FINAL
May 3, 2013

Preliminary Assessment Report for Naval Defensive Sea Area

Unalaska Island
Alaska

Department of the Navy
Naval Facilities Engineering Command Northwest
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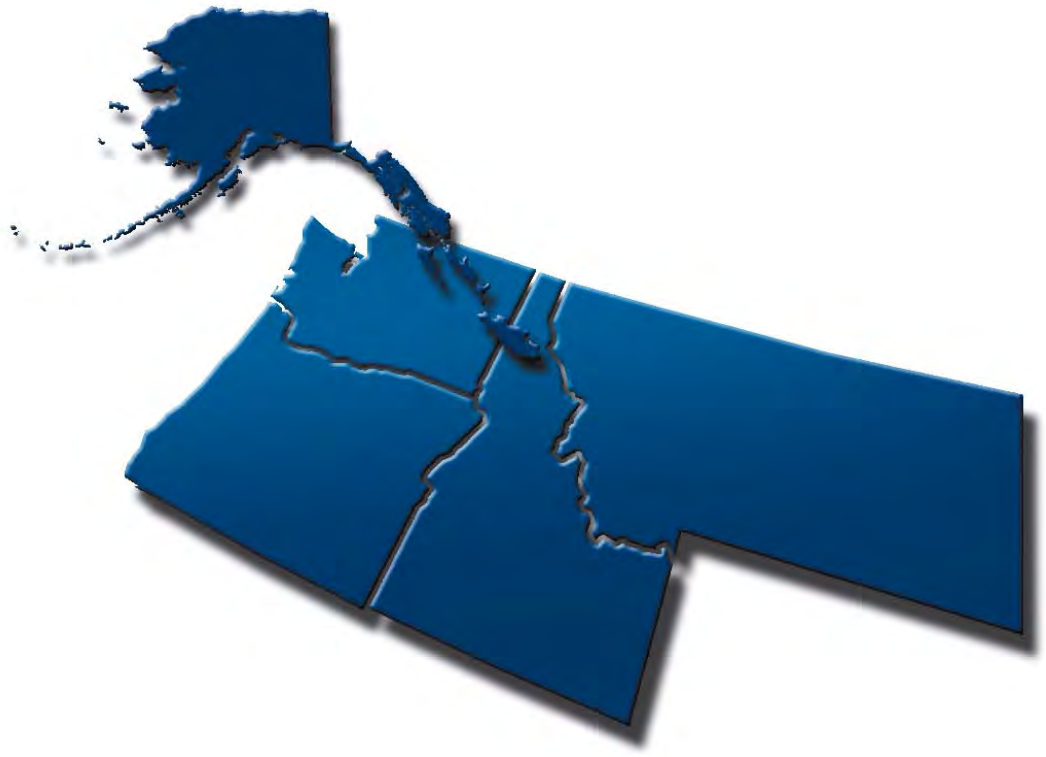
Silverdale, WA 98315



FINAL
PRELIMINARY ASSESSMENT REPORT FOR NAVAL DEFENSIVE SEA AREA

UNALASKA ISLAND
ALASKA

Naval Facilities Engineering Command Northwest
Silverdale, Washington

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DOCUMENT IDENTIFICATION

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Report Coverage:	This document presents the results of a preliminary assessment conducted to evaluate the possible presence of munitions and explosives of concern in the marine environment within the Naval Defensive Sea Area at Unalaska Island resulting from training exercises and ordnance handling activities between 1940 and 1950.
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PLATE

ABBREVIATIONS AND ACRONYMS

AA	antiaircraft
AATC	antiaircraft training center
AMNWR	Alaskan Maritime National Wildlife Refuge
AMTB	antimotor-torpedo boat
CDA	coastal defense artillery
DMM	discarded military munitions
HMX	cyclotetramethylene tetranitramine
km	kilometer
MC	munitions constituent
MEC	munitions and explosives of concern
mm	millimeter
MRP	Munitions Response Program
NAF	Naval Air Facility
NAS	Naval Air Station
NARA	National Archives and Records Administration
NDSA	Naval Defensive Sea Area
NOB	Naval Operating Base
PA	preliminary assessment
RDX	cyclotrimethylene trinitramine
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
U.S.A.T.	U.S. Army Transport
UXO	unexploded ordnance

1.0 INTRODUCTION

The U.S. Navy established a significant presence in the Unalaska-Dutch Harbor area during the World War II era, from approximately 1940 through 1944. Prior to World War II, the Navy established a communications facility (in 1911) and weather station (in 1939) in the Dutch Harbor area. Construction of military facilities began in July of 1940 and continued through 1944. A Naval Section Base, the Naval Air Station (NAS), and Fort Mears, all located in the Dutch Harbor area, were commissioned in 1941. The Japanese bombed the military facilities at Dutch Harbor on June 3 and 4, 1942. After the Japanese attacked in June 1942, the rate of construction increased and on January 1, 1943, the Dutch Harbor Naval Operating Base (NOB) was commissioned. As part of the defensive operations, the military maintained several coastal defense artillery (CDA) guns, antiaircraft (AA) guns, and air defense squadrons. The military performed target practice at a minimum of one in-water range and handled ordnance over water at several locations in the Dutch Harbor and Chernofski Harbor areas. As World War II ended, all military activity decreased at Dutch Harbor, and the NOB was decommissioned in 1947.

The Naval Defensive Sea Area (NDSA) at Unalaska Island was established on March 22, 1941 by Executive Order 8680, included as Appendix A. A NDSA is a water area set aside by executive order of the President of the United States because of its strategic nature, or for purposes of defense. The NDSA at Unalaska Island includes the territorial waters between the extreme high-water marks and the 3-mile marine boundaries.

According to 32 CFR Part 761, Subpart A §761.3 (a), there are three NDSAs in Alaska that are under the control of the Secretary of the Navy: Kiska Island, Kodiak Island, and Unalaska Island. The Navy addresses in-water ranges at the NDSA for Unalaska Island in this preliminary assessment (PA) report. The Navy addresses the NDSAs for Kiska and Kodiak Islands in separate preliminary assessment reports. The Navy is not addressing any other area in Alaska with coastal defense artillery.

The Navy's Munitions Response Program (MRP) was established because the National Defense Authorization Act of 2000 required the Department of Defense to establish a program that addresses the potential explosives safety, health, and environmental issues caused by munitions and explosives of concern (MEC) and munitions constituents (MC) used or released at sites during past operations and activities. Because there is a potential for MEC in the NDSA at Unalaska Island, the Navy initiated a PA of this NDSA.

Previous environmental and ordnance investigations conducted in similar water bodies have identified the potential for waters of NDSAs to be contaminated with MEC. Activities that may have resulted in MEC contamination included practice firing of CDA and AA guns at fixed and towed targets; aerial gunnery firing practice at surface targets; aerial bombing practice at fixed targets; ordnance lost overboard during handling activities; and in-water ordnance disposal.

1.1 PURPOSE

The purpose of a PA is to differentiate sites that pose little or no potential threat to human health and the environment from sites that warrant further investigation (USEPA 1991). The Navy completed this PA report to evaluate the potential for releases that may pose a potential threat to human health or the environment as a result of historical operations at in-water ranges and other areas suspected of containing MEC within the NDSA at Unalaska Island. The findings in the PA report were used to make recommendations for further action at the NDSA.

1.2 PROJECT SCOPE

The scope of this project consisted of reviewing records and preparing the related PA report. The records review includes an extensive search for information regarding historical operations of in-water practice ranges and ordnance handling points located within the NDSA at Unalaska Island. The PA report includes a summary of information assembled during a review of pertinent books, reports, public and private historical records, web sites, and aerial photographs. Interviews were conducted with individuals knowledgeable of MEC finds or historical ordnance activities.

This PA is based on a review of records located at facilities in the Seattle, Anchorage, and Washington, D.C. areas. Records that might exist at the Museum of the Aleutians on Unalaska Island and at the Kodiak Military History Museum located in Kodiak, Alaska were not included.

The records review included information held by the following agencies or facilities:

- U.S. Army Corps of Engineers (USACE), Alaska District
- National Archives and Records Administration (NARA) II, College Park, Maryland
- NARA, Regional Branch, Seattle, Washington
- NARA, Regional Branch, Anchorage, Alaska
- Naval History and Heritage Command, Washington Navy Yard, Washington, D.C.
- Navy Department Library, Washington Navy Yard, Washington, D.C.
- 3rd Wing U.S. Air Force History Office, Anchorage, Alaska
- Anchorage Museum, Atwood Resource Center, Anchorage, Alaska
- University of Alaska Anchorage Consortium Library, Anchorage, Alaska
- Z.J. Loussac Library—Main Branch, Anchorage, Alaska

2.0 SITE BACKGROUND

2.1 SITE LOCATION AND SETTING

Unalaska Island, located approximately 825 miles southwest from Anchorage, is the second-largest island of the Fox Island group of the Aleutian Islands. The Fox Islands are the closest of the Aleutian Islands to mainland North America and are situated east of Samalga Pass. The larger of the Fox Islands from west to east are Umnak, Unalaska, Akutan, Akun, Unimak, and Sanak. Unalaska Island is approximately 79 miles (127 km) long and 35 miles (56 km) wide. It is located at 53° 38′ north latitude, 167° 00′ west longitude. The island has an area of approximately 1,051 square miles (2,720 square km). The coastline of Unalaska Island is markedly different in appearance than other major Aleutian Islands, with innumerable inlets and peninsulas. The coastline is broken by three long, deep bays, Unalaska Bay, Beaver Inlet, and Makushin Bay. Figure 2-1 shows the location of Unalaska Island and the relative position of the remaining Fox Islands.

Unalaska Island is situated at a convergent boundary between two tectonic plates that make up the Earth's crust. The more southern or Pacific Plate is being subducted under the more northern North American plate. This results in an area that is spotted with active and/or dormant volcanos and is very earthquake prone. Earthquakes with magnitudes greater than 6 on the Richter scale are common. The Island's terrain is rugged and mountainous, and during much of the year the higher elevations are snow covered.

The City of Unalaska is located on Unalaska Island and the smaller Amaknak Island is located within Unalaska Bay. Almost all of the community's port facilities, better known as Dutch Harbor, are located on Amaknak Island. It is the largest fisheries port in the United States by volume caught. Dutch Harbor was named by the early Russian inhabitants because they believed that a Dutch vessel was the first European ship to enter the harbor.

2.2 SITE DESCRIPTION

Military installations in the vicinity of Unalaska Island consisted of the Naval Operating Base (NOB) Dutch Harbor and Army facilities required for harbor protection and support (Fort Mears). By the time it was completed in 1944, NOB Dutch Harbor contained housing capacity for 281 officers and 5,444 enlisted men. Fort Mears reached its peak capacity on October 20, 1942, with 9,976 troops listed on that morning report (Cohen 1988). Other military facilities near the west end of Unalaska Island included air defense (Fort Glenn) and CDA batteries to protect the harbor, Chernofski Harbor, and Naval Air Facility (NAF) Otter Point (ONH 1945).

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure2-1 Location Unalaska.mxd

U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	0 10 20 Scale In Miles	**Figure 2-1** **Location of Unalaska Island, Alaska**

Because no level ground was available on Unalaska Island for an airfield, Fort Glenn Army Air Field was constructed at Otter Point on the northeast end of Umnak Island (USACE 1993). To support Fort Glenn, Chernofski Harbor, situated at the west end of Unalaska Island, was developed as a section base for offloading supplies and equipment. The Navy established Naval Air Facility (NAF) Otter Point (ONH 1945) at the same time as Fort Glenn was constructed. All materials destined for Fort Glenn and NAF Otter Point were transferred from seagoing transports to barges at Chernofski Harbor for transfer to Otter Point.

The study area for this PA consists of the known in-water range areas established for target firing of the costal artillery and AA batteries installed on Unalaska Island, on-water ordnance handling locations, and documented ordnance disposal areas within the 3-mile limit of the Unalaska NDSA. Figure 2-2 shows the extent of the NDSA surrounding Unalaska Island.

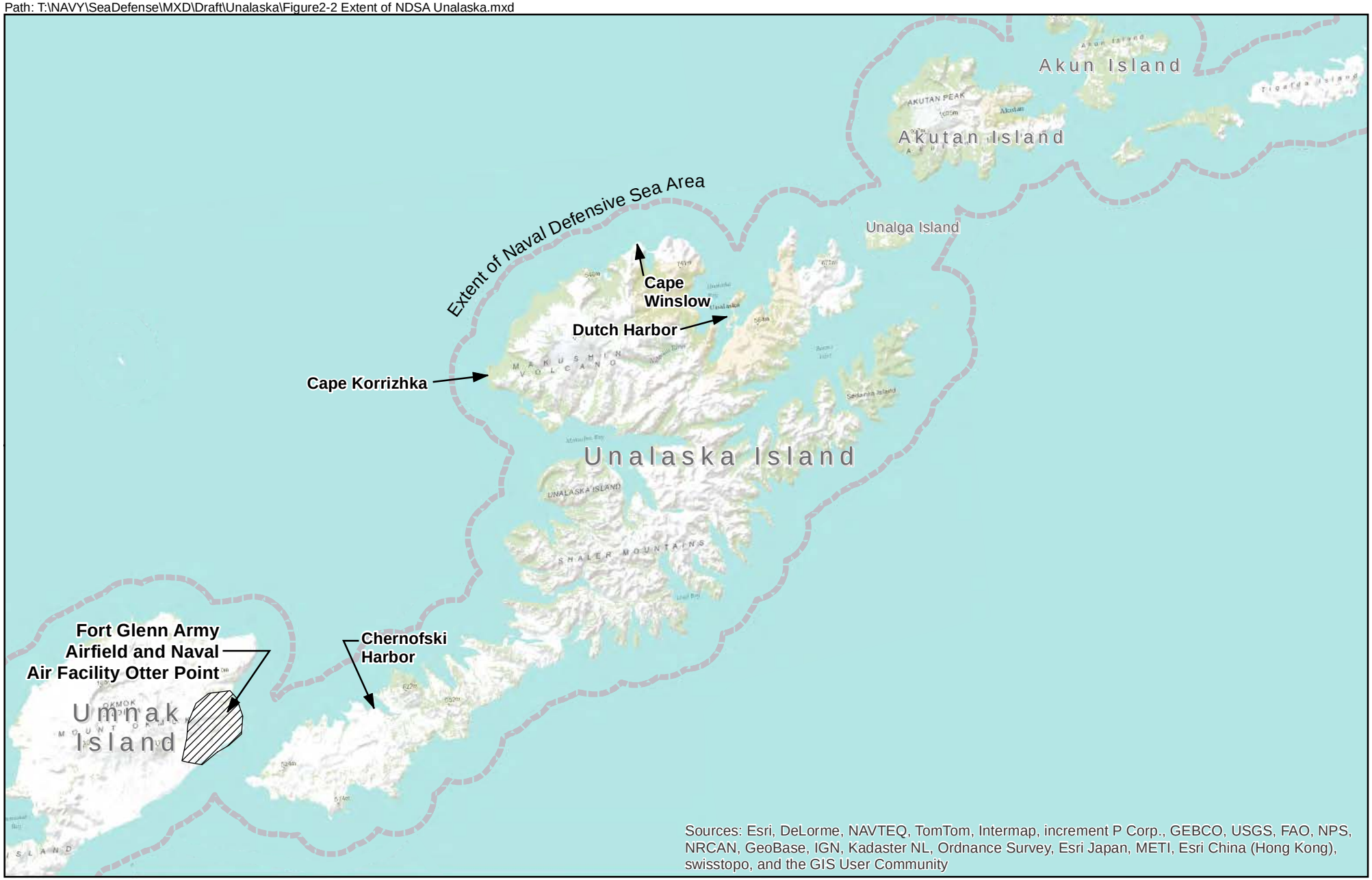
2.3 SITE OWNERSHIP HISTORY

The United States purchased Alaska, which includes the Aleutians, from Russia in 1867. The Aleut or Unangan people lived on Unalaska Island for thousands of years before their first contact with the Russian fur traders who documented their existence. From the perspective of the coastally adapted Aleuts and the length and complexity of Unalaska Island's coastline, it was likely the most populous of any Aleutian Island prior to European contact (Alaska Geographic Society 1991). By 1774, Unalaska was permanently established as a Russian trading post. During Russian ownership, Dutch Harbor was an important coaling station and supply point for naval vessels of the Bering Sea fleet and for whalers and sealers (Cohen 1981). On October 18, 1867, the United States purchased Alaska, making Unalaska U.S. territory. Between 1897 and 1905, the Klondike and Nome gold rushes brought many ships through Dutch Harbor, which was an important stopover for shipping to and from Seattle and St. Michaels near the mouth of the Yukon River (Cohen 1981).

In 1940 the Navy purchased 127 acres of Dutch Harbor from the Northern Commercial Company. Executive Order 9153-A, dated April 30, 1942, withdrew 348,110 acres of public land on Unalaska Island and the eastern portion of Umnak Island for use by the War Department for military purposes. The Army relinquished all its holdings on Unalaska Island between May 1951 and June 1959. By July 29, 1961, the Navy had relinquished all its holdings on Unalaska Island (USACE 1993).

In 1971, the United States granted the Aleuts lands and money under the Native land-claims settlement. At Unalaska, the Aleuts formed the Ounalashka Native Corporation, which holds title to nearly all the private land on Unalaska Island and nearly all of Amaknak Island and its former military structures (Faulkner and Thompson 1986). Today the City of Unalaska, which

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure2-2 Extent of NDSA Unalaska.mxd



U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	N 0 6.5 13 Scale In Miles	**Figure 2-2** **Extent of the Naval Defensive Sea Area Surrounding Unalaska Island**

includes all of Amaknak Island, is the most populated of all the communities in Southwest Alaska (4,283 persons [2000 census]). The Port of Dutch Harbor is the number one fishing port in the country. Some of the people who live in the Dutch Harbor area dive in the surrounding marine waters.

2.4 SITE OPERATIONS AND WASTE CHARACTERISTICS

Prior to World War II, the Navy established a communications facility (in 1911) and weather station (in 1939) in the Dutch Harbor area (USACE 1993). Construction of military facilities began in July of 1940 and continued through 1944. In October 1940, a naval medical detachment and a detachment of the Marines to guard the naval installations arrived, occupying a new barracks on Amaknak Island. The Naval Section Base at Dutch Harbor was commissioned in January 1941. The first Army troops arrived at Dutch Harbor on May 8, 1941, replacing the Marines. These troops moved into the Marine barracks on Amaknak Island. Fort Mears was commissioned on August 28, 1941. The Naval Air Station (NAS) Dutch Harbor was commissioned on September 1, 1941 (Faulkner and Thompson 1986). After the Japanese attacked in June 1942, the rate of construction increased such that on January 1, 1943, the Dutch Harbor NOB was commissioned (Alaska Geographic Society 1991).

At its largest expanse, NOB Dutch Harbor's components included a NAS, a submarine base, a Marine barracks, radio station, section base, 200-bed hospital, 250-ton marine railroad, 3,000-ton floating dry dock, ammunition storage facilities, seven separate docks, ship repair shops, net depot, antiaircraft training center (AATC), and facility for provisioning fleet units (Cohen 1988). During Lend-Lease activities (the system organized by the US in 1941 by which equipment and services were provided for countries fighting Germany), Soviet ship traffic through Dutch Harbor increased substantially. Eastbound Soviet ships were required to enter the harbor to pick up recognition signals, received fuel, and underwent any necessary repairs (Faulkner and Thompson 1986). To reduce ship congestion within Dutch Harbor, the Navy converted a civilian whaling station on Akutan Island into a separate refueling, repair, and provisioning station (USACE 1993). Soviet ships put into this station until it was decommissioned in April 1945.

Army-manned CDA gun and AA gun batteries were established at Unalaska. These were established at Eider Point (Fort Leonard), Ulakta Head (Fort Schwatka), Amaknak Spit (also Fort Schwatka), Summer Bay (Fort Brumback), and Hill 400 (Bunker Hill). Additional land defenses, called the Iron Ring, were constructed along the ridges and peaks from Captains Bay to Summer Bay. AA batteries were also installed at Ugadaga Bay on Beaver Inlet, Raven Pass (location could not be identified), and at the west end of the runway at Dutch Harbor (Faulkner and Thompson 1986).

In August 1942 the Army agreed to turn the Fort Mears facility located on Amaknak Island over to the Navy, and the Navy agreed to have the Navy Construction Battalion, better known as the Seabees, construct new Army facilities on Unalaska Island. Construction took time, and the last Army unit left Amaknak Island in March 1944. The new encampment was on the south slope of Unalaska Ridge in Unalaska Valley. The post contained command buildings and housing and mess facilities for officers and enlisted men. In addition, the Army constructed a 500-bed hospital in Pyramid Valley and a 470-foot-long dock, warehouses, sheds, and storage areas at Captains Bay. This reflected Unalaska's changing role during 1943 as a troop training area and supply base for installations farther west (Faulkner and Thompson 1986).

Chernofski Harbor Supply and Storage Site was established in early 1942 and encompassed the western 2 miles of Unalaska Island. It was located approximately 53 miles southwest of Dutch Harbor and 15 miles by boat from Otter Point on Unmak Island. In July 1942, the Navy moved a ship that provides facilities for seaplanes into Chernofski Harbor and stationed a seaplane squadron from Patrol Wing Four there. At the same time, other units of Patrol Wing Four began operating from Otter Point. On September 5, 1942, Naval Operations approved construction of NAF Otter Point and Naval Section Base at Chernofski Harbor. NAF Otter Point was commissioned on October 22, 1942, with Chernofski as an auxiliary unit. In December, Fleet Air Wing Four moved its headquarters squadron to Otter Point from Dutch Harbor (ONH 1945).

Chernofski Harbor was established as the transshipment facility for supplies and material destined for Otter Point. Cargo ships offloaded at Chernofski Harbor, and barges then carried the supplies to a dock at Pustoi Point on Unmak Island. Initially the harbor had no facilities, and supplies were unloaded directly onto barges and transferred to Otter Point. Barges made an average of 150 round trips per month. Eventually Chernofski harbor included 50 Quonset huts, three wood-frame buildings, a main pier that measured 72 by 402 feet, three barge docks, a separate repair dock, and two 6-inch guns for defense (Faulkner and Thompson 1986). Three barge docks and a tanker discharge facility were constructed at Otter Point (Cohen 1988). Three additional CDA gun batteries were installed at Fort Glenn (Coast Defense Office).

As World War II ended, military activity decreased at NAF Otter Point and Dutch Harbor. The NAF Otter Point was disestablished on November 1, 1944. All naval facilities at Chernofski Harbor were decommissioned in May 1945 (ONH 1945). By August 1944, the Army placed Fort Mears into caretaker status. The submarine facility was decommissioned in May 1945, and the NAS was reduced to a NAF in June. The last Navy personnel left Dutch Harbor in 1947, and the NOB was decommissioned at that time (Faulkner and Thompson 1986).

2.4.1 Historical Waste Management Practices

The primary waste of concern for this investigation is MEC and munitions constituents (MCs) (chemical aspects) within the marine environment of the NDSA surrounding Unalaska Island. MEC includes unexploded ordnance (UXO), discarded military munitions (DMM), and MCs in

high enough concentrations as to present an explosive hazard. The use and handling of ordnance and the Japanese attack on two consecutive days at Unalaska resulted in waste entering the marine NDSA by the following mechanisms:

- Ordnance fired over water from CDA and AA gun batteries during target training and gun function testing that did not detonate as intended
- Ordnance lost into the water during transfer from transport ships to the shore, either at a fixed dock or at an explosive anchorage situated in the harbor away from shore installations
- Excess ordnance deliberately disposed of (referred to as DMM) into the marine environment at the conclusion of hostilities
- In the case of Dutch Harbor, ordnance deliberately dropped or fired by Japanese forces during the June 1942 attacks that did not detonate as intended

Ordnance that was fired or dropped and did not detonate as intended is known as UXO. An unknown quantity of MEC, including UXO and DMM, was lost, discarded, or fired into the marine environment of the NDSA surrounding Unalaska Island during World War II. As much as 30 percent of the ordnance that was dropped or fired during World War II did not detonate as intended (Francis and Alama 2011).

USACE evaluated Unalaska Island under the Formerly Used Defense Sites program and presented the findings in an archive search report of findings (USACE 1993). The evaluation applied to the on-land hazards of potential ordnance and chemical warfare material. The in-water ranges in the NDSA were not evaluated.

2.4.2 Regulatory Compliance

The National Defense Authorization Act of 2000 required the Department of Defense to establish a program addressing military munitions as part of the Defense Environmental Restoration Program. The Navy's Munitions Response Program (MRP) complies with this requirement. The purpose of the MRP is to address the potential explosives safety, health, and environmental issues caused by MEC and MCs used or released on sites from past operations and activities. Based on Navy MRP policy (U.S. Navy 2007), the following criteria are used for inclusion of water sites in the MRP:

> Shallow water areas where munitions releases are known or suspected to have occurred prior to September 30, 2002, where Navy actions were responsible for the release, and where the site is not:

- Covered by water deeper than 20 fathoms (120 feet)
- Part of, or associated with, a designated operational range
- A designated water disposal site
- A Formerly Used Defense Site
- A result of combat operations
- A maritime wreck
- An artificial reef

2.5 SOURCE CHARACTERIZATION

The sources of MEC released into the marine environment at NOB Dutch Harbor and the surrounding facilities by U.S. forces consist of CDA and AA gun batteries, supply transfer points, and air combat units of the Empire of Japan.

Detailed records of training exercises, which are part of the operational records, were not required to be retained for the historical archives (Knechtmann 2012). Therefore, details of training exercises typically do not exist in the archived records. In rare instances, training exercise records may exist in the archive record if they were provided by a private individual (Knechtmann 2012).

2.5.1 Source Descriptions

Information reviewed for this PA report identified U.S. CDA and AA gun batteries in the vicinity of Unalaska Island (USACE 1993, NARA II, NARA Anchorage, and NARA Seattle). The following U.S. CDA and AA gun batteries were identified in the vicinity of Unalaska Bay and Dutch Harbor:

- Battery No. 1 located at Summer Bay, Fort Brumback:
  - Four-gun 155-mm CDA battery
  - four .50-caliber AA machine guns

- Battery No. 1a located on Amaknak Spit, Fort Schwatka:
  - Four-gun 90-mm antimotor-torpedo boat (AMTB) battery
  - Two-gun 37- or 40-mm AA battery
  - Eight .50-caliber AA machine guns

- Battery No. 2 located at Hill 400:
  - Four-gun 155-mm CDA battery
  - Four .50-caliber AA machine guns

- Battery No. 3 located on Ulakta Head, Fort Schwatka:
  - Two-gun 8-inch CDA battery (402)
  - Two-gun 37- or 40-mm AA battery
  - Two .50-caliber AA machine guns

- Battery No. 3a located on Eider Point, Fort Leonard:
  - Two-gun 90-mm AMTB battery
  - Two-gun 37- or 40-mm AA battery
  - Eight .50-caliber AA machine guns

- Battery No. 4 located at Eider Point, Fort Leonard:
  - Two-gun 6-inch CDA battery (298)
  - Two-gun 37- or 40-mm AA battery
  - Two .50-caliber AA machine guns

- An illustrated photo of the Dutch Harbor area dated May 25, 1942 identified the following additional AA gun batteries located in various temporary positions at NOB Dutch Harbor:
  - Twelve 3-inch AA guns
  - Nineteen 37-mm AA guns
  - Twenty-two 20-mm AA guns

- Coastal searchlight installations with two .30-caliber machine guns at each light were operated at various locations along the shoreline.

- The Army also maintained an Air Defense Site on Hog Island for the defense of a Radio Range Installation (USACE 1993). However, the presence and locations of guns on Hog Island are not clear.

Known locations of the U.S. gun batteries and searchlights in the vicinity of Unalaska Bay are shown on Figure 2-3. Temporary AA gun batteries are not shown in the figure because they were not stationary.

The following U.S. CDA and AA gun batteries were identified in the vicinity of Otter Point and Chernofski Harbor:

- Two 6-inch naval CDA guns at Chernofski Harbor, Unalaska Island

- One 6-inch naval CDA gun at Otter Point, Umnak Island

- Four 155-mm CDA guns at Cape Idak, Umnak Island
- Four 155-mm CDA guns at Umnak Pass, Umnak Island
- Coastal searchlight installations with two .30-caliber machine guns at each light were operated at various locations along the shoreline.

Known locations of the U.S. gun batteries and searchlights in the vicinity of Otter Point and Chernofski Harbor are shown on Figure 2-4.

The following additional AA batteries and large caliber guns were also identified at the Chernofski Harbor Otter Point area (DIO 1943):

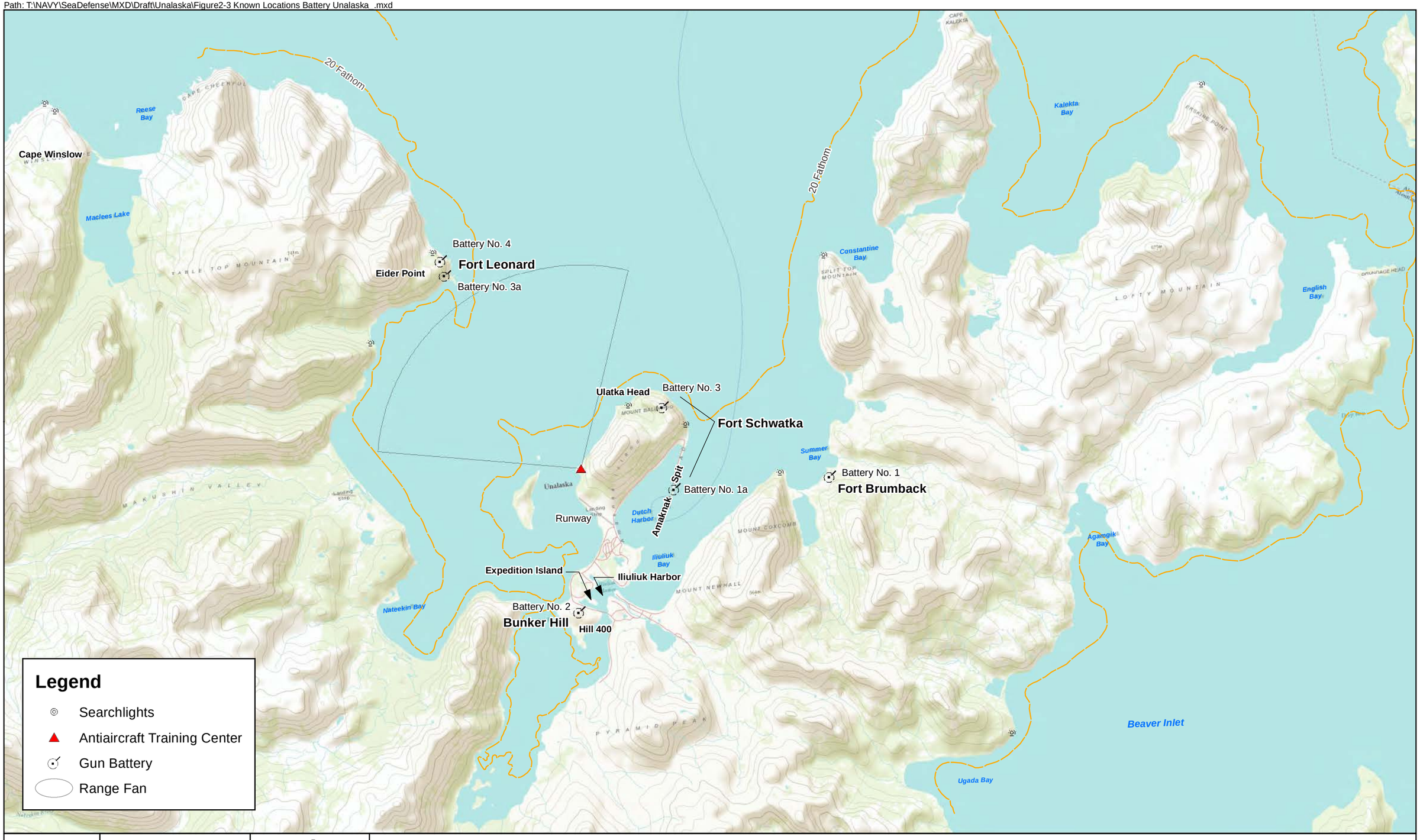
- Forty 20-mm Navy AA guns
- Twelve 105-mm howitzers
- Sixteen 3-inch AA guns
- Thirty-two 37-mm AA guns
- Thirty-two .50-caliber AA machine guns
- Eighteen 60-mm mortars
- Twelve 81-mm mortars

The locations of these guns could not be determined from the available information.

The Unalaska NOB also contained an AATC where active firing was conducted using an unspecified number of .30-caliber machine guns, two .50-caliber machine guns, five 20-mm AA guns, and one 40-mm AA gun. It was located at the northwest base of Mount Ballyhoo on Amaknak Island. The facility was sized to handle 60 men a day, 30 men in the morning and 30 in the afternoon. Firing was directed into Unalaska Bay with a presumed 100-degree danger area extending 6,000 yards seaward. The location of this AATC and the presumed danger area (range fan) is shown on Figure 2-3.

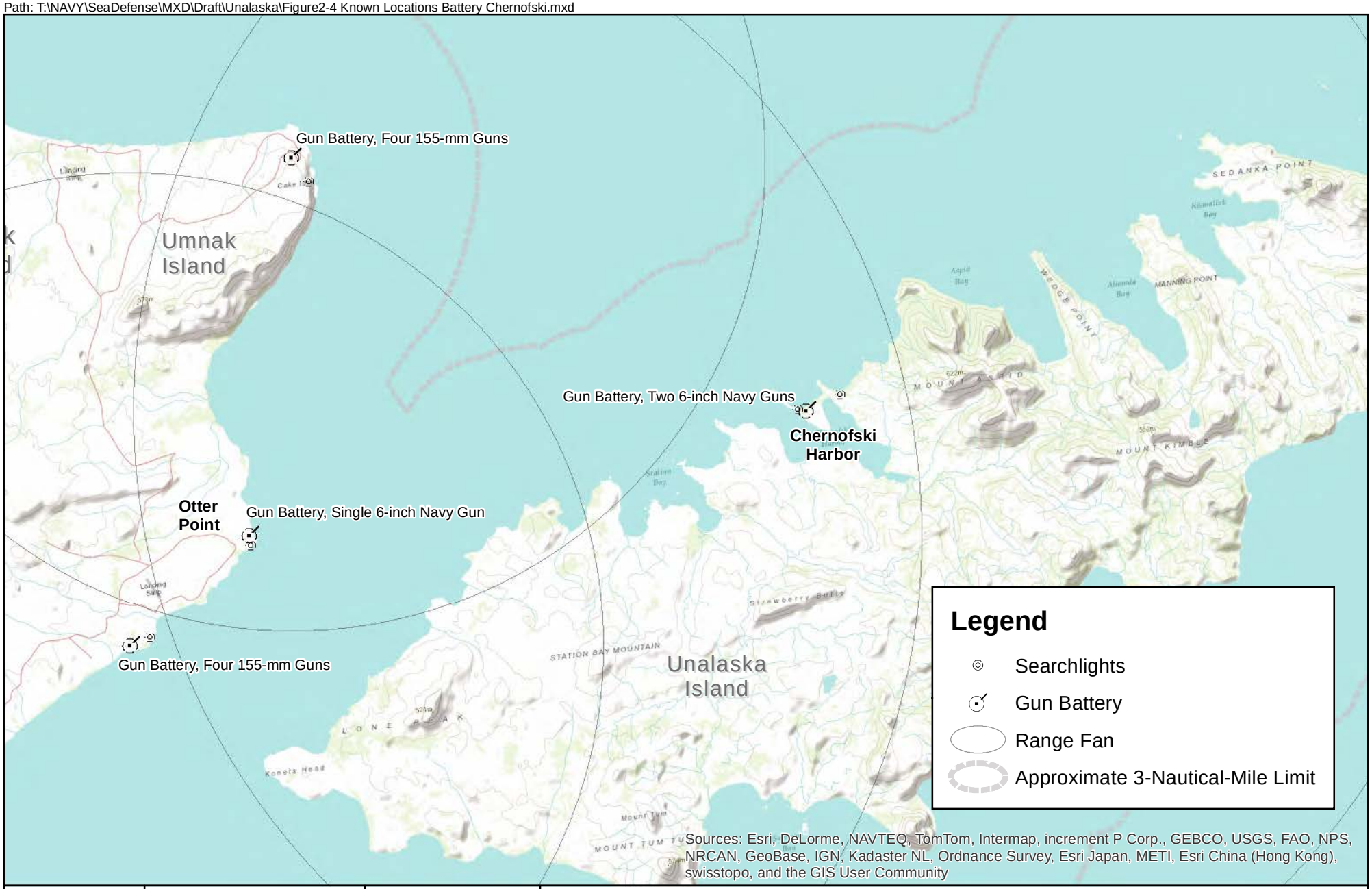
Naval ammunition activities at NOB Dutch Harbor consisted of support of submarine and seaplane operations, supply for AA air defense and the AATC, and temporary storage of ammunition during transit shipment to more forward bases, or resupply for Navy ships. In-transit ammunition storage was located in the vicinity of the dock in Captains Bay, with additional storage facilities near Mount Ballyhoo. Magazines associated with the seaplane base were also used for in-transit storage. Navy ammunition facilities were about 90 percent full at all times (USACE 2003).

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure2-3 Known Locations Battery Unalaska_.mxd



U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska		**Figure 2-3** **Known Locations of U.S. Gun Batteries, Searchlights and an Antiaircraft Training Center in the Vicinity of Dutch Harbor, Unalaska Island**

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure2-4 Known Locations Battery Chernofski.mxd



U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	0 1.5 3 Scale In Miles	**Figure 2-4** **Known Locations of U.S. Gun Batteries and Searchlights in the Vicinity of Otter Point, Umnak Island and Chernofski Harbor, Unalaska Island**

Army ammunition activities consisted of those required to support the CDA gun batteries and associated Air Defense Operations at Fort Glenn discussed above. Ordnance was dispersed to the individual batteries and stored locally in magazines (USACE 2003). All ordnance provided to Fort Glenn was transshipped through Chernofski Harbor. Ordnance was typically dispersed to gun batteries in the Dutch Harbor area by truck. However, because of a lack of roads, ordnance provided to Eider Point, Hog Island, and perhaps Summer Bay was transferred by barge. No records were located during the development of this PA that indicate the presence of an explosive anchorage in Dutch Harbor, Captains Bay, Unalaska Bay, or Chernofski Harbor. This suggests that ordnance was offloaded or transshipped at fixed docks at NOB Dutch Harbor and Chernofski Harbor.

The locations of known docks in the Dutch Harbor area are shown on Figure 2-5. The Navy-operated docks include the Dolphin Spit Dock, possibly an unnamed small dock south of the Dolphin Spit Dock, Advance Base Depot Dock, Ballyhoo Dock, Dutch Harbor Dock, Fuel Oil Dock, Y.P. Dock, docks at the submarine base, Marine Railway Dock, P.T. Dock, and Net Depot Dock. The Army-operated docks include the Summer Bay Dock, Unalaska Dock, Captains Bay Dock, Hog Island Dock, the main Eider Point Dock, the unnamed small dock at Eider Point, and several small docks at the Agnes Beach Facility.

The locations of known docks in the Chernofski Harbor and Otter Point area are shown on Figure 2-6. Chernofski Harbor included a main pier that measured 72 by 402 feet, three barge docks, and a separate repair dock; however, the locations of four of these docks could be identified in Figure 2-6. Three barge docks were also constructed at Otter Point (Fort Glenn) at the following locations:

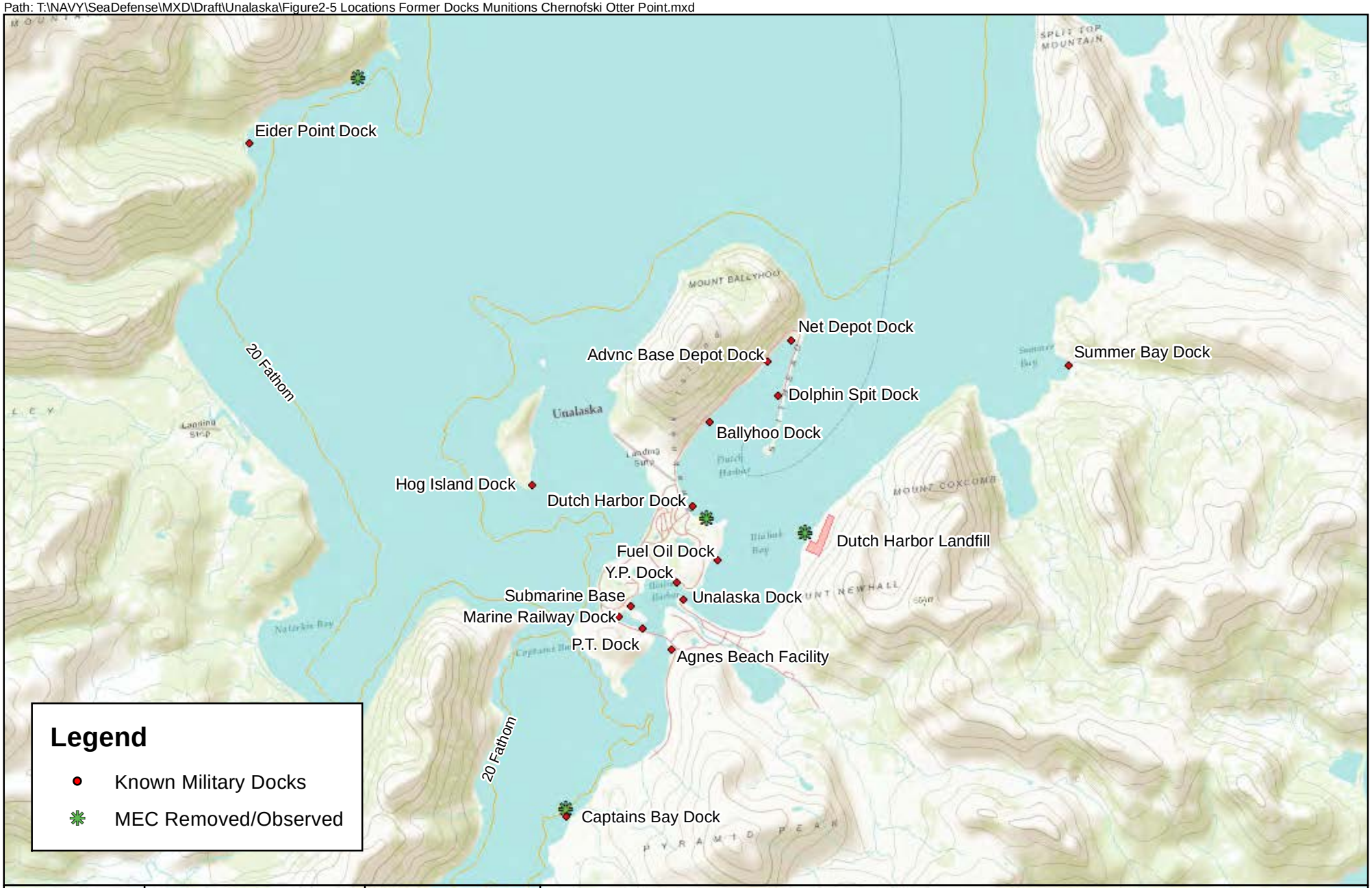
- North Dock: 53°23'46" north latitude by 167°50'30" west longitude
- Middle Dock: 53°23'42" north latitude by 167°50'37" west longitude
- South Dock: 53°23'40" north latitude by 167° 50'36" west longitude

Occasionally DMM was lost into the harbors during ordnance-handling activities. No record was found documenting the loss or recovery of MEC from the marine environment at these locations during this investigation.

2.5.2 Historical Aerial Photo Evaluation

Aero-Data Corporation in Baton Rouge, Louisiana, performed an interpretation of aerial photography of selected areas of the Unalaska Island NDSA to assist in the evaluation of the in-water ranges. Their results of the aerial photography evaluations of these areas are included as Appendix B. The time period of concern included the World War II era and post-war era. Aero-Data acquired aerial imagery, satellite imagery, maps, and oblique

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure2-5 Locations Former Docks Munitions Chernofski Otter Point.mxd



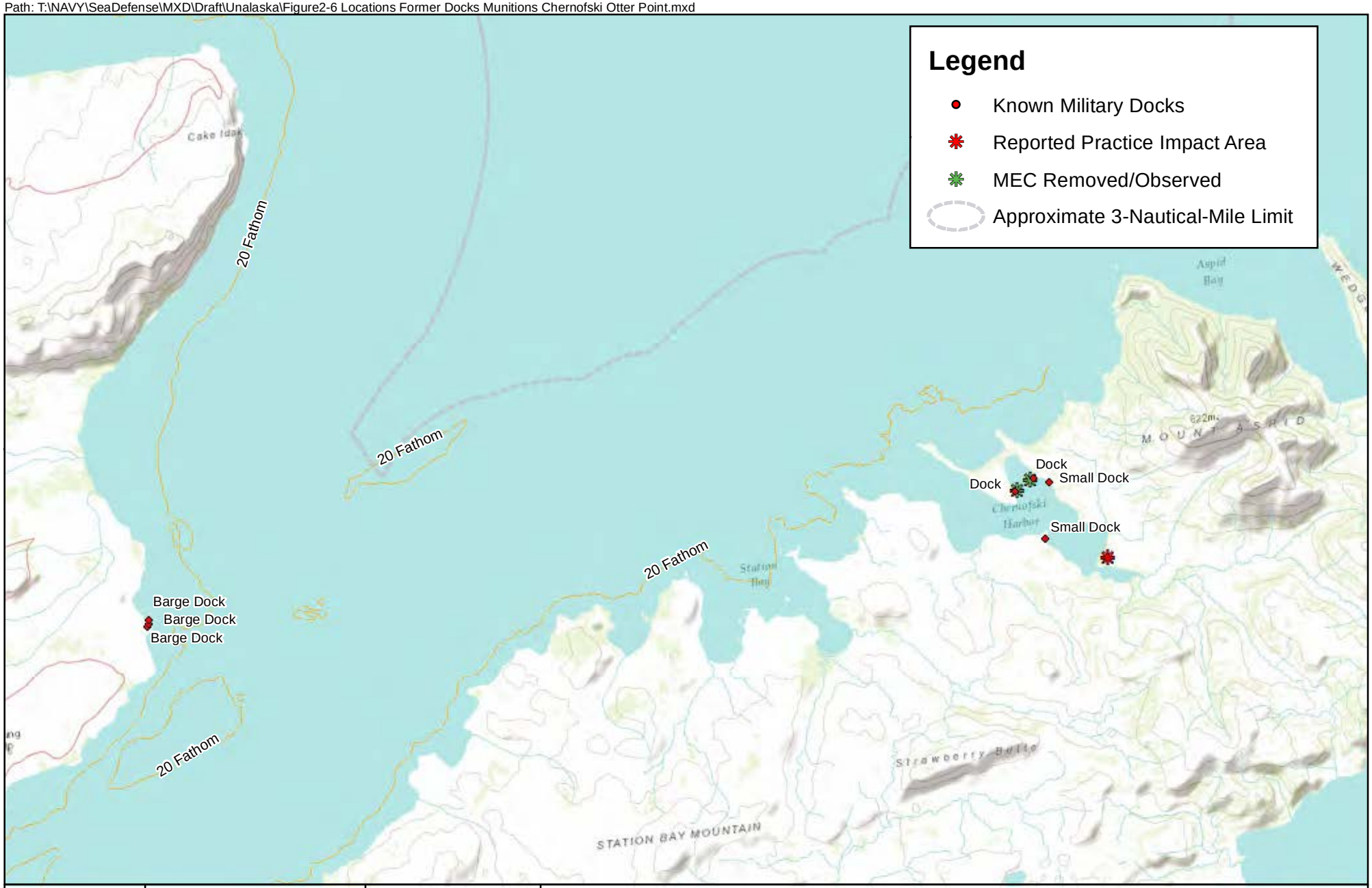
U.S. NAVY

Delivery Order 0040
Naval Defensive
Sea Area
Unalaska Island, Alaska

0 0.625 1.25
Scale In Miles

Figure 2-5
Locations of Former Military Docks and Discarded Military Munitions on the Seafloor in the Vicinity of Dutch Harbor, Unalaska Island

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure2-6 Locations Former Docks Munitions Chernofski Otter Point.mxd



U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	N 0 1 2 Scale In Miles	**Figure 2-6** **Locations of Former Military Docks and Discarded Military Munitions on the Seafloor in the Vicinity of Chernofski Harbor, Unalaska Island, and Otter Point, Umnak Island**

photographs from both public and private sources. The imagery and maps were correlated to a common coordinate system and interpreted.

Several steps were performed to identify accurate locations of points in the aerial photographs. Vertical aerial photography and maps obtained for this study were georegistered. Photos and maps were scanned to produce high-resolution digital images which were placed into a stereoplotter to enable the user to accurately measure heights and distances. Finally, digital orthophotos of selected aerial photos were created to remove most of the distortion caused by terrain displacement and tip and tilt in the mapping camera. As a result, each digital orthophoto accurately depicts the roads, buildings and other significant features in their true geographic position.

The photointerpretation identified several docks where ships may have unloaded cargo. Many of the docks identified in the photointerpretation coincide with the docks identified in the historical military records. Aero-Data identified two small docks that appear to have been military docks where the seafloor could potentially contain MEC. Although there were no related historical records found during the literature search for this project, they were present near points of previous military activity and are seen on 1950 and 1951 aerial photographs. One dock is located near the south end of the spit on the east side of Mount Ballyhoo, and the other located at Eider Point (unnamed small docks on Figure 2-5).

2.5.3 Evidence of Munitions and Explosives of Concern or Related Hazardous Substances in the Marine Environment

Historical records related to NOB Dutch Harbor were reviewed to evaluate the magnitude of gun training exercises that occurred during war-time activities. Although the CDA guns installed at Eider Point, Hill 400, Summer Bay, Amaknak Spit, Ulakta Head, Chernofski Harbor and Otter Point (Fort Glenn) were most certainly fired for gun registration and practice, no record of firing activities was discovered during the archive review conducted for this project.

However, the AATC facility at NOB Dutch Harbor was used extensively during World War II for the training of both Army and Navy personnel. The archive search for this project produced monthly reports to the Commandant of the Seventeenth Naval District indicating that thousands of men were trained at this AATC by firing at targets over Unalaska Bay. The War Diary for NOB Dutch Harbor indicates that during 1944 the AATC trained 4,860 men, while between January and August 1945 an additional 1,635 men received training (War Diary n.d.). Figure 2-3 shows the presumed danger area (range fan) associated with the AATC.

The following records were found during the archive search documenting the loss or discovery of DMM or UXO within the marine environment at locations in the Dutch Harbor area:

Harbor dock near where the U.S.A.T. *President Fillmore* was docked, but did not explode. The remains of this bomb were reportedly kicked into the waters of Dutch Harbor by a sailor (NAGD 1942).

- A report of combat actions during the June 1942 Japanese attack on Dutch Harbor indicated that the Number 1 3-inch gun on the U.S.A.T. *President Fillmore* experienced a "hangfire" during the raid. After the raid the gun was unloaded, the shell was inspected and thrown overboard (NAGD 1942).

- In January 1987 local divers working on the former Captains Bay ammunition dock (Captains Bay Dock in Figure 2-5) discovered four metal containers washed up on the shore. Each container measured about 5 inches in diameter and 30 inches long and contained a total of 44 glass vials. The containers were turned over to the Unalaska Police Department, which notified the 176th Explosive Ordnance Detachment, Fort Richardson, Alaska. Ordnance specialists identified the vials as elements of the Ml War Gas Identification Set, which was a World War II training kit used to teach soldiers how to identify chemical warfare agents by odor and immediate effects. The Explosives Ordnance Detachment repacked and transported the vials to the disposal facility at Johnston Atoll. The Technical Escort Unit conducted an additional underwater search and shoreline survey at the ammunition dock in February 1987. More containers with vials were found in the water and on the shore. A total of 469 additional vials were found, repacked, and transported to Johnston Atoll (U.S. Army Program Manager for Chemical Demilitarization 1996).

- Following a 1995 field investigation, the 176th Explosive Ordnance Disposal Unit from Fort Richardson disposed of thirty-six 90-mm projectiles discovered on the beach of Unalaska Bay, near former Magazine J, at Fort Leonard. Six additional projectiles observed in the intertidal area were determined to be inaccessible. These DMM items were identified as kick-out remnants from the detonation of Magazine J during earlier demilitarization activities conducted by the Army (USACE 2003).

- The 1995 field investigation included an underwater examination of seven sites by a remotely operated vehicle. These sites included the Former Army Dock in Captains Bay, Former Dock at the Dutch Harbor Naval Base, the Ferry Crossing at Iliuliuk Harbor, Margret Bay, Expedition Island, Iliuliuk Bay, and two areas at Eider Point. This investigation resulted in the finding of one and one-half 40-mm shell casings in the Eider Point area and one 40-mm round near the Former Navy Dock in Captains Bay, but no UXO (USACE 2003).

- A follow up investigation conducted in the summer of 2001included the removal of an additional forty-three 90-mm high-explosive projectiles. These were recovered from the top 1 foot of the beachfront in the vicinity of former Magazine J located at Fort Leonard (USACE 2003). These projectiles were consolidated and destroyed on site.

- An interview was conducted with a Ms. Marti Murray of Unalaska on June 19, 1993 as part of the information search for the archives search report for Unalaska Island (USACE 2003). During the interview Ms. Murray indicated that in the 1970s, two separate instances occurred where fishing boats from Dutch Harbor brought up land mines. The locations of these occurrences were not reported.

Alaska State Wildlife Trooper Sergeant Robin Morrisett stated that troopers have assisted local police with disposal of MEC. Navigational charts of the area identify areas with military explosives in the waters in the local waters (Rosenthal 2012a).

According to Unalaska police officer Brandon Hunter, , ordnance may have been dumped in the water off the tip of the Dutch Harbor Spit, in deep water of Captains Bay approximately 100 yards from shore at the Crowley Dock, and at the end of World War II, ordnance may have been dumped in the deepest part of Captains Bay (Hunter 2012).

Alaska State Wildlife Trooper Sergeant Morrisett, an avid diver in the Dutch Harbor area, provided information relating to the following two MEC finds:

- A shell casing measuring approximately 2 inches in diameter and 6 to 8 inches tall was discovered by a diver in Iliuliuk Bay near the Dutch Harbor Landfill.

- A shell measuring approximately 6 inches in diameter and 24 inches tall was discovered by a diver in 60 feet of water in Dutch Harbor between the Delta Western Dock (former Dutch Harbor Dock) and Rocky Point (Morrisett 2012).

Figure 2-5 shows the approximate locations within the Unalaska Bay area where DMM or UXO have been observed within the marine environment or removed from the seafloor and disposed of.

An interview was conducted with Mr. Randall Baker who lived at Chernofski Harbor continuously from 1979 to 1986, then routinely visited the area from 1986 until 2001. His family owns 80 acres in the Chernofski Harbor area. As a young boy or teenager, he witnessed divers recover hundreds of .50-caliber rounds and several larger DMM rounds from the bottom of Chernofski Harbor near both existing docks in Mutton Cove (Figure 2-6). The larger DMM were approximately 2.5 feet long and 5 inches in diameter (Baker 2012). In addition, Mr. Baker

recalled seeing impact craters in the mud flats at the head of the bay to the south, as shown on Figure 2-6, believed to result from the practice firing of guns at Chernofski Harbor.

There have been other instances of evidence of MEC in the marine environment near Dutch Harbor, but outside of the NDSA surrounding Unalaska Island. The evidence includes a 1947 ordnance disposal area and 2012 instances of commercial fishers bringing up MEC from the seafloor. Details on the 1947 ordnance disposal area and the 2012 MEC site are included in Appendix C.

2.5.4 Estimated Quantity of Munitions and Explosives of Concern

No reliable estimate of the quantity of MEC in the marine waters of the NDSA surrounding Unalaska Island can be determined from the information reviewed for this PA, although a large volume of ordnance was transshipped through NOB Dutch Harbor and the Chernofski Harbor Supply and Storage site.

Little information regarding the quantity of ordnance used during a typical CDA training exercise was discovered during the review of archive records. No record was found indicating the number of rounds (90 mm and larger) fired during periodic training or gun-registry activities. Because NOB Dutch Harbor was equipped with an AATC, all gun crew training for .30-caliber, .50-caliber, 20-mm, and 40-mm guns was conducted at this facility. The War Diary for Dutch Harbor indicates that during a three-day period in January 1945, the AATC trained 830 men, of which 450 men fired 17,100 rounds of 20- and 40-mm ammunition and 3,850 rounds of .30- and .50-caliber rounds (War Diary n.d.).

MEC exist in the marine waters of the NDSA surrounding Unalaska Island based on the following facts:

- The AATC facility at NOB Dutch Harbor was heavily used. Up to 30 percent of ordnance may not have detonated as intended, likely resulting in a portion of the fired ordnance unexploded.
- MEC was found in the marine environment of the Dutch Harbor and Chernofski Harbor areas.

MEC exists in the marine environment near the Dutch Harbor area, but outside the NDSA boundary based on the following fact:

- Fishers pulled up a land mine and projectile round near the Chelan Bank in 2012 and other MEC in prior years near the Chelan Bank as described in Appendix C.

3.0 EXPOSURE PATHWAYS AND TARGETS

This section of the PA report discusses the release mechanisms and associated exposure pathways for MEC and MCs residing in the marine environment. This includes evaluation of the surface water migration pathway, the sediment exposure pathway, and target organisms that are potentially exposed to the hazards.

3.1 MARINE SETTING

As described in Executive Order 8680, the Unalaska Island NDSA includes the territorial waters between the extreme high-water marks and the 3-mile marine boundaries (Appendix A). Typical maximum water depths in this area reach approximately 40 to 80 fathoms (240 to 480 feet), but exceed 400 fathoms (2,400 feet) in the area between Cape Winslow and Cape Kovrizhka, located northwest of Unalaska Bay (Figure 2-2).

These waters are adjacent to the Alaskan Maritime National Wildlife Refuge (AMNWR), established on December 2, 1980, when the Alaska National Interest Lands Conservation Act was signed into law by President Jimmy Carter. This act combined 11 previously established refuges totaling about 3 million acres, dating back to the early 1900s, with 1.9 million additional acres. The AMNWR includes the islands of the Aleutian chain, including Unalaska and Umnak Islands. The purpose of the AMNWR is "to conserve fish and wildlife populations and the marine resources upon which they rely" and provide "the opportunity for continued subsistence uses by local residents."

3.2 PHYSICAL RELEASES PATHWAY

As stated previously, releases of MEC into marine surface water at Unalaska Island resulted from the following activities:

- Ordnance fired over water from CDA and AA gun batteries during target training and gun function testing
- Ordnance lost into the water during transfer from transport ships to the shore, either at a fixed dock or at anchorage in Chernofski Harbor
- DMM deliberately disposed of into the marine environment at the conclusion of hostilities

- In the case of Dutch Harbor, ordnance deliberately dropped by the Empire of Japan on U.S. forces during two consecutive days in June 1942

Reviewed records and interviews suggest that each of the activities listed above may have released DMM or UXO into the marine surface waters of the Unalaska Island NDSA.

A number of complex factors affect the fate and transport of MCs released in the underwater environment. These factors include the nature of the delivery of the ordnance item to the underwater environment, its potential for corrosion, and associated release of MCs.

Underwater releases of MCs can occur when casings deteriorate (most notably from corrosion), rupture upon impact, or undergo a low-order detonation. MCs may be released immediately after impact, or may be only partially contained within the remains of the delivery system. When ordnance undergoes a low-order detonation or breaks apart upon impact, the MCs, such as bulk explosives, can be scattered over the impact area (USEPA 2003).

3.3 CHEMICAL RELEASE PATHWAY

Because MEC can remain relatively intact in the marine environment, MCs can be released through pinholes or cracks that develop over time as a result of corrosion, or through the screw threads linking the fuse assembly to the main charge.

Corrosion of the iron and steel in casings is a complex process that occurs in the presence of water and oxygen. The potential corrosiveness of the local environment can vary greatly. The effects of immersion and corrosion on the release of MCs in various underwater environments depend on site conditions. Even though saltwater is potentially more corrosive the higher the salt saturation, exposure to oxygen is a key requirement for corrosive effects. In environments where wave action and tides cause mixing with the atmosphere (typical of the Aleutian Islands), the oxygen content of the water, especially shallow water, can create a high potential for oxidation (USEPA 2003).

A variety of factors in the underwater environment may either reduce the potential for corrosion, or affect the nature of the release from an ordnance item releasing MCs. At higher pH levels, if the right conditions are present (e.g., carbon dioxide saturation or temperature), submerged or buried metal may develop a coating of calcium carbonate, with a corresponding increase in corrosion resistance. In the absence of oxygen, such as the anaerobic conditions that can exist where there are large concentrations of unoxidized metals, high content of organic matter, or in deeper, cold waters, corrosion in the underwater environment can be virtually stopped. It is also possible that submerged MEC can develop a coating consisting of biological materials (e.g., coral, barnacles, plants, etc.) that can seal the item off from the environment, as well as make it more difficult to locate (USEPA 2003).

Although no empirical evidence exists regarding the rate of corrosion or encrustation acting on MEC in the marine environment at Unalaska Island, a photograph was taken of an unexploded depth bomb that was snagged in a net by fishers near Kodiak Island during 1974. The photograph shows very little corrosion and/or encrustation of this ordnance item after approximately 30 years in the marine environment (Figure 3-1).

3.4 HUMAN EXPOSURE TARGETS

Although the Fox Islands are within the AMNWR, commercial fishing does occur in the surrounding waters. The Port of Dutch Harbor is the main port and field base for the Bering Sea king crab fishery. For the fifteenth consecutive year, Dutch Harbor-Unalaska led the nation as the port with the highest volume of seafood landed (NOAA 2012). Human exposure to MEC could occur through accidental direct contact resulting from recreational and commercial fishing or anchoring in the area, or direct contact as a result of recreational or commercial dives into the marine environment of the NDSA.

The risks from MEC in the underwater environment are driven by two different effects: the physical explosive hazard associated with direct encounter with UXO and DMM and the environmental health hazard associated with the release of the MCs contained in MEC. As mentioned in Section 2.4.2, current Navy policy is to include sites in the Navy's MRP where munitions releases of shallow water areas are known or suspected and for only those sites covered by water no deeper than 20 fathoms (120 feet) (U.S. Navy 2007), which is the approximate depth limit of recreational diving. Although MEC items are located at depths greater than 20 fathoms (120 feet), human and marine exposures at 20 fathoms (120 feet) or less are the primary exposures of concern in this report, based on the Navy's MRP policy.

During fishing operations, MEC have been pulled up in fishing equipment at depths greater than 20 fathoms (120 feet). The skipper of the *Aleutian Sable* said that he has found ordnance on several occasions, as recently as June 2012, near the Chelan Bank where he fishes (Hebert 2012). The *Aleutian Sable* typically fishes for sablefish in water that is 250 to 450 fathoms (1,500 to 2,700 feet), but has fished as deep as 650 fathoms (3,900 feet) (see Figures 3-2 and 3-3). This area is much deeper than the 20-fathom limit (120-foot) specified in the Navy MRP and should be reason for concern, because a complete pathway of exposure to MEC exists.

The conceptual site model of the Unalaska Island NDSA is presented as Figure 3-4. The populations of potential exposure to MEC are discussed in the following sections.

3.4.1 Recreational or Commercial Fishers

The physical explosive hazard is a complete pathway for fishers (recreational or commercial) who may accidently detonate MEC. Commercial fishers could potentially bring up MEC in their

33762079_03.ai

Source: Official Navy Photograph

U.S.NAVY

Figure 3-1
650-Pound Mk 29 Depth Bomb
Snagged in a Fishing Net Off Kodiak Island, 1974

Delivery Order 0040
Naval Defensive
Sea Area
Unalaska Island, Alaska

33762079_04.ai

Source: Official Navy Photograph

U.S.NAVY

Figure 3-2
Land Mine Pulled Up from the Seafloor
During Deep-Water Fishing Off Dutch Harbor in June 2012

Delivery Order 0040
Naval Defensive
Sea Area
Unalaska Island, Alaska

33762079_05.ai

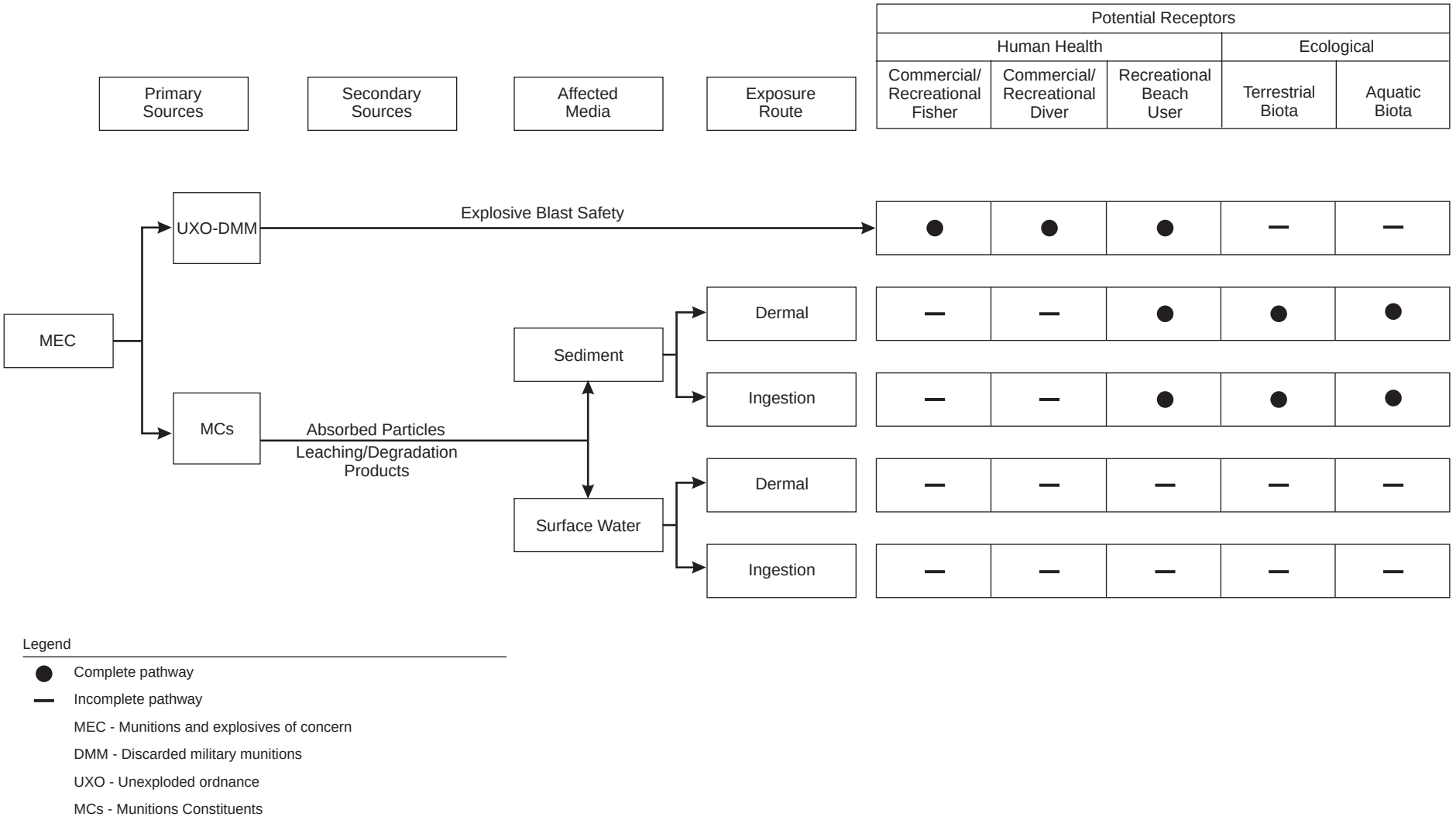
Source: Official Navy Photograph

U.S.NAVY

Figure 3-3
Projectile Pulled Up from the Seafloor
During Deep-Water Fishing Off Dutch Harbor in June 2012

Delivery Order 0040
Naval Defensive
Sea Area
Unalaska Island, Alaska

33762079_01.cdr



U.S.NAVY

Figure 3-4
Conceptual Site Model

Delivery Order 040
Naval Defensive Sea Area
Unalaska Island, AK

fishing nets, which has occurred as recently as June 2012 near the Dutch Harbor area, but outside the NDSA, as described in Section 2.5.3. In addition, a vessel's anchor could potentially detonate or get caught on MEC on the seafloor. A local interview conducted in 1993 reported that in the 1970s, two separate incidents of fishing boats in Dutch Harbor brought land mines to the surface (see Section 2.5.3). Therefore, potential physical explosive hazards for recreational and commercial fishers are considered complete and could potentially be significant.

In addition to the physical explosive hazards associated with MEC, there are also potential health hazards associated with exposure to the MCs released from ordnance items. However, because any release would be occurring into such an enormous volume of water that is subject to significant mixing by tidal movements and storms, the probability is remote of fishers coming in direct contact with dangerous concentrations of MCs in the environment. Therefore, this pathway is considered incomplete for recreational and commercial fishers.

3.4.2 Recreational or Commercial Divers

Recreational or commercial divers could come into direct contact with MEC during an underwater dive. Recreational or commercial divers will usually descend to a maximum of 20 fathoms (120 feet). Divers could encounter MEC in these shallow waters, particularly within sheltered areas such as Dutch Harbor or Chernofski Harbor. There is a reasonable likelihood that a diver could come into physical contact with MEC in the Dutch Harbor and Chernofski Harbor areas. Currently, active diving does occur around the Dutch Harbor area by the local diving community. There were also two reported findings of MEC by divers in the Dutch Harbor area (see Section 2.5.3 for details). Although the remoteness of Chernofski Harbor limits its access, a former resident stated that in the past, divers easily recovered DMM items from the Mutton Cove area of Chernofski Harbor (Baker 2012). Chernofski Harbor was also reported by a local Alaska Wildlife Trooper as an area where DMM was likely to be found (Morrisett 2012). Therefore, potential physical explosive hazards for recreational and commercial divers are considered complete and could be significant.

As discussed above for fishers, potential health hazards associated with exposure to the MCs released from ordnance items would also be unlikely for recreational and commercial divers. The probability is remote of divers coming in direct contact with MCs in the environment. Additionally, any exposure to MCs would be very limited during the short durations of dives. Therefore, this pathway is considered incomplete for recreational and commercial divers.

3.4.3 Recreational Beach User

Recreational beach users could come into direct contact with MEC. DMM or UXO could possibly wash ashore onto one of the recreational beachcombing or tide-pooling areas of Unalaska Island. MEC has been discovered in the intertidal area near Eider Point and subsequently removed from the beachfront as described in Section 2.5.3. Some MEC may still

exist in shallow water in that area. Therefore, the physical explosive hazard is a complete pathway for recreational beach users who may accidently detonate MEC.

In addition, if MEC that has washed close to or onto the shore was leaking, MCs could potentially impact the sediments immediately surrounding the MEC item. The MC-impacted sediment could be a potential health hazard to recreational beach users. Recreational beach users could be exposed to leaking MCs through dermal contact and/or incidental ingestion of sediment exposures. The most common MCs constituents, such as trinitrotoluene (TNT) and cyclotrimethylene trinitramine (RDX), are possible human carcinogens. Potential toxicity and effects that have been published in the U.S. Environmental Protection Agency's Integrated Risk Information System and the Agency of Toxic Substances and Disease Registry are liver cancer, skin irritations, and cataracts for TNT and nervous system problems, nausea, and organ damage (to animals in laboratory exposures) for RDX. Therefore, the chemical hazard from MCs is considered a complete pathway for recreational beach users.

The main concerns regarding MCs in the vicinity of Unalaska Island are likely related to impacts to the marine environment, as discussed in the following section.

3.5 MARINE EXPOSURE TARGETS

Exposure to MEC in the surface water of the Unalaska Island NDSA is limited to mammals, birds, fish, and benthic creatures found in the marine environment. Marine mammals, birds, fish, and benthic creatures within the Unalaska Island NDSA could have potential daily exposure to any MEC lost or discarded there. The risk to these creatures from detonation of the ordnance is remote. However, release of the constituents contained in the munitions could potentially impact the quality of the surface water and sediments and present a potential hazard to the marine environment. Direct exposure of munitions by marine receptors could occur wherever munitions exist in the marine environment: washed up onto beaches, on the surface of the seafloor, or buried in sediment. Therefore, exposure to chemical constituents of the explosives within the ordnance can be considered a potentially complete pathway as the marine environment slowly corrodes the metal casings.

The major environmental concern associated with releases of MCs in the underwater environment is the impacts to sediments. Sediments support biological communities that are food for marine life. The main concerns include the following:

- The continued health of the biological community and its ability to support the ecosystem

- Potential uptake of chemicals into the plants and sea life that ultimately form part of the food chain for people and marine life

- Chemical constituents of explosives that may be suspended in water and potentially available to marine life

Many MCs could be potentially toxic to aquatic organisms. However, the potential for aquatic toxicity is not completely understood because of the complexity of the marine environment. Aquatic toxicity is affected by the several factors that influence the fate and transport of the MCs and the dose exposure of the aquatic organism. MCs are often not detected in the marine environment because of a variety of factors that include advection, dispersion, diffusion, photolysis, plant uptake, and biotic transformation. There is also evidence that some of the common compounds of MCs, such as RDX, do not bioaccumulate in aquatic tissue (USEPA 2003). In contrast, some of the common metals of MCs, such as lead and mercury, may bioaccumulate in aquatic tissue. However, the effects of bioaccumulation depend on several factors: concentrations of chemicals (dose), pathways by which receptors are exposed, duration, and sensitivity of the exposed population.

Surface water in the immediate vicinity of a continuing source such as constituents leaking from a cracked ordnance casing or a low order detonation, may contain MCs in measurable quantities. The munitions compounds of interest include, but are not limited to, military explosive compounds such as TNT, pentaerythriol tetranitrate, RDX, and cyclotetramethylene tetranitramine (HMX) as they occur in munitions, as well as any breakdown products. There are many factors affecting the fate and transport of these chemicals. TNT is more water soluble than RDX and HMX and is therefore more likely to be found in small concentrations in water. Because RDX and HMX have low water solubilities, they are more likely to be dispersed as small particles by currents to sediments (which may be uptaken by plants), or dispersed in the water column (which exposes the aquatic biota via ingestion or dermal contact).

MCs differ in how easily they bind to sediments. MCs not easily bound to sediments may act as a source of continuing release to water, or as a source for aquatic life uptake. Because TNT is more water soluble than RDX or HMX, it is less likely to bind to sediments and more likely to be immediately dissolved into water. However, TNT also tends to be more susceptible to photodegradation and biotransformation, particularly in shallow water. The process of biotransformation causes TNT's amino biotransformation products to bind to the humic acids in sediments more strongly than RDX or HMX. This tendency to bind to sediment can reduce the overall concentration of TNT's biotransformation products in water, in spite of their relatively higher water solubility compared to RDX and HMX.

Biouptake and bioaccumulation of MCs into the food chain via aquatic plants and other organisms that grow in sediments is not well understood. Research on phytoremediation has shown that plants can take up MCs such as TNT, RDX, and HMX, which will also undergo some biotransformation in the plants' tissues (USEPA 2003). A recent research study has shown that TNT has very low bioacummulation potential (Yoo et al. 2006). RDX also has low bioconcentration potential in aquatic organisms (ATSDR 2012).

The MCs (including the most common ones, TNT, RDX, and HMX) are likely to present low ecological risk under expected exposure scenarios in the marine environment. Although there is not extensive research on the toxicological effects of munitions in the marine environment, a study in 2005 (Rosen and Lotufo) concluded that exposure to RDX did not cause toxicity in amphipods (invertebrate species). Furthermore, MCs typically undergo extensive transformation upon contact with marine sediment and have low potential for bioaccumulation in aquatic organisms. Therefore, the exposures of terrestrial and aquatic populations to MCs via sediment and surface water at Unalaska Island are considered complete yet insignificant.

4.0 SUMMARY AND CONCLUSIONS

This section presents a brief summary of the information presented in this PA report, as well as conclusions regarding the potential for exposure to MEC present in the marine environment by both human and marine targets species.

The stated objective of this project is to perform a review of activities related to the operations of in-water ranges located off Unalaska Island, Alaska. These operations include all activities that had the potential for release of ordnance into the marine environment that may pose a potential threat to human health or the environment.

4.1 IDENTIFIED SOURCES

The sources of MEC released into the marine environment of the Unalaska Island NDSA by U.S. forces consist of CDA and AA gun batteries, an AATC, on-water ordnance transfer operations, and ordnance disposal following the war. Locations identified by this PA where these actions occurred are shown on Plate 4-1. This plate also shows the ranges of CDA guns which are represented by the gray circles and arcs.

Information reviewed for this PA report identified U.S. CDA and AA gun batteries on Unalaska Island consisting of two 8-inch CDA guns, two 6-inch CDA guns, eight 155-mm CDA guns, six 90-mm AMTB guns, twelve 3-inch AA guns, twenty-seven 37- or 40-mm AA guns, twenty-two 20-mm AA guns, twenty-eight .50-caliber machine guns associated with the gun batteries, and .30-caliber machine guns associated with several searchlight installations. The area covered by these gun batteries included a large expanse of ocean surrounding Unalaska Harbor (see Plate 4-1).

In addition, the following CDA, AA, or other large-caliber guns were identified in the Chernofski Harbor and Otter Point areas: three 6-inch CDA guns, eight 155-mm CDA guns, twelve 105-mm howitzers, sixteen 3-inch AA guns, thirty-two 37-mm AA guns, forty 20-mm AA guns, thirty-two .50-caliber machine guns, eighteen 60-mm mortars, and twelve 81-mm mortars. These gun batteries were concentrated in the Umnak Pass to Cape Idak to Chernofski Harbor area. The estimated area covered by these gun batteries is shown on Plate 4-1.

One AATC was operated on Amaknak Island (Dutch Harbor) during World War II. This was located at the northwestern base of Mount Ballyhoo where 40-mm, 20-mm, .50-caliber, and .30-caliber guns fired north-northwest over Unalaska Bay. The presumed danger area (range fan) for this AATC is shown on Figure 2-3.

Information reviewed for this PA report identified Dutch and Chernofski Harbors as through-shipping point for materials and supplies bound for combat units in the Aleutians. Although it has not been confirmed, available information suggests that the bulk of the ordnance-handling activities occurred in the Captains Bay and Chernofski Harbor areas. The lack of an identified explosive anchorage area suggests that MEC was handled at fixed docks in these areas. The locations of known docks in the Captains Bay and Chernofski Harbor areas, respectively, are shown on Figures 2-5 and 2-6. Occasionally DMM were lost into the marine environment during ordnance-handling operations.

Information reviewed and interviews with two persons familiar with the area confirm that MEC have been found on the seafloor near the former Army Dock in Captains Bay, along the shoreline of Unalaska Bay at Eider Point, on the seafloor near Dutch Harbor Landfill, on the seafloor near the Delta Western Dock, and near the former docks in the Mutton Cove portion of Chernofski Harbor. In addition, MEC has been recovered from the seafloor during deep-water sable fishing along the northern edge of Chelan Banks. The reported recoveries have occurred at a position outside the Unalaska Island NDSA, approximately 6.5 miles north of Cape Cheerful (Appendix C, Figure C-1).

4.2 EXPOSURE PATHWAYS

The two populations of potential human exposure to MEC are recreational or commercial fishers and recreational or commercial divers. The physical explosive hazard is a complete pathway for both fishers and divers (recreational or commercial) who may accidently detonate MEC. Commercial fishers have been known to bring MEC up in their fishing nets or attached to their traps. In addition, a vessel's anchor could potentially detonate or get caught on MEC on the seafloor. Therefore, potential physical explosive hazards for recreational or commercial fishers are considered complete and could potentially be significant.

Recreational or commercial divers will not usually descend deeper than a maximum of 20 fathoms (120 feet). MEC could be encountered in these shallow waters by a diver. Areas of particular concern are former explosive-handling areas along docks and documented gun-training areas. These areas are located within Unalaska Bay, Captains Bay, Iliuliuk Bay, and Chernofski Harbor. The potential pathway for a physical explosive hazard to a diver is considered complete in these areas. The likelihood of a diver coming into physical contact with MEC in these areas is considered moderate to high.

Exposure to MCs within the ordnance can be considered a potentially complete pathway as the marine environment slowly corrodes the metal casings. The major environmental concern associated with releases of MCs in the underwater environment is the impacts to sediments. Sediments support biological communities that are the food for marine life. However, the MCs are likely to present low ecological risk under expected exposure scenarios in the marine

environment. Therefore, the exposures of terrestrial and aquatic populations to MCs via sediment and surface water within the Unalaska Island NDSA are considered complete yet insignificant.

4.3 AREAS POTENTIALLY CONTAINING MEC IN THE MARINE ENVIRONMENT

Several areas within the Unalaska Island NDSA have been identified as potentially containing DMM, practice-fired UXO, or ordnance lost in the water during transfer. To be consistent with the Navy MRP, each of these areas contain known or suspected munitions releases that occurred prior to September 30, 2002, where Navy actions were responsible for the release, and the site is not covered by water deeper than 20 fathoms (120 feet). The specific areas are defined as follows:

- The area of the seafloor associated with the former Dutch Harbor AATC extending north-northwest into Unalaska Bay approximately 6,000 yards, as shown on Figure 4-1: This area is documented to be heavily used as a gun training range.

- Areas of the seafloor within Dutch Harbor surrounding the former military docks including Fuel Oil Dock, Dutch Harbor Dock, Ballyhoo Dock, Advanced Base Depot Dock, Net Depot Dock, Dolphin Spit Dock, and the unnamed small dock as shown on Figure 4-2: These dock areas were heavily used during World War II as transshipment points for ordnance and other supplies destined for Aleutian bases farther west.

- Areas of the seafloor surrounding the former Navy dock in Captains Bay, as shown on Figure 4-3: This dock was also heavily used during World War II as a transshipment point for ordnance and other supplies destined for Aleutian bases farther west.

- Areas of the seafloor surrounding the former docks at Summer Bay, Hog Island and Eider Point as shown on Figure 4-4: These docks were used as supply transfer points for remote gun locations not accessible by truck.

- Areas of the seafloor surrounding the former dock facilities in Iliuliuk Harbor, including Unalaska Dock, Y.P. Dock, Submarine Base, Marine Railway Dock, P.T. Dock, and the Agnes Beach Facility, as shown on Figure 4-5: These docks could have been used as supply transfer points from temporary storage at NOB Dutch Harbor onto ships slated for combat missions.

- Areas of the seafloor surrounding the docks in the Mutton Cove portion of Chernofski Harbor and the former barge docks at Otter Point, as shown on Figure 4-6: All munitions and supplies used at Fort Glenn were transshipped through the Navy facility at Chernofski harbor. Mutton Cove is reported to have MEC on the seafloor.

- The area at the southern end of Chernofski Harbor that reportedly was used as a Gun Practice Impact Area, as shown on Figure 2-6

- The area within Iliuliuk Bay near the Dutch Harbor Landfill where MEC has been observed within the marine environment, as shown on Figure 4-7

- The area where MEC identified in the nearshore waters of Unalaska Bay near Eider Point, as shown on Figure 2-5, where DMM items were identified as kick-out remnants from the detonation of Magazine J resulting from demilitarization activities conducted by the Army

The Navy MRP does not address MEC that is in water greater than 20 fathoms (120 feet). However, fishers can encounter MEC at depths greater than 20 fathoms (120 feet).

Two 90-mm AMTB gun batteries have been identified at NOB Dutch Harbor: Battery No. 1a located on Amaknak Spit and Battery No. 3a located on Eider Point. Information reviewed for this PA indicated that the range coverage for these guns extended into Iliuliuk Bay and Unalaska Bay. Because no gun practice record associated with these batteries was discovered during this PA, target areas potentially containing MEC could not be established.

A similar situation exists for the large CDA and AA gun batteries that existed during World War II surrounding NOB Dutch Harbor, Chernofski Harbor, and Fort Glenn (Plate 4-1). No gun practice record associated with these batteries was discovered during this PA that could be used to establish target areas potentially containing MEC.

The presence of MEC as a result of combat operations is expected to be insignificant if it is present. The Empire of Japan bombed the Dutch Harbor area on two consecutive days, apparently targeting on-land military facilities based on descriptions of the attack. No documentation was found that identified any recovered MEC as Japanese in origin. Most, if not all, of the MEC in the marine environment is expected to be the result of several years of historical operations at the U.S. military facilities on Unalaska Island.

4.4 RECOMMENDATIONS

Based on this preliminary assessment of the NDSA of Unalaska Island, the Navy recommends the following:

1. The Navy will perform a Site Inspection within the areas defined above where the water depth is less than 20 fathoms (120 feet). In-water survey efforts should concentrate on the areas identified in the eight bullets in Section 4.3.

2. The Navy will perform a non-time-critical removal action (NTCRA) to initiate a Notice to Mariners and an information advisory to increase awareness of the presence of MEC in the area. The Navy will request that the National Oceanic and Atmospheric Administration include a Notice to Mariners on navigational charts for Unalaska Island. The warning will notify fishers and divers to be extremely careful when within the NDSA for Unalaska Island because MEC exist in the waters around Unalaska Island, including the ordnance disposal areas north of the Chelan Bank shown on Figure C-1 in Appendix C. The Navy will request that these disposal areas be identified with the designation "Ordnance Disposal Area." In 2013 the Navy intends to distribute copies of an educational fact sheet titled *3Rs Explosives Safety Guide, Maritime Industry* (U.S. Army Technical Center for Explosives Safety 2010) to fishers in the main fishing ports in the Aleutians which include Dutch Harbor and Kodiak areas. The colored 12-page fact sheet informs readers of the dangers of encountering munitions from the seafloor and promotes safety by following the "3Rs" of explosives safety: recognize, retreat, and report. A copy of this fact sheet is included in Appendix D.

Battery No. 4
Battery No. 3a
Battery No. 3
Battery No. 1a
Battery No. 1
Battery No. 2

Legend
- Antiaircraft Training Center
- Gun Battery
- 20 Fathom Contour
- Range Fan

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure 4-1 Former Range Area Potentially Containing MEC off the Dutch Harbor AATC.mxd

U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	0 3,750 7,500 Scale In Feet	Unalaska Island

Figure 4-1
Former Range Area Potentially Containing MEC
Off the Dutch Harbor AATC, Unalaska Island

Path: T:\NAVY\SeaDefenseMXD\Draft\Unalaska\Figure 4-21 Location Former Military Docks DutchH Potentially MEC.mxd

U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	0 900 1,800 Scale In Feet	**Figure 4-2** **Locations of Former Military Docks Within Dutch Harbor Where the Seafloor Could Potentially Contain MEC, Unalaska Island**

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure 4-3 Location Former Military Docks CaptBay Potentially MEC.mxd

U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	0 750 1,500 Scale In Feet	**Figure 4-3** **Location of Former Military Dock Within Captains Bay Where the Seafloor Could Potentially Contain MEC, Unalaska Island**

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure 4-4 Former Military Docks UnalaskaBay Potentially MEC.mxd

U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska		**Figure 4-4** **Locations of Former Military Docks Within Unalaska Bay Where the Seafloor Could Potentially Contain MEC, Unalaska Island**

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure 4-5 Former Military Docks IliuliukH Potentially MEC.mxd

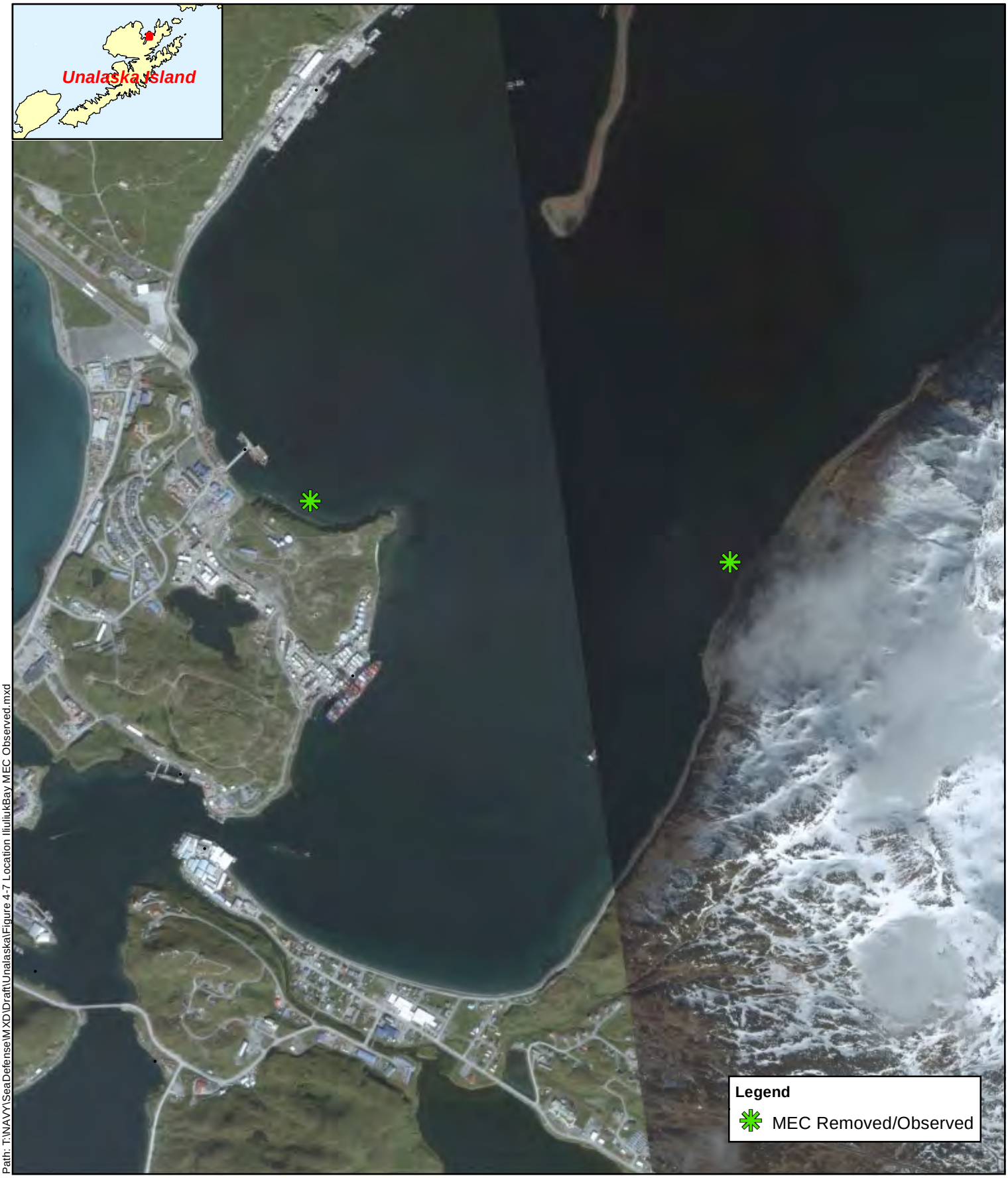
U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	0 400 800 Scale In Feet	Unalaska Island	**Figure 4-5** **Locations of Former Military Docks Within Iliuliuk Harbor Where the Seafloor Could Potentially Contain MEC, Unalaska Island**

Otter Point

Chernofski Harbor

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure 4-6 Former Military Docks Chernofski OtterPt Potentially MEC.mxd

U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	0 1,000 2,000 Scale In Feet	Unalaska Island	**Legend** 20 Fathom Contour	**Figure 4-6** **Locations of Former Military Docks Within Chernofski Harbor and at Otter Point Where the Seafloor Could Potentially Contain MEC, Unalaska Island**



Path: T:\NAVY\SeaDefenseMXD\Draft\Unalaska\Figure 4-7 Location IliuliukBay MEC Observed.mxd

U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	0 750 1,500 Scale In Feet	**Figure 4-7** **Locations Within Iliuliuk Bay Where MEC was Observed on the Seafloor, Unalaska Island**

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APPENDIX A

Executive Order 8680

Executive Order 8680--Establishing naval defensive sea areas around and naval airspace reservations over the islands of Kiska and Unalaska

Source: The provisions of Executive Order 8680 of Feb. 14, 1941, appear at 6 FR 1014, 3 CFR, 1938-1943 Comp., p. 892, unless otherwise noted.

Alaska

By virtue of the authority vested in me by the provisions of section 44 of the Criminal Code, as amended (U.S.C., title 18, sec. 96), and section 4 of the Air Commerce Act approved May 20, 1926 (44 Stat. 570, U.S.C., title 49, sec. 174), the territorial waters between the extreme high-water marks and the three-mile marine boundaries surrounding the islands of Kiska and Unalaska are hereby established and reserved as naval defensive sea areas for purposes of national defense, such areas to be known, respectively, as "Kiska Island Naval Defensive Sea Area", and "Unalaska Island Naval Defensive Area" and the airspaces over the said territorial waters and islands are hereby set apart and reserved as naval airspace reservations for purposes of national defense, such reservations to be known, respectively, as "Kiska Island Naval Airspace Reservation", and "Unalaska Island Naval Airspace Reservation".

At no time shall any person, other than persons on public vessels of the United States, enter either of the naval defensive sea areas herein set apart and reserved, nor shall any vessel or other craft, other than public vessels of the United States, be navigated into either of said areas, unless authorized by the Secretary of the Navy.

At no time shall any aircraft, other than public aircraft of the United States, be navigated into either of the naval airspace reservations herein set apart and reserved, unless authorized by the Secretary of the Navy.

The provisions of the preceding paragraphs shall be enforced by the Secretary of the Navy, with the cooperation of the local law enforcement officers of the United States and of the Territory of Alaska; and the Secretary of the Navy is hereby authorized to prescribe such regulations as may be necessary to carry out such provisions.

Any person violating any of the provisions of this order relating to the above-named naval defensive sea areas shall be subject to the penalties provided by section 44 of the Criminal Code as amended (U.S.C., title 18, sec. 96), and any person violating any of the provisions of this order relating to the above-named naval airspace reservations shall be subject to the penalties prescribed by the Civil Aeronautics Act of 1938 (52 Stat. 973).

This order shall take effect ninety days after date hereof.

[EO 8680 amended by EO 8729 of Apr. 2, 1941, 6 FR 1791, 3 CFR, 1938-1941 Comp., p. 919]

APPENDIX B

Historical Aerial Photo Interpretation

STATEMENT OF OPINIONS
WAYNE M. GRIP
AERO-DATA CORPORATION
CONCERNING INTERPRETATION OF AERIAL PHOTOGRAPHS
OF UNALASKA ISLAND NAVAL DEFENSIVE AREA

IN

THE ALEUTIAN ISLANDS, ALASKA

NOVEMBER 2012

Wayne M. Grip

Introduction

I was engaged to perform an historical aerial photography study of four areas within the Unalaska Island Naval Defensive Sea Area: Eider Point, Hog Island, Obernot Point and Amaknak Island. I was asked to obtain and interpret aerial photography primarily for the World War II time period.

Aerial Imagery, satellite imagery and maps were acquired of these Sites from both public and private sources. In addition, I obtained the USGS 1:63,360 topographic maps of Unalaska. The imagery and maps were registered to a common coordinate system and interpreted. Oblique photographs and ground photographs were also obtained, which showed locations where munitions were probably offloaded from ships. These photographs were much higher in resolution than the vertical aerial photography.

The primary purpose of this study was to use historical aerial photography to identify potential areas impacted by legacy ordnance activities.

Statement of Qualifications

My name is Wayne M. Grip. I have a BS degree in Geology from the University of Wisconsin, Madison. After I received my degree in Geology, I served as a cartographic officer in the US Air Force for four years from 1967 through 1971. In this position, I interpreted aerial photography and satellite imagery to produce air target charts (maps). Following my release from active duty, I worked for the Louisiana Department of Natural Resources (LADNR) for five years as a geologist. In this position, I flew photomissions and interpreted aerial photography to evaluate mining permit applications and to monitor oil and gas and mining operations. I also conducted many on-site inspections to determine the compliance of regulated facilities with environmental standards.

In 1982, I co-founded Aero-Data Corporation. I worked part-time for Aero-Data until 1985 when I left the LADNR and went full time with Aero-Data as its president. As of 2012, I have worked for Aero-Data for thirty years. I am currently the president and principal owner. Aero-Data specializes in aerial mapping and environmental studies using aerial photography and historical maps. I have over thirty-five years of professional experience in this field. I have served as an expert witness in the areas of photointerpretation, photogrammetry, and hydrology in both Federal and State courts in the United States. I am also an active licensed pilot with over 2,500 hours of flying time as pilot in command including over 1,000 hours of photomissions. In the past thirty years with Aero-Data Corporation, I have completed over 700 environmental site investigations in more than thirty states using historical aerial photography.

Information Considered

This report is based upon vertical stereoscopic aerial photography, oblique aerial photography, ground photography, maps of the Site and my experience and training. Attachment A is a listing of the aerial photography, documents and other information that I have relied upon.

Production of Geo-Registered Images and Maps

Following my standard procedures, I have produced geo-registered imagery of the vertical aerial photography obtained for this study. In addition, maps showing the boundary of the Sites and maps of other features were geo-registered to the aerial photography. The imagery and maps are included in the attachments to this report.

Methods and Materials

Aerial research and acquisition
The historical aerial photography study of the Sites began with research for available photo coverage from public and private vendors. Vertical, oblique and ground imagery were acquired.

Because of the typically poor flying weather and remoteness of Unalaska Island, the availability of photography during the war years was very limited. There was almost no aerial photography identified that was taken during WWII. Conventional aerial photography is normally taken of developed areas during clear weather with good visibility and lack of cloud cover. These conditions are very rare in the Aleutians.

The National Archives and Records Administration (NARA) catalog was researched using their Online Public Access (OPA) system. Through OPA, several record groups were identified as having possible photographic coverage. The record groups were as follows:

- RG 18 – Records of the Army Air Forces
- RG 23 – Records of the Coast and Geodetic Survey
- RG 37 – Records of the Hydrographic Office
- RG 80 – General Records of the Department of the Navy
- RG 373 – Records of the Defense Intelligence Agency

Aero-Data Corporation forwarded this information to Do You Graphics in Maryland, who performed onsite research at NARA to verify coverage. Upon completing their research, Do You Graphics sent Aero-Data Corporation the results of their findings. ***No aerial photographs from the requested World War II time period were found at NARA.***

After consulting with URS Group, Inc., Aero-Data Corporation ordered the following post-war NARA aerial photographs (This 1950 date of photography is still on order):

- Unalaska Site 1 – Eider Point
    - 9/26/1950, 1:43,000, Black and White

Vertical stereoscopic aerial photography from 6/20/1951 was obtained from the United States Geological Survey of the following:

- Unalaska Site 2 – Hog Island
- Unalaska Site 3 – Obernot Point
- Unalaska Site 4 – Amaknak Island

No 1951 imagery was available of Site 1 – Eider Point.

Additional photographic collections were reviewed, including the Alaska Digital Archives, which provides online access to the Alaska State Archives, Alaska State Library, Alaska State Museum and University of Alaska collections; the Library of Congress, the National Geodetic Survey; the Naval History and Heritage Command; the United States Department of Agriculture Aerial Photography Field Office; and the Alaska District of the United States Army Corps of Engineers. ***No stereoscopic aerial photography from World War II was available from these sources.*** When available, ground shots and oblique imagery were obtained from these sources.

Initial review and date verification
All imagery that was obtained was examined for proper geographic coverage of the Sites.

For the 1951 imagery acquired, the date of the photomission was stamped by the provider directly on the edge of each individual frame. The date annotation was normally added to the film by the provider shortly after the film was developed. In recent years, the date annotation has been added to the film during the instant of image exposure. Date annotation on the image has been a common practice used in the aerial photo survey industry and military dating back to the 1920's.

The dates of the satellite, oblique and ground photos were included in metadata and other documentation provided to us from the photo providers.

Scanning of Selected Photography
The aerial photographs from NARA and the USGS were purchased in the form of frames consisting of vertical stereoscopic photography in a 9" X 9" digital format. The NARA frames will be scanned by Do You Graphics at a resolution of 16 microns. The USGS scanned the 1951 frames at a resolution of 14 microns. The scanned images are true reproductions of the original photography. They are not enhancements.

The vertical and oblique photographs that were obtained from the Naval History and Heritage Command were scanned using a flatbed scanner. All other ground and oblique imagery was obtained in digital format.

Setting up the stereomodels
High resolution raster images for the 1951 stereo date of photography were then imported into a digital stereoplotter capable of providing stereoscopic viewing of the images at magnification levels ranging from 1x to 128x. The digital stereoplotter also allows precise mapping of significant environmental features, which are interpreted in the 3-D imagery.

Ground control (UTM Zone 3 NAD 83) was derived from the 9/12/2005 DigitalGlobe Quickbird satellite imagery and the USGS 1:63,360 topographic map of the area. Distant mapped features, thousands of feet off the Sites but which were also visible in the aerial photography were measured (coordinates derived) from the satellite imagery and used as ground control points.

The coordinates of each selected visible ground control point were then entered into a control point file in the digital stereoplotter. The floating dot (measuring point) of the stereoplotter was carefully positioned by the operator with the hand controller, one point at a time, onto each of the visible control points and the coordinates of that point (from the ground control point file) were assigned to the image. When sufficient control points had been visited, accepted and the model checked for residual errors, the stereo model was then confirmed to be level, scaled and locked into the coordinate system. As a result, accurate measurements of heights and distances could now be made within the stereo model area by using the digital stereoplotter.

Digital Ortho Production
Next, using the stereomodels and digital stereoplotter, a digital orthophoto was produced of the 1951 photography. A digital orthophoto is a two dimensional raster image produced from one or more frames of vertical aerial photography such that most of the distortion caused by terrain displacement and tip and tilt in the mapping camera has been removed, and the resulting raster image is accurately registered to a chosen coordinate system. As a result, each digital orthophoto accurately depicts the roads, buildings and other significant features located within the Sites in their true geographic position. However, distortion

caused by the height of buildings was not removed. As a result, the bases of these structures are displayed in their true position, while their tops may be displaced.

Digital orthophotos are widely accepted today by both government and industry as an improvement over the base maps and photomosaics previously used to show the locations of features within a geographic area. Digital orthophotos have the accuracy of a stereoplotter or land survey produced map with the resolution of a photograph. Digital orthophotomosaics are more accurate and easier to produce than photomosaics. Google Earth/ Google Maps are examples of software that uses digital orthophotos.

Photointerpretation

It is an accepted practice in photointerpretation to rely upon different types of information such as oblique aerial photography, ground photography, maps, ground surveys and site investigation studies in addition to vertical aerial photography and the interpreter's experience and training. This study relied primarily upon aerial photography, maps and my experience and training

Photointerpretation of the Sites was conducted on the digital stereoplotter using the same digital stereo models used to produce the digital orthophotos. The digital stereoplotter allowed me to view the Sites in 3-D on a stereo, 20" computer monitor or large computer projection screen, normally at magnification factors ranging from 8X to 32X while identifying and mapping the outlines of significant environmental features. I also reviewed the aerial photography in a time lapse format using a geographic information system containing the geo-registered orthophotos.

When necessary to map very small features, I could zoom to magnification factors as high as 128X. Generally speaking, zoom settings greater than 32X do not yield more detail, but they do help in carefully mapping small features.

The photointerpretation done with the digital stereoplotter captured all features in their true position. Each class of significant features mapped was recorded on a separate layer and color-coded. The vector files and images were then exported from the soft copy system to a personal computer for further use. The digital stereoplotter (soft copy) when used in this manner is an extremely powerful photointerpretation tool.

ArcGIS

The digital orthophotos with the interpretation overlays were next imported into ArcGIS. ArcGIS is a very popular geographic information system (GIS) produced by ESRI and sold throughout the world. For the purposes of this report, the interpreted images will be referred to as "mapped images".

The interpreted images, registered maps, oblique photography and ground photography located in the interpretations section of this report contain specific information which must be viewed by the reader in order to fully understand this report. The mapped images (Attachment B) constitute the primary source of information in this report. They were prepared so that they may be displayed using computer generated prints or a computer projection system running ArcGIS or PowerPoint software. ArcGIS provides a wide range of capabilities such as zooming, turning themes (layers) on and off and measuring distances.

Conclusions

No target buoys or target ships were seen in any of the limited dates of photography obtained for this report. The gunnery targets (buoys) that were floating on the water would not be present from day to day. Frequent photomissions would be required to capture when the targets would be present. Spent ordnance was not visible in the water.

Hence, I was unable to map any locations in the water where ordnance expended by shore defense batteries may still be found today. I was however able to identify and map piers where ships may have been loaded and unloaded during the war. These locations are depicted on the georegistered aerial photography and maps in this report. The oblique and ground photography taken during the war also shows ships moored in Dutch Harbor and near to the naval base.

The recent photography shows the former locations of the coastal defense guns and ammunition bunkers of which there were many. These features could be accurately mapped but they are not the subject of this report.

The reader should review my interpreted and mapped photography while reading this report as it conveys the majority of my findings in my report**.**

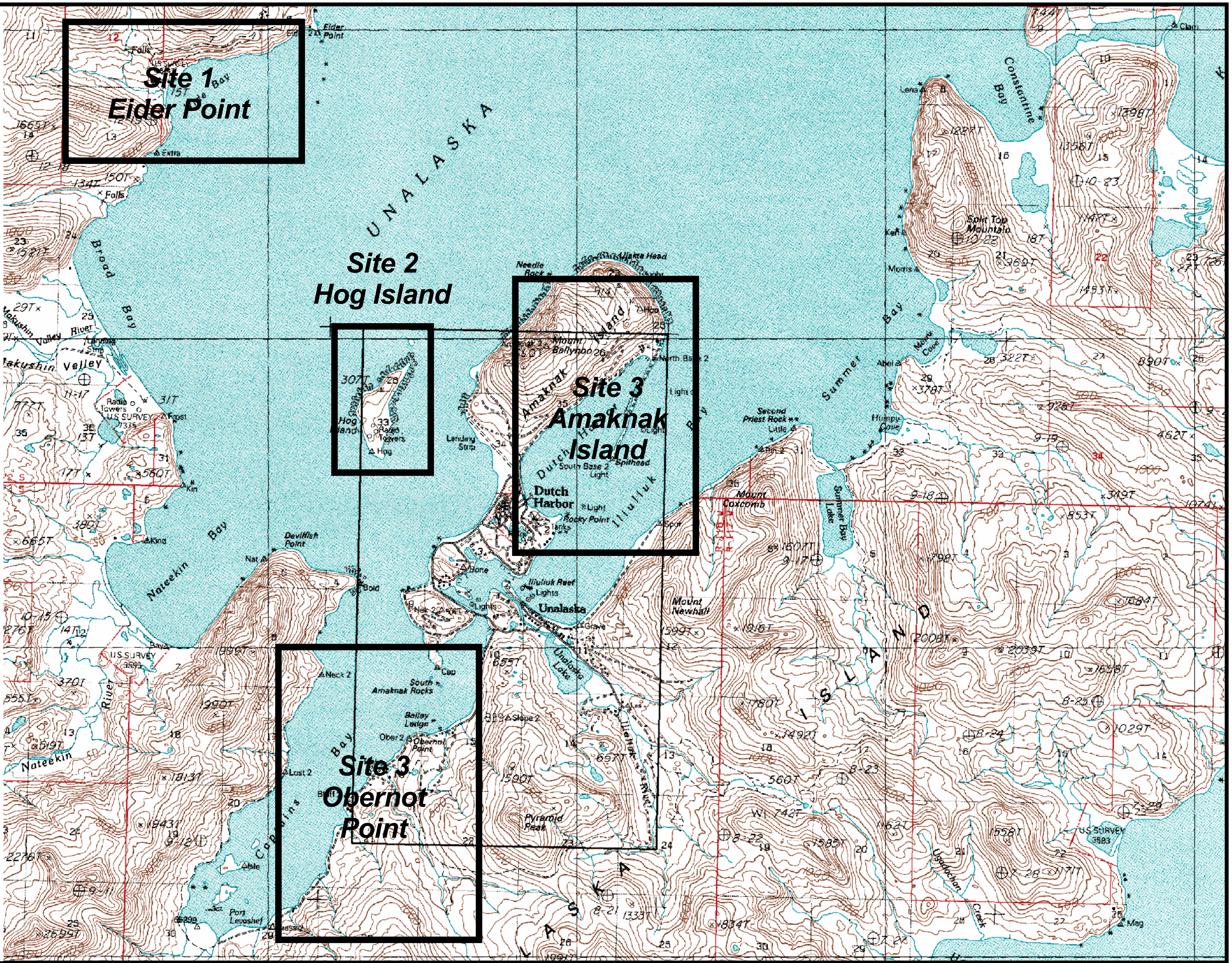
ATTACHMENT A - AERIAL PHOTOGRAPHS AND MAPS

SITE	STATUS	DATE	SOURCE	TYPE	RATIO	ROLL	FRAMES	DESCRIPTION
Unalaska All Sites	Received	1990	USGS	MAP	1:63,360			"Unalaska C-2" Topographic Map
Unalaska All Sites	Received	9/12/2005	DigitalGlobe Quickbird	COLOR			Orthophoto	Satellite Imagery.
Unalaska Site 1 Eider Point	Ordered	9/26/1950	NARA	BW	1:43,000	91SRW-91RTS-M467 Proj 50 M6	31-33, 52-54	Stereoscopic Aerial Photography.
Unalaska Site 2 Hog Island	Received	6/20/1951	USGS	BW	1:42,000	2	29-33	Stereoscopic Aerial Photography.
Unalaska Site 3 Obernot Point	Received	6/20/1951	USGS	BW	1:42,000	2	10-14	Stereoscopic Aerial Photography.
Unalaska Site 4 Amaknak Island	Received	6/20/1951	USGS	BW	1:42,000	2	29-33	Stereoscopic Aerial Photography.
Unalaska Site 4 Amaknak Island	Received	5/25/1942	NARA	BW	Oblique			Oblique Aerial Photograh. Dutch Harbor Naval Station and Fort Mears.
Unalaska Site 4 Amaknak Island	Received	6/27/1942	Naval History & Heritage Command	BW	Oblique		80-G-215442	Oblique Photograph. View of the Dutch Harbor Naval Air Station. Shows the burned out S.S. Northwestern at its center. She had been hit in the Japanese air raid on June 4, 1942.
Unalaska Site 4 Amaknak Island	Received	11/8/1943	Naval History & Heritage Command	BW	Oblique		80-G-343740	Oblique Aerial Photograph. View of Dutch Harbor looking east, with the Naval Air Station at Right.
Unalaska Site 4 Amaknak Island	Received	1942-1945	Alaska Digital Archives	BW	Oblique		ASL-P338-0058	Oblique Photograph. Looking down on village and harbor.
Unalaska Site 4 Amaknak Island	Received	1942-1945	Alaska Digital Archives	BW	Oblique		ASL-P338-0053	Oblique Aerial Photograph. View of Dutch Harbor. Wide view of city, naval base and harbor.

ATTACHMENT A - AERIAL PHOTOGRAPHS AND MAPS

SITE	STATUS	DATE	SOURCE	TYPE	RATIO	ROLL	FRAMES	DESCRIPTION
Unalaska Site 4 Amaknak Island	Received	1942-1945	Alaska Digital Archives	BW	Oblique		ASL-P338-0431	Oblique Photograph. Navy ships in Dutch Harbor. Ship at wharf along with smaller vessel.

Attachment B



N

Exhibit 1 - Unalaska
Site Map

Image Source: USGS

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392000 392500 393000 393500 394000 394500 395000

5980000 5979500 5979000 5978500

12

Falls

U.S SURVEY
8447

15T
Wide

Bay

Eide

12-19

13

Extra

Exhibit 2 - Unalaska Site 1
Eider Point
DRG

Map Source: USGS

392500 393000 393500 394000 394500 395000

900 0 900 Feet

N

Tic Marks : UTM Zone 3N NAD83 Meters

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392000 392500 393000 393500 394000 394500 395000

5980000 5979500 5979000 5978500

Exhibit 3 - Unalaska Site 1
Eider Point
9/12/2005
Image Source: Quickbird

392500 393000 393500 394000 394500 395000

900 0 900 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

Possible Pier/Mooring Point

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396000 396300 396600 396900 397200 397500

5975100 5974800 5974500 5974200 5973900 5973600 5973300 5973000

307

Hog Island

28

33

Radio Towers

Hog

Exhibit 4 - Unalaska Site 2
Hog Island
DRG

Map Source: USGS

400 0 400 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

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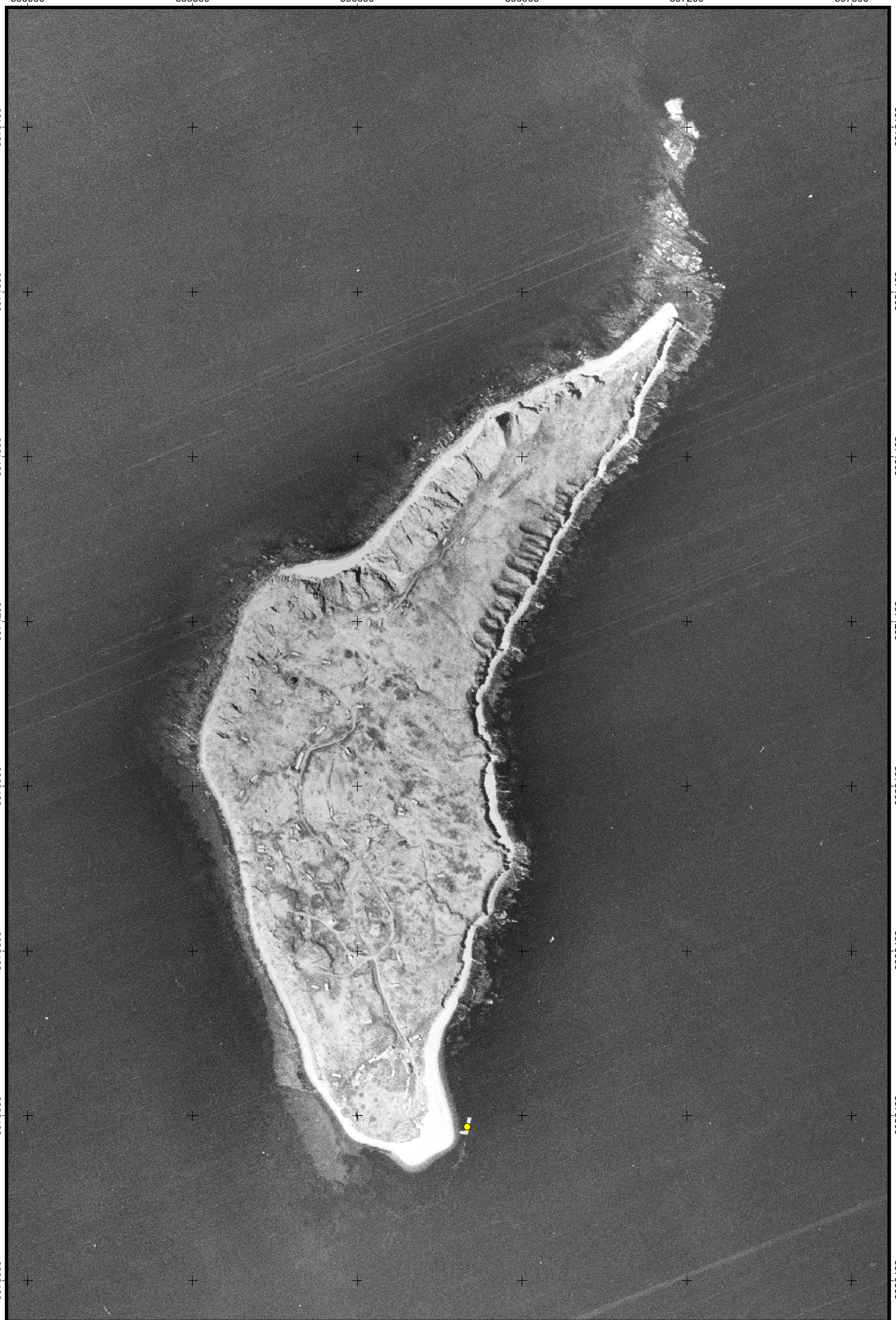
396000 396300 396600 396900 397200 397500

5975100 5974800 5974500 5974200 5973900 5973600 5973300 5973000



396600 396900 397200 397500

Exhibit 5 - Unalaska Site 2
Hog Island
6/20/1951

Image Source: USGS

400 0 400 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

Possible Pier/Mooring Point

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396000 396300 396600 396900 397200 397500

5975100 5974800 5974500 5974200 5973900 5973600 5973300 5973000

Exhibit 6 - Unalaska Site 2
Hog Island
9/12/2005

Image Source: Quickbird

400 0 400 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

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225.767.5725

395500 396000 396500 397000 397500 398000

5970000 5969500 5969000 5968500 5968000 5967500 5967000 5966500 5966000 5965500

Neck 2

Cap

South Amaknak Rocks

Bailey Ledge

Ober 2

Obernoi Point

Tanks

Lost 2

Bluff 2

15

16

21

22

28

27

Exhibit 7 - Unalaska Site 3
Obernot Point
DRG

Image Source: USGS

800 0 800 Feet

N

Tic Marks : UTM Zone 3N NAD83 Meters

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395500 396000 396500 397000 397500 398000

5970000 5969500 5969000 5968500 5968000 5967500 5967000 5966500 5966000 5965500

Exhibit 8 - Unalaska Site 3
Obernot Point
6/20/1951

Image Source: USGS

800 0 800 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

Possible Pier/Mooring Point

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225.767.5725

395500 396000 396500 397000 397500 398000

5970000 5969500 5969000 5968500 5968000 5967500 5967000 5966500 5966000 5965500

Exhibit 9 - Unalaska Site 3
Obernot Point
9/12/2005

Image Source: Quickbird

800 0 800 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

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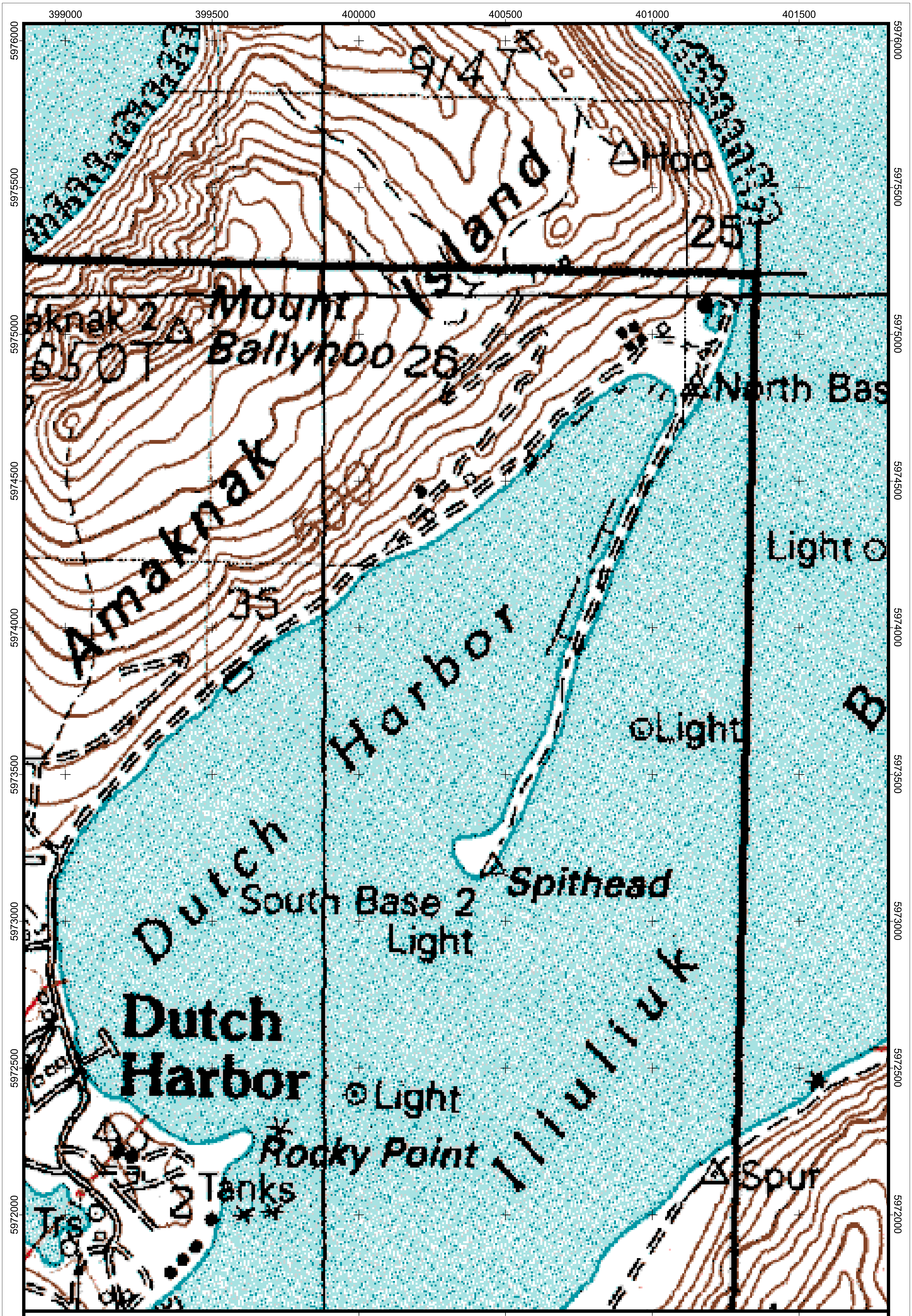

Exhibit 10 - Unalaska Site 4
Amaknak Island
DRG

Map Source: USGS

700 0 700 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

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399000 399500 400000 400500 401000 401500

5976000 5975500 5975000 5974500 5974000 5973500 5973000 5972500 5972000

Exhibit 11 - Unalaska Site 4
Amaknak Island
6/20/1951

Image Source: USGS

700 0 700 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

Approx. Ship Location
Possible Pier/Mooring Point

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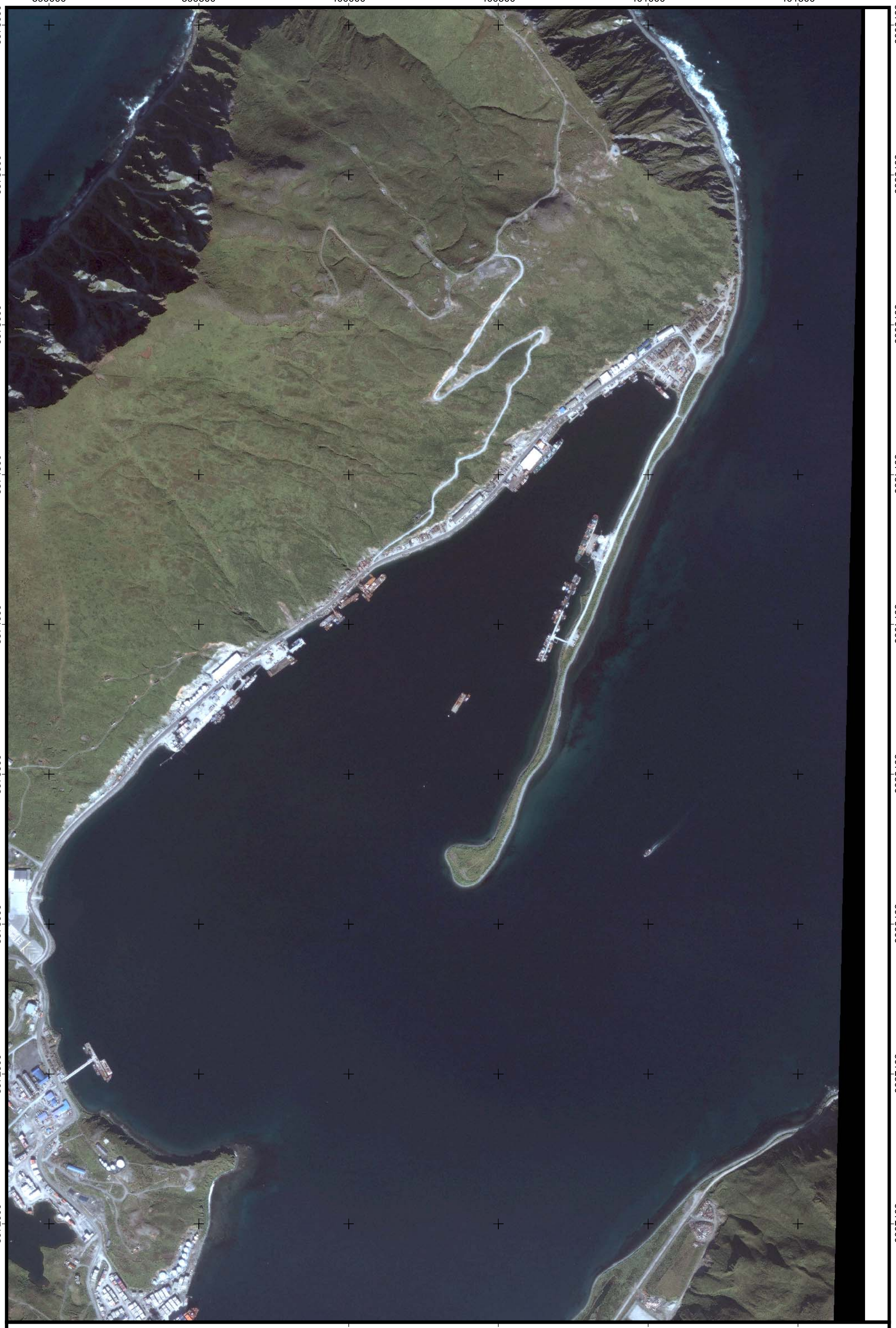
399000 399500 400000 400500 401000 401500

5976000 5975500 5975000 5974500 5974000 5973500 5973000 5972500 5972000



400000 400500 401000 401500

Exhibit 12 - Unalaska Site 4
Amaknak Island
9/12/2005

Image Source: Quickbird

700 0 700 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

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399000 399500 400000 400500 401000 401500

5976000 5975500 5975000 5974500 5974000 5973500 5973000 5972500 5972000

Approximate ship location
from Exhibit 16 11/8/1943
oblique photo

Approximate ship location
from Exhibit 16 11/8/1943 oblique photo

Approximate ship location
from Exhibit 15 6/27/1942 oblique photo

Approximate ship location
from Exhibit 15 6/27/1942 oblique photo

Approximate ship locations
from Exhibit 19 1942-1945 oblique photo

Exhibit 13 - Unalaska Site 4
Amaknak Island Composite Map
6/20/1951

Image Source: USGS

700 0 700 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

Approx. Ship Location
Possible Pier/Mooring Point

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Exhibit 14 - Unalaska
Dutch Harbor
5/25/1942
Image Source: NARA

Dutch Harbor Naval Air Station and Fort Mears.

Exhibit 15 - Unalaska
Dutch Harbor
6/27/1942

Image Source: Naval History

VIEW OF THE DUTCH HARBOR NAVAL AIR STATION, ON 27 JUNE 1942. THE BURNED OUT S.S. NORTHWESTERN IS AT CENTER. SHE HAD BEEN HIT IN THE JAPANESE AIR RAID ON 4 JUNE 1942.

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Exhibit 16 - Unalaska
Dutch Harbor
11/8/1943
Image Source: Naval History

AERIAL OF DUTCH HARBOR, LOOKING EAST, WITH THE NAVAL AIR STATION AT RIGHT, 8 NOVEMBER 1943.

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Alaska State Library - Historical Collections

Exhibit 17 - Unalaska
Dutch Harbor
Date Range 1942-1945

Image Source: Alaska Digital

Looking down on village and harbor.

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Exhibit 18 - Unalaska
Dutch Harbor
Date Range 1942-1945

Image Source: Alaska Digital

Aerial view of Dutch Harbor/Unalaska.

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Alaska State Library - Historical Collections

Exhibit 19 - Unalaska
Dutch Harbor
Date Range 1942-1945
Image Source: Alaska Digital

Ship at wharf, along with smaller vessel.

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Attachment C - Exhibit Notes

	Name	***Description***	***Notes***
Exhibit 1	Unalaska Site Map	Site Map on USGS Quad Map with areas of study delineated with black boxes	
Exhibit 2	Unalaska Site 1 - Eider Point DRG	Study area of Eider Point - USGS Quad Map	
Exhibit 3	Unalaska Site 1 -Eider Point 9/12/2005	Eider Point study area with three pier/mooring points identified on 2005 image	
Exhibit 4	Unalaska Site 2 - Hog Island DRG	Study area of Hog Island - USGS Quad Map	
Exhibit 5	Unalaska Site 2 - Hog Island 6/20/1951	Hog island study area with one pier/mooring point identified on southeast tip of island	
Exhibit 6	Unalaska Site 2 - Hog Island 9/12/2005	Study area of Hog Island - 2005 Image	
Exhibit 7	Unalaska Site 3 - Obernot Point DRG	Study area of Obernot Point - USGS Quad Map	
Exhibit 8	Unalaska Site 3 - Obernot Point 6/20/1951	Obernot Point study area with four pier/mooring points identified	
Exhibit 9	Unalaska Site 3 - Obernot Point 9/12/2005	Study area of Obernot Point - 2005 Image	
Exhibit 10	Unalaska Site 4 - Amaknak Island DRG	Study area of Amaknak Island - USGS Quad Map	
Exhibit 11	Unalaska Site 4 - Amaknak Island 6/20/1951	Amaknak Island study area with eight pier/mooring points and three ships identified	
Exhibit 12	Unalaska Site 4 - Amaknak Island 9/12/2005	Study area of Amaknak Island - 2005 Image	
Exhibit 13	Unalaska Site 4 - Amaknak Island Composite Map	Features mapped from 1951 imagery along with features in their estimated location based on oblique and ground photos	
Exhibit 14	Unalaska Dutch Harbor 5/25/1942	Oblique Image showing Dutch Harbor Naval Air Station and Ft. Mears	
Exhibit 15	Unalaska Dutch Harbor 6/27/1942	Oblique Image showing the burned out S.S. Northwestern and a Smaller Ship	Approx. Ship locations plotted on Exhibit 13

Exhibit 16	Unalaska Dutch Harbor 11/8/1943	Oblique Image of Dutch Harbor looking east	Approx. Ship locations plotted on Exhibit 13
Exhibit 17	Unalaska Dutch Harbor Date Range 1942-1945	Oblique Image looking down on village and harbor	
Exhibit 18	Unalaska Dutch Harbor Date Range 1942-1945	Oblique Image of Dutch Harbor	
Exhibit 19	Unalaska Dutch Harbor Date Range 1942-1945	Oblique image of ship at wharf, along with smaller vessel	Approx. Ship locations plotted on Exhibit 13

STATEMENT OF OPINIONS
WAYNE M. GRIP
AERO-DATA CORPORATION
CONCERNING INTERPRETATION OF AERIAL PHOTOGRAPHS
OF EIDER POINT, UNALASKA ISLAND NAVAL DEFENSIVE AREA

IN

THE ALEUTIAN ISLANDS, ALASKA

JANUARY 2013

Wayne M. Grip

Introduction
I was engaged to perform an historical aerial photography study of Eider Point within the Unalaska Island Naval Defensive Sea Area. I was asked to obtain and interpret aerial photography primarily for the World War II time period.

Aerial Imagery, satellite imagery and maps were acquired of the Site from both public and private sources. In addition, I obtained the USGS 1:63,360 topographic maps of Unalaska. The imagery and maps were registered to a common coordinate system and interpreted.

The primary purpose of this study was to use historical aerial photography to identify potential areas impacted by legacy ordnance activities.

Statement of Qualifications
My name is Wayne M. Grip. I have a BS degree in Geology from the University of Wisconsin, Madison. After I received my degree in Geology, I served as a cartographic officer in the US Air Force for four years from 1967 through 1971. In this position, I interpreted aerial photography and satellite imagery to produce air target charts (maps). Following my release from active duty, I worked for the Louisiana Department of Natural Resources (LADNR) for five years as a geologist. In this position, I flew photomissions and interpreted aerial photography to evaluate mining permit applications and to monitor oil and gas and mining operations. I also conducted many on-site inspections to determine the compliance of regulated facilities with environmental standards.

In 1982, I co-founded Aero-Data Corporation. I worked part-time for Aero-Data until 1985 when I left the LADNR and went full time with Aero-Data as its president. As of 2013, I have worked for Aero-Data for thirty years. I am currently the president and principal owner. Aero-Data specializes in aerial mapping and environmental studies using aerial photography and historical maps. I have over thirty-five years of professional experience in this field. I have served as an expert witness in the areas of photointerpretation, photogrammetry, and hydrology in both Federal and State courts in the United States. I am also an active licensed pilot with over 2,500 hours of flying time as pilot in command including over 1,000 hours of photomissions. In the past thirty years with Aero-Data Corporation, I have completed over 700 environmental site investigations in more than thirty states using historical aerial photography.

Information Considered
This report is based upon vertical stereoscopic aerial photography, maps of the Site and my experience and training. Attachment A is a listing of the aerial photography and maps that I have relied upon.

Production of Geo-Registered Images and Maps
Following my standard procedures, I have produced geo-registered imagery of the vertical aerial photography obtained for this study. In addition, maps showing the boundary of the Site and other features were geo-registered to the aerial photography. The imagery and maps are included in the attachments to this report.

Methods and Materials

Aerial research and acquisition
The historical aerial photography study of the Site began with research for available photo coverage from public and private vendors. Vertical stereoscopic imagery was acquired.

Because of the typically poor flying weather and remoteness of Unalaska Island, the availability of photography during the war years was very limited. There was no aerial photography identified that was

taken during WWII of Eider Point. Conventional aerial photography is normally taken of developed areas during clear weather with good visibility and lack of cloud cover. These conditions are very rare in the Aleutians.

The National Archives and Records Administration (NARA) catalog was researched using their Online Public Access (OPA) system. Through OPA, several record groups were identified as having possible photographic coverage. The record groups were as follows:

- RG 18 – Records of the Army Air Forces
- RG 23 – Records of the Coast and Geodetic Survey
- RG 37 – Records of the Hydrographic Office
- RG 80 – General Records of the Department of the Navy
- RG 373 – Records of the Defense Intelligence Agency

Aero-Data Corporation forwarded this information to Do You Graphics in Maryland, who performed onsite research at NARA to verify coverage. Upon completing their research, Do You Graphics sent Aero-Data Corporation the results of their findings. ***No aerial photographs from the requested World War II time period were found at NARA.***

After consulting with URS Group, Inc., Aero-Data Corporation ordered the following post-war NARA aerial photographs.

- Unalaska Site 1 – Eider Point
    - 9/26/1950, 1:43,000, Black and White

Additional photographic collections were reviewed, including the Alaska Digital Archives, which provides online access to the Alaska State Archives, Alaska State Library, Alaska State Museum and University of Alaska collections; the Library of Congress, the National Geodetic Survey; the Naval History and Heritage Command; the United States Department of Agriculture Aerial Photography Field Office; the United States Geological Survey and the Alaska District of the United States Army Corps of Engineers. ***No stereoscopic aerial photography from World War II was available from these sources.***

Initial review and date verification
All imagery that was obtained was examined for proper geographic coverage of the Site.

For the 1950 imagery acquired, the date of the photomission was stamped by the provider directly on the edge of each individual frame. The date annotation was normally added to the film by the provider shortly after the film was developed. In recent years, the date annotation has been added to the film during the instant of image exposure. Date annotation on the image has been a common practice used in the aerial photo survey industry and military dating back to the 1920's.

The date of the satellite imagery was included in metadata and other documentation provided to us from the MapMart, a provider of DigitalGlobe satellite imagery.

Scanning of Selected Photography
The aerial photographs from NARA were purchased in the form of frames consisting of vertical stereoscopic photography in a 9" X 9" digital format. The NARA frames were scanned by Do You Graphics at a resolution of 16 microns. The scanned images are true reproductions of the original photography. They are not enhancements.

Setting up the stereomodels
High resolution raster images for the 1950 stereo date of photography were then imported into a digital stereoplotter capable of providing stereoscopic viewing of the images at magnification levels ranging from 1x to 128x. The digital stereoplotter also allows precise mapping of significant environmental features, which are interpreted in the 3-D imagery.

Ground control (UTM Zone 3 NAD 83) was derived from the 9/12/2005 DigitalGlobe Quickbird satellite imagery and the USGS 1:63,360 topographic map of the area. Distant mapped features, thousands of feet off the Site but which were also visible in the aerial photography were measured (coordinates derived) from the satellite imagery and used as ground control points.

The coordinates of each selected visible ground control point were then entered into a control point file in the digital stereoplotter. The floating dot (measuring point) of the stereoplotter was carefully positioned by the operator with the hand controller, one point at a time, onto each of the visible control points and the coordinates of that point (from the ground control point file) were assigned to the image. When sufficient control points had been visited, accepted and the model checked for residual errors, the stereo model was then confirmed to be level, scaled and locked into the coordinate system. As a result, accurate measurements of heights and distances could now be made within the stereo model area by using the digital stereoplotter.

Digital Ortho Production
Next, using the stereomodels and digital stereoplotter, a digital orthophoto was produced of the 1950 photography. A digital orthophoto is a two dimensional raster image produced from one or more frames of vertical aerial photography such that most of the distortion caused by terrain displacement and tip and tilt in the mapping camera has been removed, and the resulting raster image is accurately registered to a chosen coordinate system. As a result, each digital orthophoto accurately depicts the roads, buildings and other significant features located within the Sites in their true geographic position. However, distortion caused by the height of buildings was not removed. As a result, the bases of these structures are displayed in their true position, while their tops may be displaced.

Digital orthophotos are widely accepted today by both government and industry as an improvement over the base maps and photomosaics previously used to show the locations of features within a geographic area. Digital orthophotos have the accuracy of a stereoplotter or land survey produced map with the resolution of a photograph. Digital orthophotomosaics are more accurate and easier to produce than photomosaics. Google Earth/ Google Maps are examples of software that uses digital orthophotos.

Photointerpretation
It is an accepted practice in photointerpretation to rely upon different types of information such as oblique aerial photography, ground photography, maps, ground surveys and site investigation studies in addition to vertical aerial photography and the interpreter's experience and training. This study relied primarily upon aerial photography, maps and my experience and training

Photointerpretation of the Site was conducted on the digital stereoplotter using the same digital stereo models used to produce the digital orthophotos. The digital stereoplotter allowed me to view the Sites in 3-D on a stereo, 20" computer monitor or large computer projection screen, normally at magnification factors ranging from 8X to 32X while identifying and mapping the outlines of significant environmental features. I also reviewed the aerial photography in a time lapse format using a geographic information system containing the geo-registered orthophotos.

When necessary to map very small features, I could zoom to magnification factors as high as 128X. Generally speaking, zoom settings greater than 32X do not yield more detail, but they do help in carefully mapping small features.

The photointerpretation done with the digital stereoplotter captured all features in their true position. Each class of significant features mapped was recorded on a separate layer and color-coded. The vector files and images were then exported from the soft copy system to a personal computer for further use. The digital stereoplotter (soft copy) when used in this manner is an extremely powerful photointerpretation tool.

ArcGIS

The digital orthophotos with the interpretation overlays were next imported into ArcGIS. ArcGIS is a very popular geographic information system (GIS) produced by ESRI and sold throughout the world. For the purposes of this report, the interpreted images will be referred to as "mapped images".

The interpreted images and registered maps located in the interpretations section of this report contain specific information which must be viewed by the reader in order to fully understand this report. The mapped images (Attachment B) constitute the primary source of information in this report. They were prepared so that they may be displayed using computer generated prints or a computer projection system running ArcGIS or PowerPoint software. ArcGIS provides a wide range of capabilities such as zooming, turning themes (layers) on and off and measuring distances.

Conclusions

No target buoys or target ships were seen in any of the limited dates of photography obtained for this report. The gunnery targets (buoys) that were floating on the water would not be present from day to day. Frequent photomissions would be required to capture when the targets would be present. Spent ordnance was not visible in the water.

Hence, I was unable to map any locations in the water where ordnance expended by shore defense batteries may still be found today. I was however able to identify and map piers where ships may have been loaded and unloaded during the war. These locations are depicted on the georegistered aerial photography and maps in this report.

The reader should review my interpreted and mapped photography while reading this report as it conveys the majority of my findings in my report**.**

ATTACHMENT A - AERIAL PHOTOGRAPHS AND MAPS

SITE	DATE	SOURCE	TYPE	PHOTO RATIO OR ORTHOPHOTO RESOLUTION	ROLL	FRAMES	DESCRIPTION
Unalaska Site 1 Eider Point	8/5/1946	Corps of Engineers	MAP				Eider Point, As Constructed Drawing Plot Plan
Unalaska Site 1 Eider Point	1990	USGS	MAP	1:63,360			"Unalaska C-2" Topographic Map
Unalaska Site 1 Eider Point	9/26/1950	NARA	BW	1:43,000	91SRW-91RTS-M467 Proj 50 M6	31-33, 52-54	Stereoscopic Aerial Photography.
Unalaska Site 1 Eider Point	9/12/2005	DigitalGlobe Quickbird	COLOR	2 foot		Orthophoto	Satellite Imagery.

Attachment B

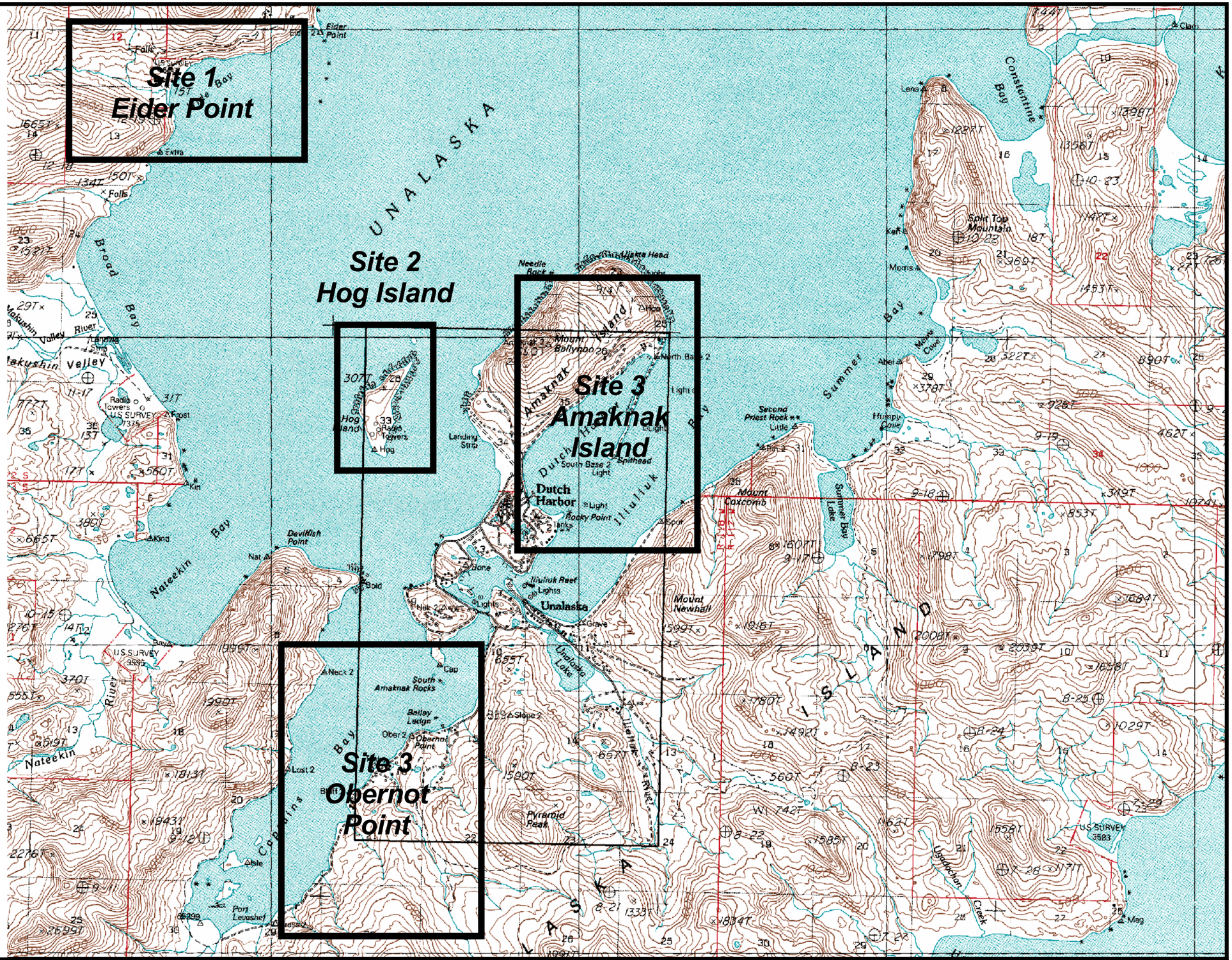

Exhibit 1 - Unalaska
Site Map

Image Source: USGS

N

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392000 392500 393000 393500 394000 394500 395000

5980000 5979500 5979000 5978500

12

Falls

U.S SURVEY
8447

15T Boy
Wide

12-19

13

Extra

Eide

392500 393000 393500 394000 394500 395000

Exhibit 2 - Unalaska Site 1
Eider Point
DRG

Map Source: USGS

900 0 900 Feet

N

Tic Marks : UTM Zone 3N NAD83 Meters

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392000 392500 393000 393500 394000 394500 395000

5980000

5979500

5979000

5978500

Exhibit 2B - Unalaska Site 1
Eider Point
9/26/1950

Image Source: NARA

392500 393000 393500 394000 394500 395000

900 0 900 Feet

Tic Marks : UTM Zone 3N NAD83 Meters

N

Possible Pier/Mooring Point

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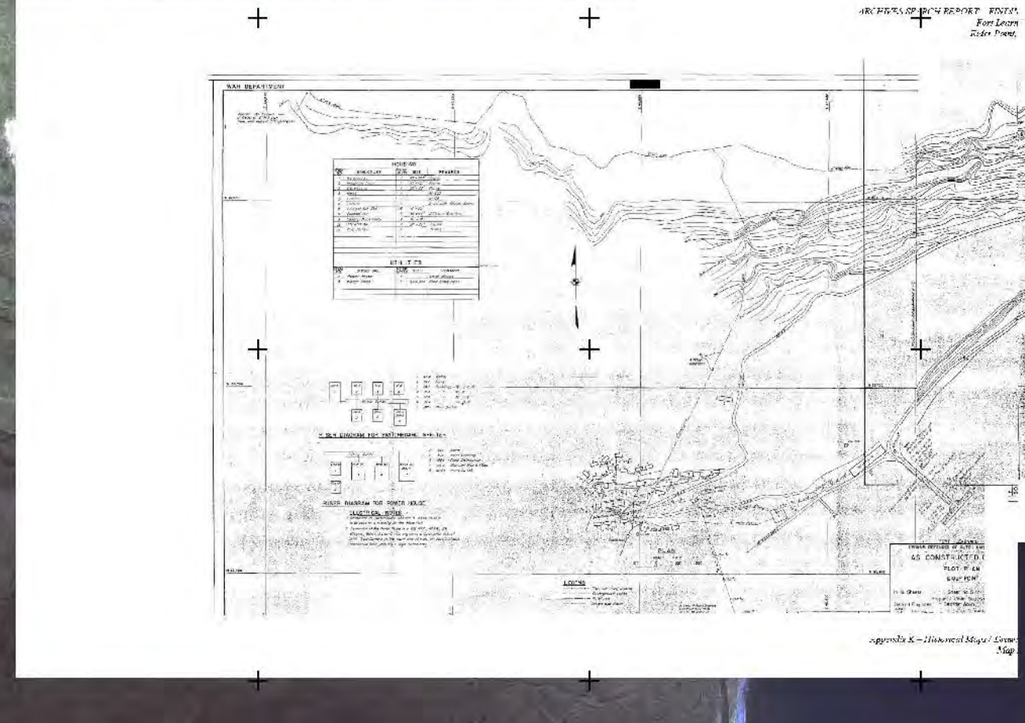

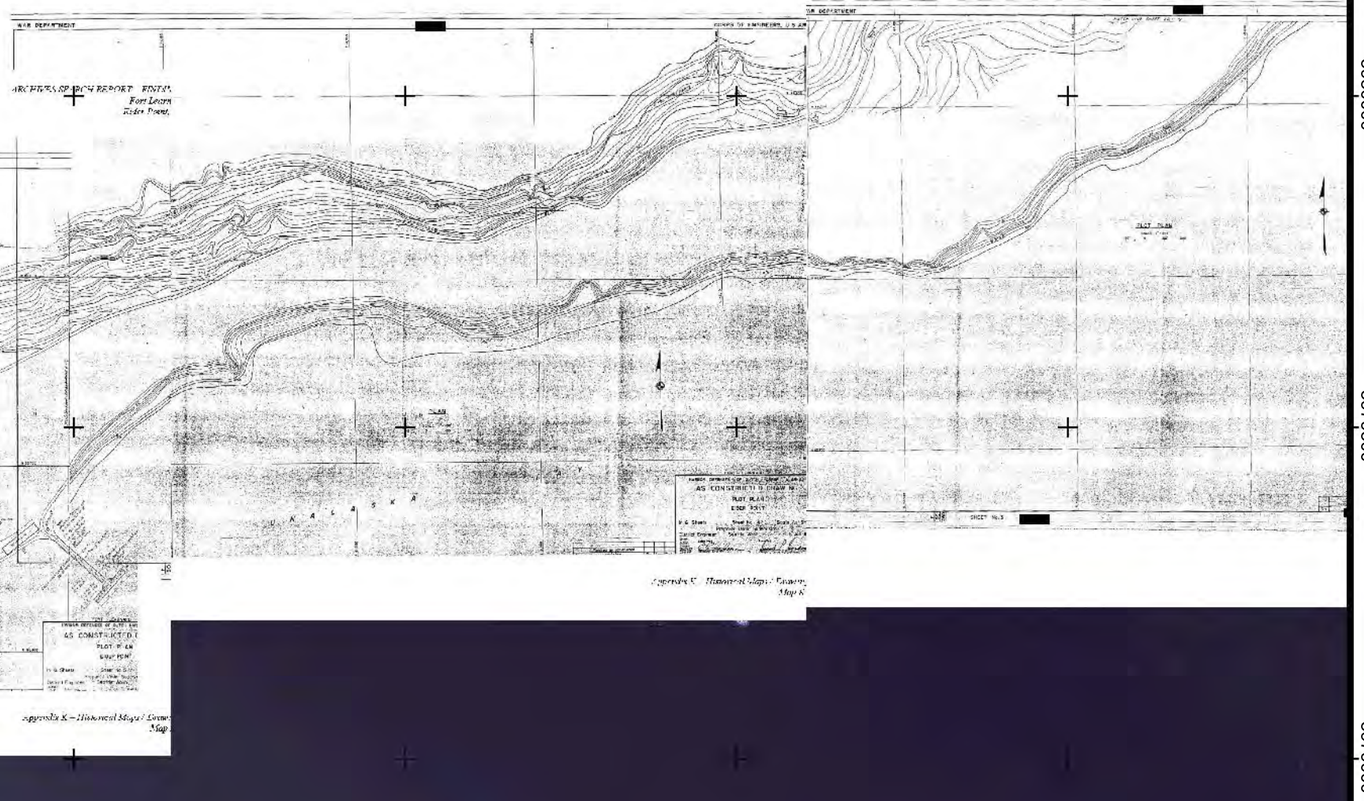

Exhibit 2C - Unalaska Site 1
Eider Point 8/5/1946 Maps
Superimposed on 2005 Imagery

Map Source: COE-Seattle

392500 393000 393500 394000 394500 395000

900 0 900 Feet

N

Tic Marks : UTM Zone 3N NAD83 Meters

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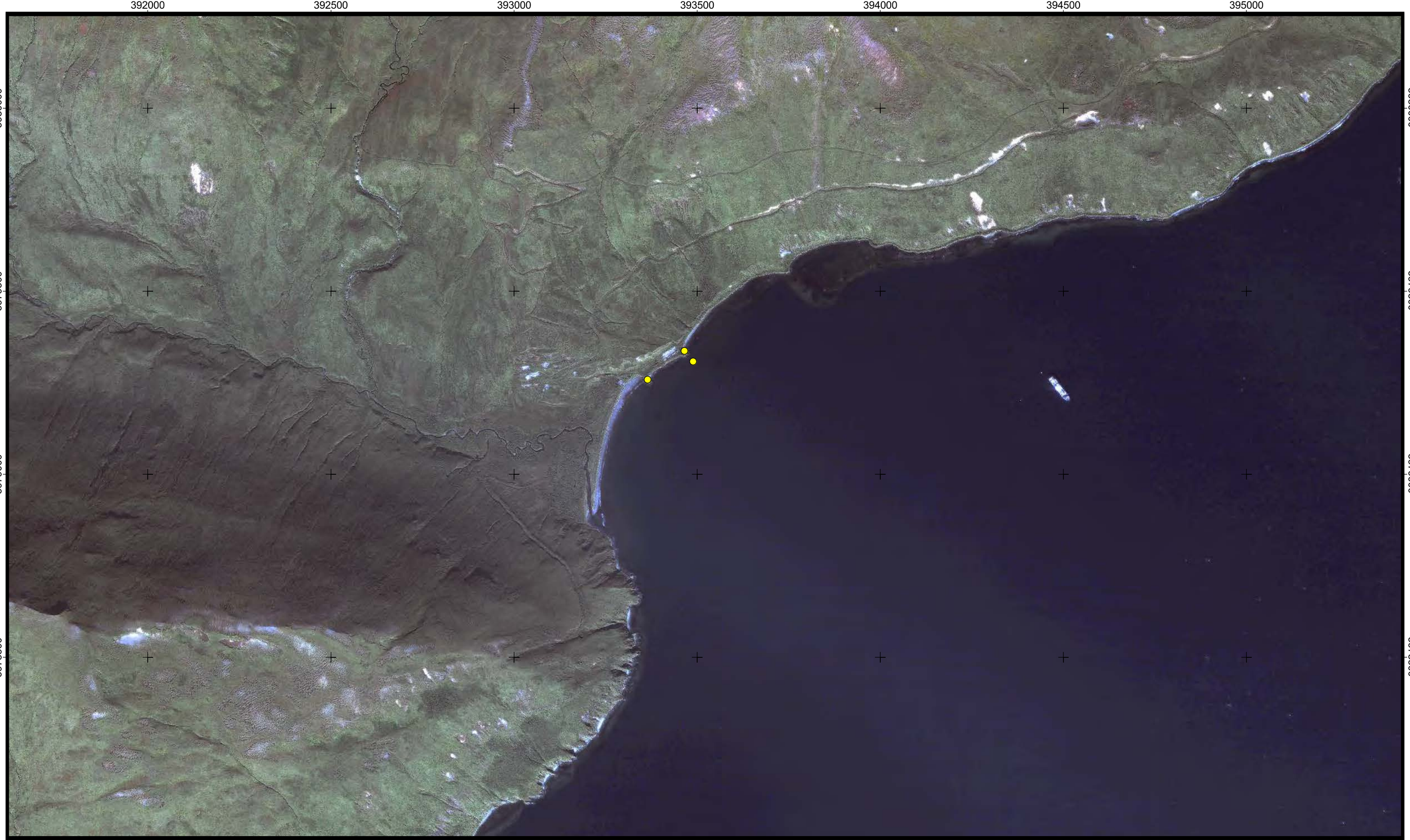
392000 392500 393000 393500 394000 394500 395000

5980000 5979500 5979000 5978500



392500 393000 393500 394000 394500 395000

900 0 900 Feet

N

Possible Pier/Mooring Point

Exhibit 3 - Unalaska Site 1
Eider Point
9/12/2005

Image Source: Quickbird

Tic Marks : UTM Zone 3N NAD83 Meters

AERO - DATA CORP.
Environmental
Remote Sensing Consulting Services
Interpretation and Mapping
225.767.5725

Attachment C - Exhibit Notes

	Name	***Description***	***Notes***
Exhibit 1	Unalaska Site Map	Site Map on USGS Quad Map with areas of study delineated with black boxes	
Exhibit 2	Unalaska Site 1 - Eider Point DRG	Study area of Eider Point - USGS Quad Map	
Exhibit 2B	Unalaska Site 1 - Eider Point 9/26/1950	Eider Point study area with 2 piers, 0 mooring points, and 0 ships identified	
Exhibit 2	Unalaska Site 1 - Eider Point 8/5/1946 Maps	Eider Point study area historical maps superimposed on 2005 image	
Exhibit 3	Unalaska Site 1 -Eider Point 9/12/2005	Eider Point study area with three pier/mooring points identified on 2005 image	

APPENDIX C

Evidence of Munitions and Explosives of Concern Located Outside of the NDSA

Although the Navy Munitions Response Program only addresses MEC within NDSAs at depths less than 20 fathoms, it is important to document locations of potential MEC disposal areas near the Dutch Harbor area even though they may be beyond the NDSA boundary. This appendix describes evidence of a 1947 ordnance disposal area and instances of commercial fishers bringing up MEC from the seafloor in 2012. This information was identified during research for this project.

The official War Diary for Dutch Harbor indicates that from August through November 1945, the Ordnance Department disposed of more than 227 tons of ammunition out at sea. The ammunition types included unspecified quantities of depth charges, bombs, bomb fuses, 37-mm, 40-mm, and 3-inch AA shells, and .50-caliber and smaller rounds. The disposal locations were not reported (War Diary n.d.).

During the archive search for this project, five confidential reports from the Commander of NOB Dutch Harbor to the Commandant of Seventeenth Naval District were found that detailed ammunition disposal at sea conducted between April 11 and September 24, 1947 (Meehan 1947a, b, c, d, and e). The reports document the disposal in deep water (approximately 625 fathoms [3,750 feet]) of excess ammunition at position 54^{o} 11' north latitude by 166^{o} 41' west longitude. The location of this disposal site is shown on Figure C-1. The excess ammunition reported to be disposed of at this location during this 5-month period consists of the following DMM items:

- 438 Mk.13 bombs
- 405 Mk.12 bombs
- 228 Mk.4 bombs
- 48 Mk.10 depth charges
- 5 Mk.7 depth charges
- 89 350-pound depth bombs
- 780 5-inch Mk.1 rocket heads
- 492 7.5-inch Mk.4 rocket heads
- 120 Mk.230 bomb fuses
- 36 Mk.228 bomb fuses
- 21 Mk.224 bomb fuses
- 561 Mk.221 and 223 bomb fuses in pairs
- 1,491 Mk.219 bomb fuses
- 219 Mk.131 bomb fuses
- 659 Mk.136 bomb fuses
- 600 AN-N 103 bomb fuses
- 304 AN-N 100A1 bomb fuses
- 460 AN-N 102A1 bomb fuses
- 37 E115 bomb fuses, 4- to 5-second delay
- 428 impulse projector charges
- 59 AN Mk.3 destructors
- 350 Mk.2 W/IF M10A2 grenades
- 3,200 30 to 40 Krag

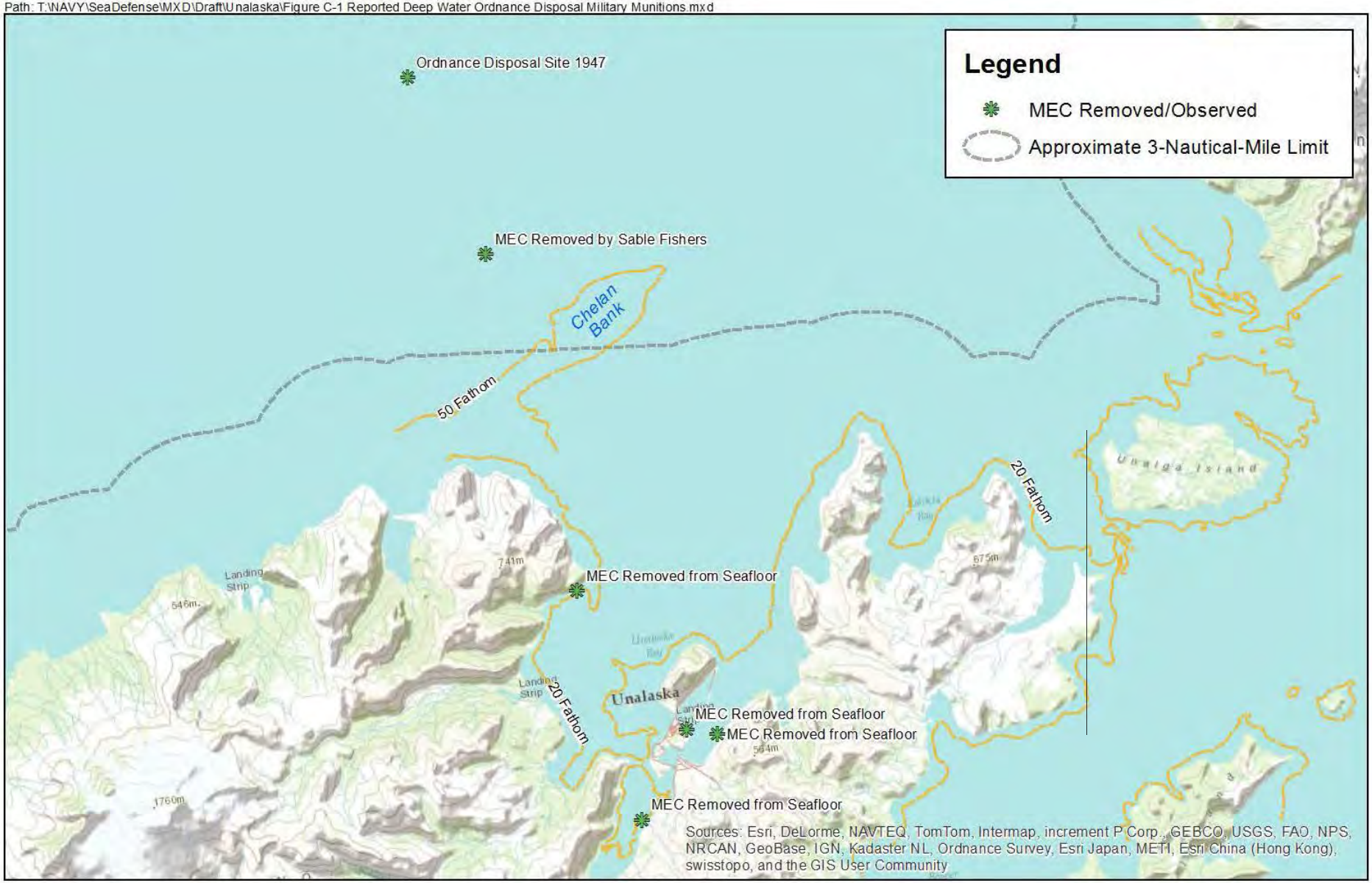
- 39,000 .300 RAF
- 40,000 (approximate) 20-mm rounds
- 25,000 (approximate) .50-caliber rounds

As recently as June 2012, fishers from Dutch Harbor pulled up MEC from the seafloor. The crew of the fishing vessel *Aleutian Sable* pulled up what appeared to be a World War II era land mine (Paulin 2012 and Rosenthal 2012a). The land mine was snagged while fishing for sablefish using pots that were dragged along the sea floor during retrieval. The *Aleutian Sable* pulled up a second MEC item (projectile) on the same day (Rosenthal 2012b).

The crew of the *Aleutian Sable* found the two ordnance items at position 54°06'29" north latitude by 166°38'01" west longitude (Henley 2012). This location, shown on Figure C-1, is north of Unalaska Bay on the northern side of the Chelan Bank in approximately 400 fathoms (2,400 feet) of water. The *Aleutian Sable* typically fishes for sablefish in water that is 250 to 450 fathoms (1,500 to 2,700 feet), but has fished as deep as 650 fathoms (3,900 feet) (Henley 2012).

The crew of the *Aleutian Sable* also previously encountered MEC while fishing near the Chelan Bank (Henley 2012). The crew pulled up several rifle shells, and one exploded in a crewman's hand. The other crew smelled the sulfur odor from the small explosion. No one was seriously injured. In a subsequent interview, the skipper of the *Aleutian Sable* said that he had found ordnance on several occasions near the Chelan Bank where he fishes (Hebert 2012).

Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\Figure C-1 Reported Deep Water Ordnance Disposal Military Munitions.mxd



U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	0 2 4 Scale In Miles	**Figure C-1** **Reported Deep-Water Ordnance Disposal and Discarded Military Munitions Recovery Areas Near Dutch Harbor**

APPENDIX D

3Rs Explosives Safety Guide, Maritime Industry

3Rs Explosives Safety Guide

Maritime Industry

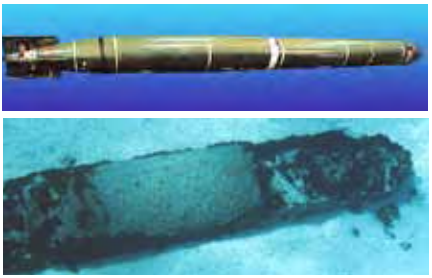
Recognize
Retreat
Report

DURING COMMERCIAL OPERATIONS SUCH AS FISHING, CLAMMING OR DREDGING; NETS; BOTTOM TENDING GEAR; AND DREDGES MAY CATCH OR DREDGE UP MUNITIONS FROM THE OCEAN. THESE MUNITIONS SHOULD BE CONSIDERED A SERIOUS DANGER TO A VESSEL AND ITS CREW.

Many vessel crews tell sea stories about catching suspicious items in their nets or dredging gear. The lucky crews live to spin their own tales, while others become the subject of tragic sea stories.

Unexploded Ordnance Recovered During Dredging

In July 1965, such a tragedy took place aboard the fishing vessel *(FV) Snoopy*. The *FV Snoopy* was trawling for scallops off the coast of North Carolina when it caught a large cylinder in its net. A witness said he could clearly see a long round object swaying in the net amidships, over the deck.



A Clean Torpedo (top) and a Heavily Corroded Torpedo on the Seafloor (bottom)

What happened next is unclear; but an explosion caused the loss of the *FV Snoopy* and eight members of her crew.

What went wrong? Was it preventable? Could something have been done to save the crew? While all these questions were asked, no one but the *FV Snoopy's* crew knows what actually happened that day. However, the tale of the *FV Snoopy* is meaningful if others learn from this tragedy.

(Note: Both commercial and sport divers should also be aware of the hazards munitions present).

To protect your crew and vessel if you encounter or suspect you have encountered a munition at sea, follow the 3Rs of explosives safety: Recognize, Retreat, Report.

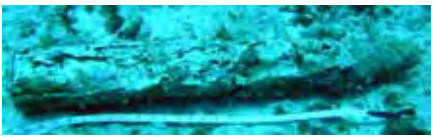
ORecognize
ORetreat
OReport

ORecognize

The military has conducted training and combat operations at sea for centuries. Prior to 1970, the U.S. military as well as the militaries of other nations also sea-disposed of excess, obsolete and unserviceable munitions either en route to port or as part of planned disposals. In the 1970s, the U.S. military stopped the practice, now only allowing it in an emergency. Mariners are cautioned they could encounter munitions during commercial operations, such as fishing or dredging. Using common sense and basic knowledge, Mariners can spin their own story rather than becoming a character in a tragic sea tale.

Various Recovered Projectiles

Munitions can be encountered anywhere at sea, not just in charted hazard areas. Munitions that may be encountered include mines, torpedoes, depth charges, artillery shells, bombs and missiles. These munitions, which can contain high explosives or chemical agents, can present a serious danger to a vessel and its crew.



Projectile and Cartridge Case on Seafloor

- Munitions, to include those that have been lying dormant in sea or fresh water for many years, should be considered extremely dangerous.
- In some cases, munitions that have been in water for a long period may become more sensitive.
- Regardless of whether encountered on land or recovered from the sea, munitions can explode when handled.
- Munitions submerged in sea or fresh water for any length of time may be:
  - Like new and easy to identify;
  - Heavily encrusted with sea growth and difficult to identify.

This guide includes drawings representative of munitions that may be encountered at sea. Drawings may help in recognizing suspect munitions.

MUNITIONS ARE DESIGNED TO BE DANGEROUS

Munitions are designed to injure, maim, or kill people, or to destroy equipment (e.g., vessels). The best protection from the potential hazards associated with munitions is to heed the warnings on nautical charts, avoid known disposal areas, and follow the 3Rs (Recognize, Retreat, Report).

CHEMICAL MUNITIONS AND CHEMICAL AGENTS

Beginning in World War I, the Department of Defense (then, the Department of War) designed toxic chemical agents to kill, seriously injure, or incapacitate an enemy. In the past, the United States and other countries sea-disposed chemical munitions and chemical agents in bulk containers, such as 55-gallon drums. As a result, some munitions or containers recovered from the sea may contain toxic chemical agents.

Recovered Chemical Filled Projectile

Vessel crews should be alert for conditions or signs that could indicate the presence of toxic chemical agents:

- Unusual odor from equipment or fish;
- A stinging sensation in the eyes, or burning or irritated skin;
- Corroded containers or suspicious clay-like lumps.

Chemical Filled Projectile Recovered from Clam Bed

IF CHEMICAL AGENTS ARE SUSPECTED, IMMEDIATE ACTION IS NECESSARY TO PROTECT THE CREW AND VESSEL.

If You Suspect You Have Encountered a Chemical Munition:

- Move all crew members up wind;
- Close all doors and hatches;
- Shut down all ventilation systems;
- Steam into the wind to carry contaminants away from the crew;
- Contact the U.S. Coast Guard for assistance

Munitions on the Seafloor

In case of physical contact with toxic chemical agents, immediately rinse the contaminated area with large amounts of water (if possible, use warm soapy water), even if no effects are felt.

Crewmembers should not work in a contaminated area and every effort should be made to prevent the spread of contaminants. Fishing vessels that have come into contact with toxic chemical agents must not bring their catch ashore until it has been checked and released by the appropriate state's Department of Environmental Health. Sea life contaminated by chemical agents is unsuitable for human or animal consumption.

A Clean Aerial Bomb Prepared for Shipping (above) and an Aerial Bomb on the Seafloor (below).

ORetreat

Because munitions present a potential explosive hazard, they should never be touched, moved or disturbed (handled); however, at sea, the specific action required will depend on the circumstances.

- If possible, crews should avoid bringing munitions (or suspect munitions) onboard. If a munition is ensnared or fouled in gear, retreat by carefully jettisoning the munition, or by cutting away the gear. If this is not possible, carefully secure the munition onboard and move and keep the crew as far away from the munition as possible.
- Great care should be taken to avoid bumping the munition; each action carries risk.

A Clean 5-inch Caliber Projectile (above) and Recovered 5-inch 38 Caliber Projectiles (below)

NEVER BRING A MUNITION OR SUSPECT MUNITION INTO PORT

Munitions Not On Board

If an actual or suspect munition is recovered:

- Immediately stop all operations;
- Do not bring the munition or gear containing it onboard, if possible;
- Do not allow the munition to come or remain along side the vessel where wave action may cause contact with the hull;

- If a munition is in the gear and has not been brought onboard, try to safely lower it back into the water and, as indicated below, note the position and report it to the U.S. Coast Guard.
- If in shallow water (less than 130 feet), lower the munition to the bottom, buoy off the net or dredge recovery lines (remain in the immediate area).
- If in deep water, stream the munition as far aft as possible and maintain steerageway as necessary.
- Remain in the area while awaiting assistance.

A Clean Rifle Grenade (above) and a Recovered Grenade. Item is about four inches long.

Munitions Onboard

- If the gear is brought over the deck with an actual or suspected munition, but remains suspended and can continue to be safely suspended in place or nearby, immediately:
- Secure the munition with guy lines to prevent further movement;
- Keep the crew away from that area.

If a suspect munition is brought onboard:

- Keep unneeded crew members as far away as possible.
- Decide whether to do one of the following:
  - Carefully jettison it, or
  - Retain it onboard.
- If jettisoned, note and report position.
- If retained onboard:
  - Limit handling and avoid hitting or bending any part of the munition;
  - Stow the munition on deck as far away as possible from heat sources, vibration and the crew, but limit handling;
  - Firmly chock and lash the munition to prevent movement;
  - Cover and/or wet to minimize the potential for:
    - Deterioration of metal parts and release of any fill;
    - Explosives to dry out and become sensitive to shock.
  - Keep crew away from item.
  - Request assistance (Channel 16--156.800 MHz).
- If within 2 or 3 hours of land, the safest measure is to notify the U.S. Coast Guard and move to a rendezvous area offshore.

Report

Careful observation is necessary prior to reporting, so that proper instructions and assistance can be provided. The information you provide may be combined with other reports to produce new warnings to mariners and update nautical charts.

Floating Mine Washed Up on Beach

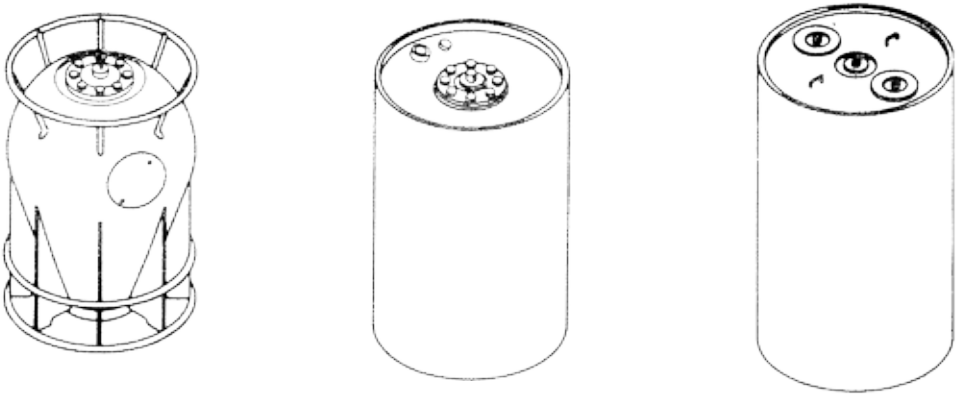
When actual or suspect munitions are encountered at sea, the vessel's captain should notify the U.S. Coast Guard and provide the below information, as soon as possible. (Note: If a munition is encountered while in port [e.g., during off loading or processing] call 911.)

- The vessel's position (use World Geodetic System 1984 [WGS-84] for reporting).
- If the exact position is unknown, give approximate coordinates, or a range and bearing from a charted feature.
- The activity being conducted when the munition was encountered (e.g., fishing, dredging).
- A general description of the munition's key features (size, shape, fins, props, markings) and condition. (Never attempt to clean, open, or tamper with a munition in any way).
- The action taken (e.g. stowed or jettisoned).
- If jettisoned, also provide:
  - The position of the release, water depth, and buoys or markings used;
  - A description of any entanglement (e.g., net, dredge) or other details.
- Any unusual odors, if noticed.
- Whether the munition was jettisoned:
  - In or near a charted munitions dump;
  - Near (within 1,000 yards of) any surface or sub-surface structures.

THE US COAST GUARD WILL NOTIFY THE APPROPRIATE MILITARY EXPLOSIVE ORDNANCE DISPOSAL UNIT TO ARRANGE FOR REQUIRED SUPPORT.

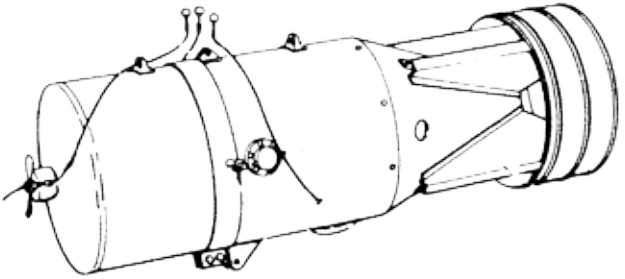
DEPTH CHARGES

Length 28" / Diameter 18" to 25"

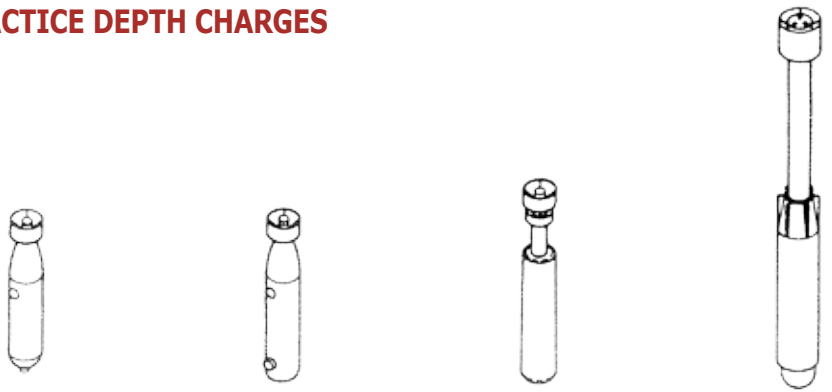


DEPTH BOMB

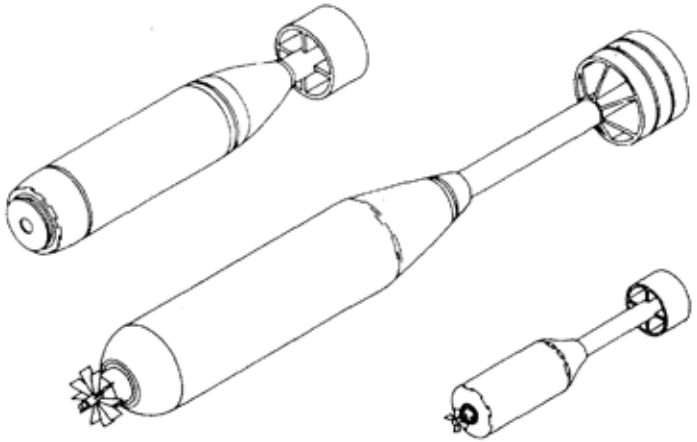
Length 50" to 59" / Diameter 15" to 18"



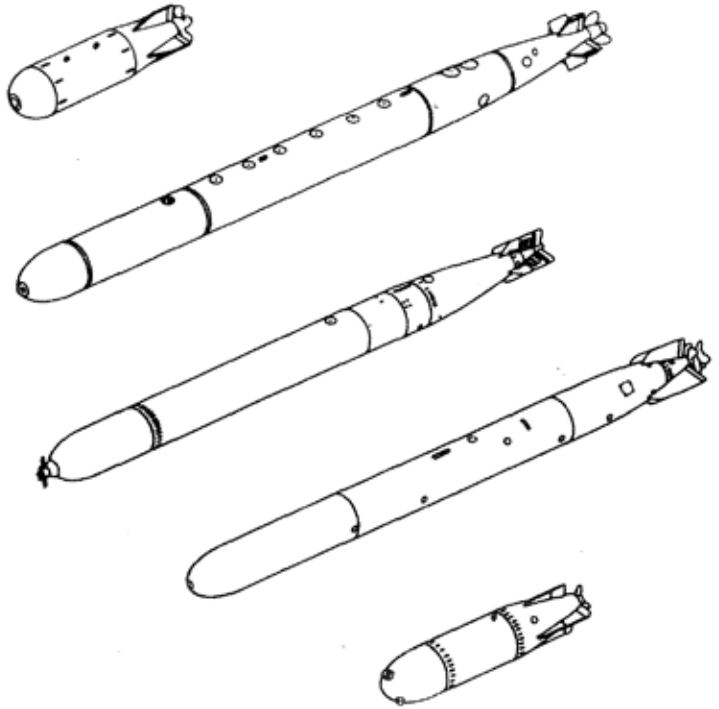
PRACTICE DEPTH CHARGES



PROJECTED ANTI-SUBMARINE-WARFARE WEAPONS



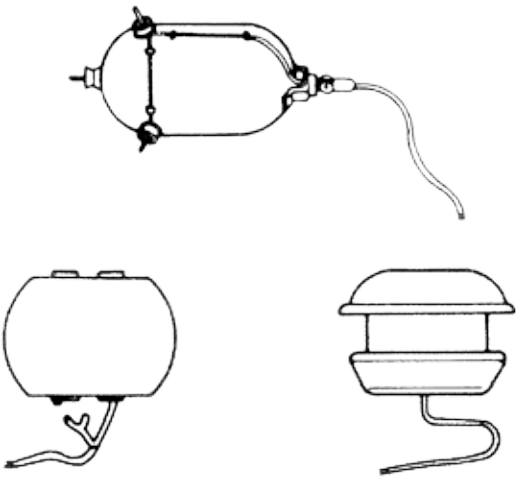
REPRESENTATIVE TORPEDOES



MISCELLANEOUS MINE FLOATS

Length 10" to 24"

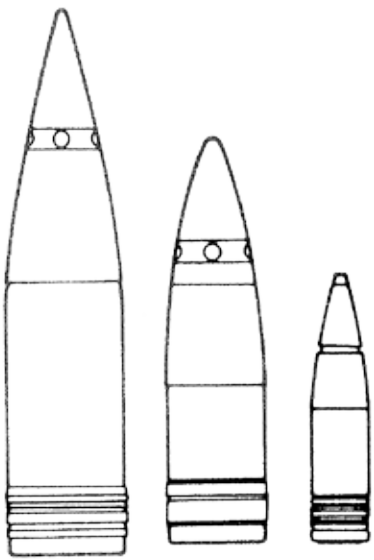
Diameter 12" to 18"



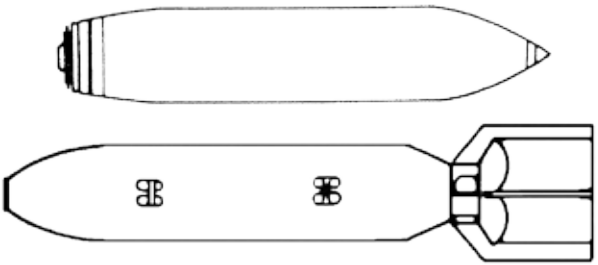
PROJECTILES

Lengths 20 mm to 16"

3" to 5" in Diameter (Typically)

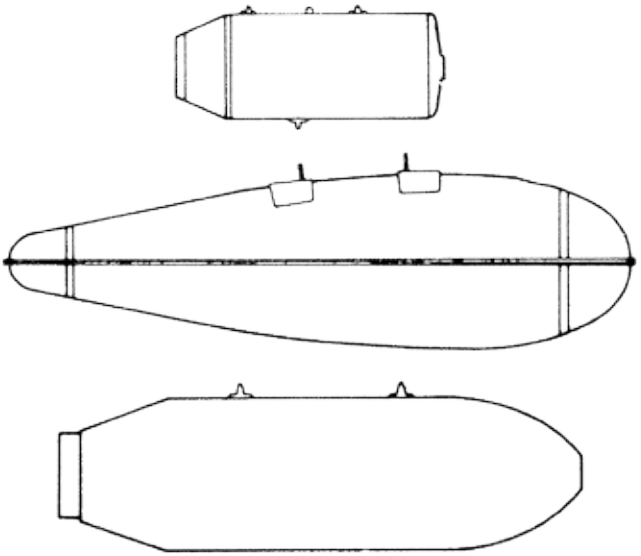


AERIAL BOMBS



Bomb Body Lengths 39" to 97"

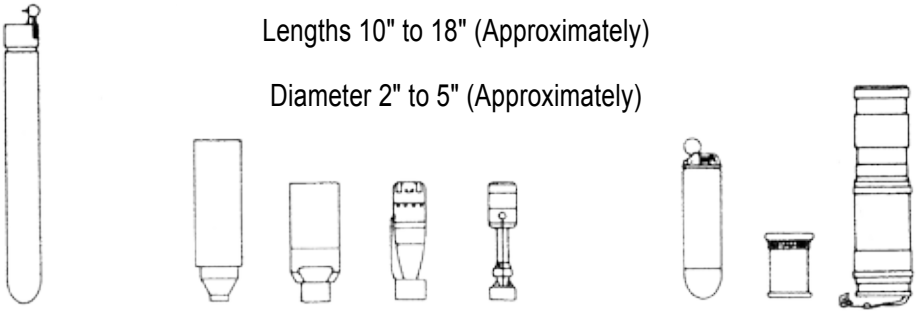
Diameter 7" to 19"



MARKERS AND SIGNALS

Lengths 10" to 18" (Approximately)

Diameter 2" to 5" (Approximately)



Don't Forget

- Munitions are dangerous and may not be easily recognizable!
- Avoid military and former military ranges and disposal areas!
- Do not bring munitions on-board!
- Never bring a munition into port, unless directed to do so by USCG!

Follow the 3Rs

Recognize

When you may have encountered a munition.

Retreat

If you know or suspect you have encountered a munition, jettison it or secure it and keep the crew from the immediate area.

Report

Immediately notify the US Coast Guard of the vessel's or munitions' location and provide a description of the munition.

Emergency contacts:

- In Port: Call 911
- At sea: Use Channel 16 (156.800 MHz)

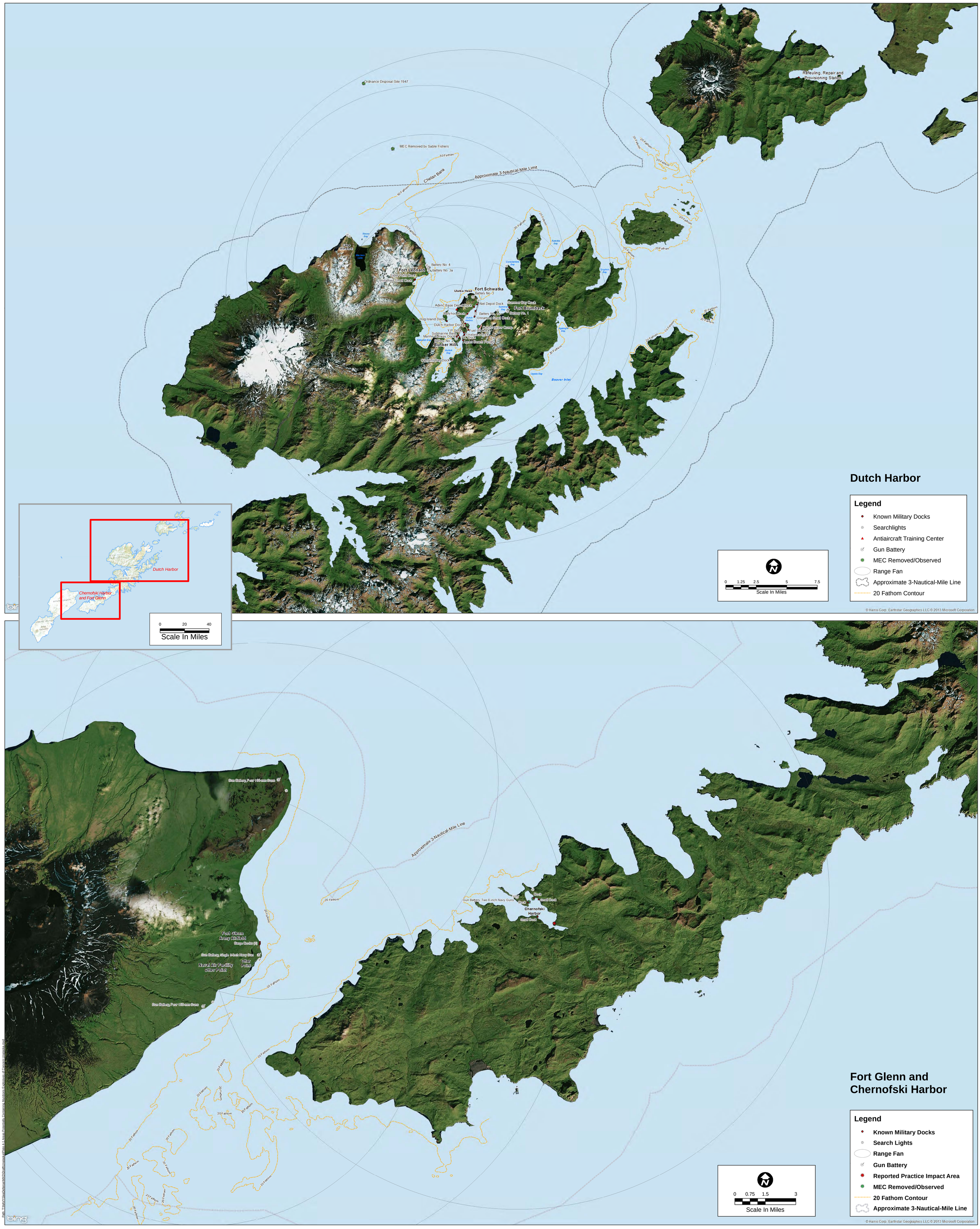
For additional information call
U.S. Army Technical Center for Explosives Safety
at (918) 420-8919
or see

the US Army's UXO Safety Education website
https://www.denix.osd.mil/uxosafety

FEBRUARY 2010

Plate 4-1

Locations of Areas Potentially Containing Munitions and Explosives of Concern within the Naval Defensive Sea Area at Unalaska Island



Path: T:\NAVY\SeaDefense\MXD\Draft\Unalaska\[Plate 4-1 Areas Potentially Containing Munitions Explosives of Concern Unalaska.mxd

U.S. NAVY	Delivery Order 0040 Naval Defensive Sea Area Unalaska Island, Alaska	*Note: These maps are at different scales.	**Plate 4-1** **Locations of Areas Potentially Containing Munitions and Explosives of Concern Within the Naval Defensive Sea Area at Unalaska Island**