005) with regard to Hazards of Electromagnetic Radiation to Ordnance (HERO). The G858 will not produce measurable electromagnetic radiation during normal operation and therefore poses no HERO concerns. The EM-61 system operating at an average power level will necessitate a safe separation distance of 1 foot (0.3 meters) be maintained between the coils and the soil surface. HERO warning labels will be affixed to the EM-61 indicating the required standoff distance.

Search instruments were selected to represent the best available technology to locate the expected anomalies at depths characteristic for each of the areas. Capabilities of the EM-61 and G-858 systems will be verified at a nearby 100 x 100 foot test plot established in representative soil conditions (Figure 2-4). Blind seeding of test plot targets representing the range of potential



MEC items will be utilized to verify the combined capabilities of system and operator. The proposed seed items are listed in Table 6-1.

The GPO test area will be developed to duplicate, as closely as possible, the conditions under which the geophysical surveys will be conducted. Representative inert ordnance will be used as seed items for burial in the GPO. If inert ordnance items are not available, surrogates of approximately the same composition, size, and shape will be utilized.

The GPO process will ensure that the following DQOs are satisfied:

- Instrument Latency DQO: Instrument latency will be corrected based on the lags or time differences observed in anomaly peak positions. Corrections will be applied using an appropriate correction routine that accounts for instrument latency time and sensor velocity. “Zig-zag” or “chevron” effects should not be visible in the data maps when plotted at the scales used to detect the smallest amplitude signal for a given MEC item.
- Magnetic heading DQO: For proper heading correction there should be no ‘striping’ visible in vertical gradient data above a 0.2 nanoTeslas per foot (nT/ft) level between lines and no ‘striping’ visible in total field data above a 0.4 nT/ft level between lines.”
- Diurnal data DQO statement: The base station data should exhibit normal characteristics for such data. Background variations of less than 1 nt are typical between measurements during periods without magnetic storms.
- EM leveling DQO statement: For any given dataset of EM data, all data channels will be leveled using the same routines and parameters.
- Processing DQO statement: All leveling and/or filtering routines that are applied to datasets will be evaluated, on a dataset by dataset basis, to confirm that those routines do not alter the nature of the original measured response.
- Sampling density/velocity DQOs: Along-track sampling densities should not exceed 0.5 feet. For EM and magnetometer data, the across-track line spacing will not exceed 3.5 feet. Average sampling velocity will not exceed 2.5 miles per hour.



**TABLE 6-1
GPO SEED ITEMS**

Item Identification	X (feet)	Y (feet)	Target Type	Depth (inches)	Orientation (degrees from horizontal)	Azimuth
GPO 1-1	10	10	3 inch projo	30	60	E-W
GPO 1-2	40	20	5 inch projo	24	45	E-W
GPO 1-3	70	10	4 inch projo	36	60	N-S
GPO 1-4	90	30	40 mm	24	90	--
GPO 1-5	15	50	5 inch projo	48	45	N-S
GPO 1-6	50	50	8 inch projo	36	45	N-S
GPO 1-7	60	30	Projo fuze	12	90	--
GPO 1-8	80	60	20 mm	6	0	N-S
GPO 1-9	25	80	20 mm	24	0	E-W
GPO 1-10	55	90	4 inch projo	24	90	--
GPO 1-11	85	80	8 inch projo	48	30	E-W
GPO 1-12	10	30	40 mm	18	90	--
GPO 1-13	33	2	8 inch projo	48	90	--
GPO 1-14	4	97	40 mm	30	60	E-W
GPO 1-15	10	86	20 mm	12	90	--
GPO 1-16	2	72	4 inch projo	12	60	N-S
GPO 1-17	32	97	6 inch projo	24	30	N-S
GPO 1-18	77	98	40 mm	6	45	N-S
GPO 1-19	56	73	6 inch projo	36	90	--
GPO 1-20	32	46	3 inch projo	12	45	E-W
GPO 1-21	96	48	Projo fuze	6	90	--
GPO 1-22	76	46	3 inch projo	24	90	--
GPO 1-23	32	48	20 mm	18	45	N-S
GPO 1-24	95	5	5 inch projo	36	90	--
GPO 1-25	76	24	20 mm	0	45	N-S



- Anomaly Selection DQO: The senior geophysicist, or one of his/her designees, will certify that all anomaly selections have been performed or reviewed by them, and that they accept the anomaly selection as reasonable for the intended purpose of this project.
- Navigation DQO: The sum of all data positioning errors in the final datasets will not exceed +/- 2.0 foot. This DQO is specific to the reported positions of the state-plane coordinates for each data point in the final version of geophysical data. Many factors affect DGPS accuracies, including PDOP, SNRs, base-station geodetic coordinate accuracies, carrier-phase ambiguity resolution, etc.

Oasis Montaj data analysis software will be utilized to select anomalies for investigation. The effectiveness of anomaly discrimination techniques will be evaluated by comparing data from anomaly “dig sheets” with predicted anomaly characteristics.

Quality Control measures relating to the geophysical survey will include the following:

- Initial equipment calibration “prove-out” surveys will be performed prior to the start of survey activities. Inert munitions items representative of those recovered in IR05 and DP 7S will be planted at a 100 x 100 ft test area adjacent to Dredge Pond 7 at depths that will demonstrate the detection capability of the EM61 and G858 survey systems. Results of the calibration surveys will be used to establish operational baselines for equipment use and data processing, including lane spacing, baseline equipment calibration data, and anomaly identification.
- Prior to the start of each survey activity, equipment operators will divest themselves of all metallic objects (i.e., keys, steel-toed shoes, pocket knives) to eliminate the potential for interference. Cellular phones, radio transceivers, and other sources of EM noise will not be permitted in close proximity of the coils due to the interference potential. The operator will then move away from and back toward the energized search instrument to verify that there is no variation in instrument output.
- Prior to each initialization of the survey instruments (at a minimum once daily or more frequently based on varying survey or site conditions), the equipment will be calibrated in accordance with the manufacturer’s specifications. Satisfactory operation will be verified by reacquiring the same fixed test target for each check to ensure that the instrument



output remains consistent within 20%. Instrument battery levels will be within specified parameters (>10.6 volts for the EM61; >65% for the G858). A one minute static check of instrument response at rest will indicate acceptable instrument drift (1.5 mV for the EM61; 1.5 nT/ft for the G858).

- Prior to each use of the Differential Global Positioning System (DGPS) positioning system (at a minimum once prior to and following each survey session or more often based on varying survey or site conditions), accuracy of the equipment will be verified. Satisfactory operation of the DGPS receiver will be verified by locating a known point in the survey area to within 1 meter accuracy and by observing that the position threshold (Percent Dilution of Position or PDOP) during the survey remains less than 6.0.
- Random duplicate transects of the areas already surveyed will be conducted to demonstrate the repeatability of the measurements. A minimum number of transects required to meet the Verification Level III requirements of MIL-STD-1916 (DOD, 1996) will be completed. Any anomalies noted after data processing of the original data should also be mirrored in the data from the duplicate transects.
- Survey data stored in the data loggers at the completion of each day's fieldwork will be downloaded to a computer and reviewed by the project geophysicist. Data will be available for review by regulatory agencies upon request.
- All collected data will be reviewed daily for completeness, accuracy, and comprehensive DGPS coverage. Areas with incomplete survey data coverage ("data gaps") will be resurveyed at the earliest opportunity.
- A second geophysicist will examine the collected geophysical data for each grid to verify that all appropriate anomalies were selected for investigation.

Quality Control measures relating to the relocation, excavation, and evaluation of selected survey anomalies will include the following:

- Satisfactory operation of the MK26 magnetometers will be verified daily by reacquiring a buried test target established at the site. The MK 26 instruments will undergo factory calibration within 12 months of use.



- Satisfactory operation of the AN-19/2 metal detectors will be verified daily by establishing their ability to satisfactorily acquire the test item supplied by the manufacturer.
- Operation of radiological monitoring instruments will be verified using a known radiological source. Manufacturer calibration of radiological instruments will have been performed within 12 months of use. To validate the anomaly tracking and relocation processes, the positions of each relocated survey anomaly will be verified using MK26 and/or AN-19/2 instruments prior to excavation.
- The boundary of each anomaly excavation will be searched using both the MK26 and AN-19/2 instruments to ensure that all metallic objects are removed or are evaluated and determined not to represent a munitions hazard prior to backfilling.
- All disturbed soil will also be surveyed with the search instruments to ensure that all hazardous items have been removed.
- Disturbed soil will be returned and the excavation area restored only after the excavation and soil have both been verified to be free of additional munitions as well as any suspected chemical contaminants.
- Information from the investigation of each anomaly will be compared with the geophysical data to ensure that the dig results match the expected targets.

Additional periodic monitoring of munitions cleared areas will be accomplished independent of the anomaly investigation process using visual and geophysical search methods. The random independent search will ensure that the quality of the removal process is maintained throughout the operation.



Qualification requirements for project personnel include the following:

- Sweep personnel performing the visual surface search and assisting with the anomaly investigation and removal will receive training consisting of a general munitions safety briefing and familiarization with typical MEC items encountered at IR05 and dredge outfall locations. Sweep personnel will also be required to demonstrate proficiency at performing assigned tasks while under the oversight of a qualified UXO Technician.
- Survey personnel will be required to demonstrate their proficiency using each specific survey instrument by locating typical anomalies at the appropriate test plot. Survey personnel will also be trained in general munitions safety and recognition of typical MEC items encountered at IR05 and dredge outfall locations.
- UXO Technicians must be qualified at the U.S. Army Corps of Engineers (USACE) Tech II or Tech III level and be familiar with the typical MEC items encountered at IR05 and dredge outfall locations. The UXO Technician will evaluate and handle all suspected munitions items.

Recovered MEC items will be packaged and transported to Magazine A180 for temporary storage pending on-site treatment. All small arms ammunition and inert ordnance scrap will be controlled from discovery through disposal. Items identified as ordnance scrap will be inspected, containerized, and kept in a secure storage area until they are certified and verified to be inert, demilitarized in accordance with DOD Instructions 4160.21-M and 4160.21-M-1 (DOD, 1995) (if necessary), and transferred to an approved processing facility (recycler). Small arms ammunition will be handled, transported, and treated with other MEC items.

7. QUANTITY—DISTANCE

The site MGF D is a World War II era 5 inch/38 caliber MK 32 or MK 46 projectile typically loaded with up to 2.54 lbs of Explosive D (ammonium picrate) and incorporating a Mk 20 base fuze. A summary of exclusion zone requirements relating to the MGF D is presented in Table 7-1.

The location and corresponding Inhabited Building Distance (IBD) Explosives Safety Quantity-Distance (ESQD) footprint of the existing DDESB site approved storage magazine (Magazine A180) is shown on Figure 2-2. The storage site, with an established 1,250 foot ESQD footprint (IBD) and a limit of 1,000 lbs Net Explosive Weight (NEW), was site-approved for the storage of recovered MEC in 1997 (NOC, 1997). Access into the ESQD is controlled by the Navy and is restricted by a series of fences and locked gates.

The location and corresponding exclusion zone footprint of the existing DDESB approved treatment range (Disposal Range #2) is also shown on Figure 2-2. The range was site-approved for the disposal of recovered MEC in 1994, (NOC, 1994), with an established 1,250 foot exclusion zone that is controlled by the Navy and is restricted by fencing and gates. Since an established demolition area exists, no in-grid consolidated shots will be required. Table 13-1 of NAVSEA OP 5 indicates that the maximum fragment range for the intentional detonation of a 5 inch diameter projectile (the site MGF D) is 2,772 feet. However the use of earth cover, as discussed in Section 6 of DDESB Technical Paper 16 (DDESB, 2003) and quantified in the associated Buried Explosion Module (DDESB, 2004), can effectively reduce fragment range and size of the required exclusion zone. Based on a comparison by analogy to similar items (5"/38 cal MK 41 projectile), the BEM indicates that a dramatic reduction in fragment range can be obtained when earth cover is used to mitigate fragmentation. The current site-approved 1,250 foot exclusion zone is therefore considered adequate for the MGF D (within the established range limit of 25 lbs NEW), provided that a minimum of 6 feet of dry sand cover is used to mitigate fragmentation.



Recovered MEC placed into storage during this project will be managed and treated by the Navy under separate contract. MEC storage and disposal will be in accordance with the requirements of the *Engineering Evaluation/Cost Analysis and Removal Action Workplan for the Operation of Mare Island Ordnance Storage and Treatment Facilities* (Weston, 2004). As described in the EECA/RAW, contained detonation technology may be utilized to treat recovered MEC when significant quantities of appropriately sized MEC are to be treated; otherwise treatment will be performed by open detonation at the established MEC treatment facility (Disposal Range #2) shown on Figure 2-2.

An exclusion zone extending a minimum of 401 feet around each work site will be established to prevent the entry of non-essential personnel during the excavation, evaluation, and removal of anomalies that could represent live munitions. The 401 foot arc represents the hazardous fragment distance (per Table 7-9 of NAVSEA OP 5) for the unintentional detonation of the site MGF, a 5 inch/38 caliber projectile. The size of the exclusion zone may be increased by the Senior UXO Supervisor based on the hazardous fragment distances in Table 7-9 of NAVSEA OP 5 for other munitions types that may be encountered. Team separation distances will correspond to the hazardous fragment distance (401 feet minimum) established for the exclusion zone. Figure 2-2 illustrates the 401 foot exclusion zone (red boundary) extended around the entire MRS (shaded in yellow). No inhabited areas or public transportation routes are located within the exclusion zone. The golf course clubhouse and other nearby structures are the nearest Inhabited Buildings to the MRS; they are well outside the exclusion zone as shown in Figure 2-2.

No “blow-in-place” operations are anticipated since munitions items recovered at Mare Island have all been discarded military munitions (DMM) and not fuzed/fired items that might pose a hazard during handling. However, should an unsafe item be encountered, the established 401 foot exclusion zone for the site is also considered adequate as a minimum evacuation distance for all potential MEC items. As discussed earlier in this section, the MGF maximum fragment distance shown in Table 13-1 of NAVSEA OP 5, representing the minimum evacuation distance, may be reduced by the use of dry sand cover, as outlined in DDESB Technical Paper 16 (DDESB, 2003) and quantified in the associated BEM (DDESB, 2004). The maximum



fragment distance of a 5 inch/38 caliber MK 41 projectile and 1.5 pound donor charge detonated with 5 feet of dry sand cover to mitigate fragmentation, would effectively be zero.

Since a relatively few number of MEC items are expected, recovered items will be immediately packaged and transported to the storage facility, precluding the need to establish collection points.

**TABLE 7-1
MGFD EXCLUSION ZONE SUMMARY**

Site	MGFD ¹		Exclusion Zones (feet)			
	Description	NEW ²	Fragmentation Effects		Blast Overpressure Effects	
			HFD ³	MFD ⁴	K328 ⁵	K40 ⁶
IR05 & Dredge Pond 7S	5"/38 cal MK 32/46	2.58	401	2,772	959	55

NOTES:

1. Munition having the Greatest Fragmentation Distance.
2. Net Explosive Weight (in pounds) of one MGF, from OP 1664.
3. Hazardous Fragment Distance from OP 5 Table 7-9 (specific MGF data is not available in TP-16), applicable to unintentional detonations.
4. Maximum Fragment Distance from OP 5 Table 13-1 (specific MGF data is not available in TP-16), applicable to intentional detonations.
5. Reflects detonation of multiple items and associated donor charges within range limit (25 lbs NEW).
6. Reflects detonation of a single MGF item without donor charge.

Summary:

- ***Intentional detonation EZ for public & essential/non-essential personnel*** is K328 or MFD, whichever is greater (2,772 ft). Based on a comparison by analogy to similar items (5"/38 cal MK 41) in the TP-16 Buried Explosion Module (BEM), 3' dry sand overburden lowers MFD to 1142' and 5' dry sand overburden lowers MFD to zero.
- ***Unintentional detonation EZ for public & non-essential personnel*** is greater of K40 or HFD (401 ft).
- ***Unintentional detonation EZ for essential personnel*** is K40 (55 ft).



8. OFF-SITE DISPOSAL

Off-site disposal of recovered munitions (with the exception of small arms ammunition) is not a viable option since munitions recovered at Mare Island have been subjected to unknown environmental conditions for many years and cannot be considered safe to transport over public highways. No munitions of a size or type that would preclude on-site treatment are anticipated to be encountered at the site.



9. ENVIRONMENTAL CONSIDERATIONS

There are environmental considerations involved with the confirmation survey; largely with the DP 7S bottom area classified as potential habitat for the endangered Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*). However, since the proposed survey will be performed only along 100 foot grid lines and since dredge pond bottoms typically have contained little (if any) anomalies, no significant impact on the wetlands is expected. Surveys will be performed by handheld survey instruments and any detected anomalies will be investigated using hand tools wherever possible. Should the use of heavy equipment be required, additional consultation with regulatory agencies will be required to minimize impact on native endangered species.

The IR05 site also contains limited wetland areas (located primarily within the red “Detonation/Burn Area” of Figure 2-3). Impact abatement measures similar to those described above for the DP 7S bottom will be implemented for the IR05 areas. An environmental briefing will be provided to all site workers, and they will be instructed to avoid the wetland areas whenever possible, and to minimize impact on the areas when entry is required.

The MEC storage facility (Building A180) and the MEC treatment facility (Disposal Range #2) will be operated in accordance with the requirements of the *Engineering Evaluation/Cost Analysis and Removal Action Workplan (EECA/RAW) for the Operation of Mare Island Ordnance Storage and Treatment Facilities* (Weston, 2004). Approval of the EECA/RAW document in 2004 constituted approval by State and Federal regulatory agencies (in lieu of the RCRA Part A/B permitting process) to continue use of the established MEC storage and treatment facilities until all MEC actions on Mare Island have been completed.



10. TECHNICAL SUPPORT

The evaluation and handling of suspected munitions items will be performed by Weston Solutions, Inc. UXO Technicians qualified at the USACE Tech II or Tech III level. Additional emergency support from military EOD personnel based at Travis Air Force Base is available, via the Vallejo Police Department, should it be required. Note that, although a formal Memorandum of Understanding with the Air Force for responses to Mare Island is not in effect, established EOD policy is to respond to requests from municipal emergency services agencies when military munitions are involved. This process was successfully implemented in at least two recent instances when unexpected MEC items were encountered by contractors on Mare Island.



11. LAND USE RESTRICTIONS

The site is currently still under Navy control. Once all required actions have been completed to facilitate transfer of the property, restrictions appropriate for the MEC-related history of the site will be developed and implemented during the Record of Decision phase of the CERCLA process. Although no engineering controls are anticipated, institutional controls similar to those implemented for the adjoining Western Early Transfer Area may be required by regulatory agencies and may include the following:

- Deed restrictions limiting allowable reuse of the property (property is currently slated for recreational and wildlife preserve reuses)
- Restriction on excavations unless approved by regulatory agencies and performed with UXO support
- Informational signage to educate the public on the munitions hazard and to instruct them on the steps to follow should they encounter a suspected munitions item
- Periodic long-term monitoring of the site will be implemented to minimize the chance of any remaining munitions being encountered by the public



12. PUBLIC INVOLVEMENT

Public involvement has been maintained throughout all munitions response actions performed at Mare Island. Preliminary discussions concerning the planned confirmation survey with regulatory agency representatives and members of the Mare Island Restoration Advisory Board (RAB) have generated a favorable response. The public information process, following the CERCLA framework, may include:

- A presentation of planned actions and subsequent updates during monthly RAB meetings
- A public notice published in local newspapers for the remedial actions, when appropriate
- A fact sheet mailed to local concerned citizens and organizations for decision documents, when appropriate



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