FINAL

ENGINEERING EVALUATION
and
COST ANALYSIS

Public Beaches
Surf City and Ship Bottom
New Jersey

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Baltimore District

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ENGINEERING EVALUATION / COST ANALYSIS

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ACRONYM LIST

CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act
DMM	Discarded Military Munitions
EE/CA	Engineering Evaluation and Cost Analysis
HA	Hazard Analysis
LUC	Land Use Controls
MEC	Munitions and Explosives of Concern
NJDEP	New Jersey Department of Environmental Protection
TCRA	Time-Critical Removal Action
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

ENGINEERING EVALUATION / COST ANALYSIS

Public Beaches
Surf City and Ship Bottom
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EXECUTIVE SUMMARY

E.1.1 PURPOSE

E.1.1.1 This Engineering Evaluation and Cost Analysis (EE/CA) for the Public Beaches at Surf City and Ship Bottom, New Jersey, contains: a description of the site, the results of a recent Time Critical Removal Action (TCRA), details of the Public Information Plan with the Land Use Controls currently in place, the identification and analysis of proposed future course-of-action alternatives, and, a recommendation for the selected alternative.

E.1.2 BACKGROUND

E.1.2.1 As the first phase of the Barnegat Inlet to Little Egg Harbor Inlet Coastal Storm Damage Reduction project, the U.S. Army Corps of Engineers (USACE) and the New Jersey Department of Environmental Protection (NJDEP) completed oceanfront beach replenishment in Surf City and Ship Bottom, New Jersey. The sand placement portion of the project was completed in February 2007. Sand dredged from an offshore borrow area in the Atlantic Ocean located approximately three miles northeast of Surf City was pumped onto the public beach of Surf City and the northern five blocks of the Ship Bottom beach.

E.1.2.2 In early March 2007, discarded military munitions (DMM) were discovered by local residents using metal detectors. The beach was closed to the public at that time. All access points were barricaded with construction fencing, and "beach closed" signs were posted. A private security firm was contracted to assist in enforcing the beach closure around-the-clock.

E.2 SITE DESCRIPTION

E.2.1 The Boroughs of Surf City and Ship Bottom are located on Long Beach Island in Ocean County, New Jersey. The Coastal Storm Damage Reduction project (approximately 79-acre site) included placement of 886,000 cubic yards of sand over 8,100 linear feet of oceanfront flat beach to approximate depths of eight feet from North 25th Street in Surf City, New Jersey, to South 5th Street in the northern five blocks of Ship Bottom, New Jersey. A pre-existing dune was supplemented to create a project dune of 6,600 linear feet with a crest height of + 22 feet.

E.3 TIME-CRITICAL REMOVAL ACTION

E.3.1 A TCRA was immediately implemented to reduce the explosive hazard presented to individuals due to presence of DMM on the Public Beaches in Surf City and Ship Bottom, New Jersey. The objective of the TCRA (Phase I) was to safely locate, identify, and dispose of DMM items to instrument detection depth on the oceanfront beach before Memorial Day, 2007.

E.3.2 While the geophysical survey of the oceanfront beach was being conducted, the TCRA Action Memorandum, dated 26 April 2007, was prepared and approved. The TCRA was completed by May 18, and removed DMM to the depth of instrument detection over the entire beach - Berm, Surf Zone and Dune. Over 1,100 DMM items were recovered from the beach by the TCRA investigation including those that were turned-in by citizens.

E.3.3 Subsequent to the TCRA (Phase I), a Public Information Plan with Land Use Controls (Phase II) was approved by the stakeholders and implemented as documented in the Statement of Response to Munitions and Explosives of Concern, dated 17 May 2007, and is currently in place to ensure public safety. As of 5 December 2007, fourteen more DMM items have been recovered during the Phase II beach monitoring by the USACE Ordnance and Explosive Safety Specialist, or as reported by municipal workers and citizens.

E.4 SOURCE, NATURE, AND EXTENT OF DMM

E.4.1 Due to the location where the military munitions were dredged, and the configuration of the items (fuzed and unfired projectiles, fuzes with boosters, and boosters by themselves), these items are considered to be discarded military munitions (DMM).

E.5 IDENTIFICATION OF FUTURE COURSE-OF-ACTION ALTERNATIVES

E.5.1 **Alternative A**. No Further Action.

E.5.2 **Alternative B**. Close Beach.

E.5.3 **Alternative C**. Continue Land Use Controls for five years.

E.5.4 **Alternative D**. Annual Repetition of Phase I Surface and Subsurface Clearance to Instrument Detection Depth with Continued Land Use Controls for five years.

E.5.5 **Alternative E**. Sieve Berm and Surf Zone to the Depth of the Sand Placement Project. Continue Land Use Controls on the Dune for five years.

E.5.6 **Alternative F**. Sieve Entire Beach - Berm, Surf Zone, and Dune to the Depth of the Sand Placement Project.
Maintain informational signs for five years.

E.6 RISK EVALUATION

E.6.1 A Hazard Analysis qualitatively evaluated future course-of-action alternatives to address the residual risk to the public from DMM inadvertently placed on public beach areas during a recently completed coastal storm damage reduction project.

E.6.2 The alternative that presents the highest potential for an explosive event is Alternative A, *No Further Action*, where the beach remains open without Land Use Controls, and no additional DMM clearance. The beach likely contains hazardous munitions that may be accessible in the subsurface, with migration potential for surface exposure of the DMM to the public.

E.6.3 The alternative that presents the lowest potential for an explosive event even under high-intensity recreational activities is Alternative F, *Sieve Entire Beach* - Berm, Surf Zone, and Dune to remove the buried DMM from the beach and public access.

E.7 ANALYSIS OF FUTURE COURSE-OF-ACTION ALTERNATIVES

E.7.1 This EE/CA judges the future course-of-action alternatives with specific criteria. The three general categories are effectiveness, implementability, and cost.

E.7.2 The evaluation of individual alternatives determined that three alternatives would not be further evaluated due to the lack of effectiveness and implementability.

E.8 COMPARATIVE ANALYSIS OF FUTURE COURSE-OF-ACTION ALTERNATIVES

E.8.1 Three future course-of-action alternatives were ranked in accordance with a comparative analysis to determine their relative performance in relation to each of the three criteria: effectiveness, implementability, and cost.

E.9 RECOMMENDED FUTURE COURSE-OF-ACTION

E.9.1 Based on the evaluation of the individual alternatives and the comparative analysis, the recommended future course-of-action is:

Alternative E. Sieve Berm and Surf Zone to the Depth of the Sand Placement Project. Continue Land Use Controls on the Dune for five years.

E.9.2 Following stakeholder and public review, and the incorporation of their comments into the Final EE/CA, an Action Memorandum will be prepared to document the selected alternative.

ENGINEERING EVALUATION / COST ANALYSIS

Public Beaches
Surf City and Ship Bottom
New Jersey

1.0 INTRODUCTION

1.1 PURPOSE AND STAKEHOLDERS

1.1.1 This Engineering Evaluation and Cost Analysis (EE/CA) for the Public Beaches at Surf City and Ship Bottom, New Jersey, contains: a description of the site, the results of a recent Time Critical Removal Action (TCRA), details of the Public Information Plan with the Land Use Controls currently in place, the identification and analysis of proposed future course-of-action alternatives, and, a recommendation for the selected alternative.

1.1.2 This EE/CA is prepared in accordance with the response program identified in the National Contingency Plan (NCP), 40 CFR 300, and particularly subpart E, sections 300.400 through 300.415 and subpart I, sections 300.800 through 300.825. The U.S. Army Corps of Engineers (USACE) is committed to following the NCP through performance of additional Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions, as warranted, ultimately resulting in issuance of a Decision Document (DD) that provides for close-out of the site.

1.1.3 The USACE is the lead agency for this removal action. Participation of, and cooperation with, Federal, State, and local authorities and the local public will be actively pursued for the duration of this activity to reduce the public safety risks associated with Discarded Military Munitions (DMM) on the Public Beaches. Stakeholders involved in the response action selection include (but are not limited to):

- New Jersey Department of Environmental Protection (NJDEP)
  (lead regulatory agency)
- US Environmental Protection Agency Region II
- Boroughs of Surf City and Ship Bottom
- Ocean County

1.1.4 The CERCLA, Department of Defense, and U.S. Army policies require the involvement of the local community. As part of the public involvement element of the EE/CA, the USACE will issue this EE/CA for public review and comment. The USACE, will publish a notice of the availability of this document, and may schedule a public meeting, if requested. The USACE will then hold a 30-day public comment period.

Responses to the public's comments received during this period will be presented in the Responsiveness Summary (Appendix E), which will become a part of this EE/CA.

1.2 BACKGROUND

1.2.1 As the first phase of the Barnegat Inlet to Little Egg Harbor Inlet Coastal Storm Damage Reduction project, the USACE and NJDEP completed oceanfront beach replenishment in Surf City and Ship Bottom, New Jersey. The sand placement portion of the project was completed in February 2007. Sand dredged from an offshore borrow area in the Atlantic Ocean located approximately three miles northeast of Surf City was pumped onto the public beach of Surf City and the northern five blocks of the Ship Bottom beach.

1.2.2 Between March 2nd and 5th, 2007, five Mark II Point Detonating Fuzes with attached booster, were recovered from the beach in the area between 24th Street and 17th Street in Surf City. These discarded military munitions (DMM) were discovered by local residents using metal detectors, prompting the beaches to be closed in the interest of the public safety through coordination between USACE, NJDEP, and the local Boroughs.

1.2.3 On 12 March 2007, the dredging contractor encountered eight booster assemblies while installing sand fencing (to prevent access to the dune) and replacing dune crossover structures at the crest of the protective dune. The eight booster assemblies were reported to have been lying on the surface of the sand. A stop work order was issued for that activity. All beach access points were barricaded with construction fencing (orange plastic), and "beach closed" signs were posted. A number of local residents ignored these controls.

1.2.4 A private security firm was contracted to enforce the beach closure around-the-clock starting on 17 March until the completion of the TCRA on 18 May 2007.

2.0 SITE DESCRIPTION

2.1 SITE LOCATION

2.1.1 The Boroughs of Surf City and Ship Bottom are located on Long Beach Island in Ocean County, New Jersey, as shown in Figure 2-1.

2.1.2 The public oceanfront beaches are owned in combination between the Boroughs of Surf City and Ship Bottom. Private ownership is limited to portions of the dunes. Currently, the Boroughs of Surf City and Ship Bottom operate and maintain the beaches.

2.1.3 The Coastal Storm Damage Reduction project (approximately 79-acre site) included placement of 886,000 cubic yards of sand over 8,100 linear feet of oceanfront flat beach to approximate depths of eight feet from North 25th Street in Surf City, New Jersey, to South 5th Street in the northern five blocks of Ship Bottom, New Jersey. The flat portion of the beach (berm), as shown in Figure 2-2, was constructed 80-feet wide with an additional 160-feet wide section sloping into the ocean. A pre-existing dune was supplemented to create a project dune of 6,600 linear feet with a crest height of + 22 feet, a 30-feet wide flat top, sloping down seaward 70 feet to the flat beach. The Coastal Storm Damage Reduction project also included the surf zone, or the underwater area adjacent to the beach to a water depth of four feet at low tide.

2.2 GEOLOGY AND SOIL INFORMATION

Geomorphology **–** The central coast of New Jersey lies within the coastal plain province of Eastern North America. In New Jersey, the province extends from a line through Trenton and Perth Amboy southeastward for approximately 150 miles to the edge of the continental shelf. The land portion of the province is bounded on the northeast by Raritan Bay and on the west by the Delaware River. The line of maximum elevation runs from the Navesink Highlands southeastward to the Mount Holly area. The land rises gradually from the sea as a moderately dissected plain to an elevation of approximately 300 feet in the center, from where it slopes toward the Delaware River and Raritan River drainage systems. The submerged portion of the plain slopes gently southeastward at 5 or 6 feet per mile for nearly 100 miles to the edge of the continental shelf. The surface of the shelf consists of broad swell and shallow depressions with evidence of former shorelines and extensions of river drainage systems. The Atlantic coastal shelf is essentially a sandy structure with occasional silty, gravelly, or stony deposits. It extends from Cape Cod to Florida, and is by far the world’s largest sandy continental shelf.

Physiography **–** The New Jersey shore line can be divided into those sections where the sea meets the mainland, at the northern and southern ends of the state, and where the sea meets the barrier beach, in the central portion of the state. The barrier beach extends from Bay Head, down the coast for approximately 90 miles and is continuous, except for the interruption by ten inlets. The shoreline of the Coastal Storm Damage Reduction project

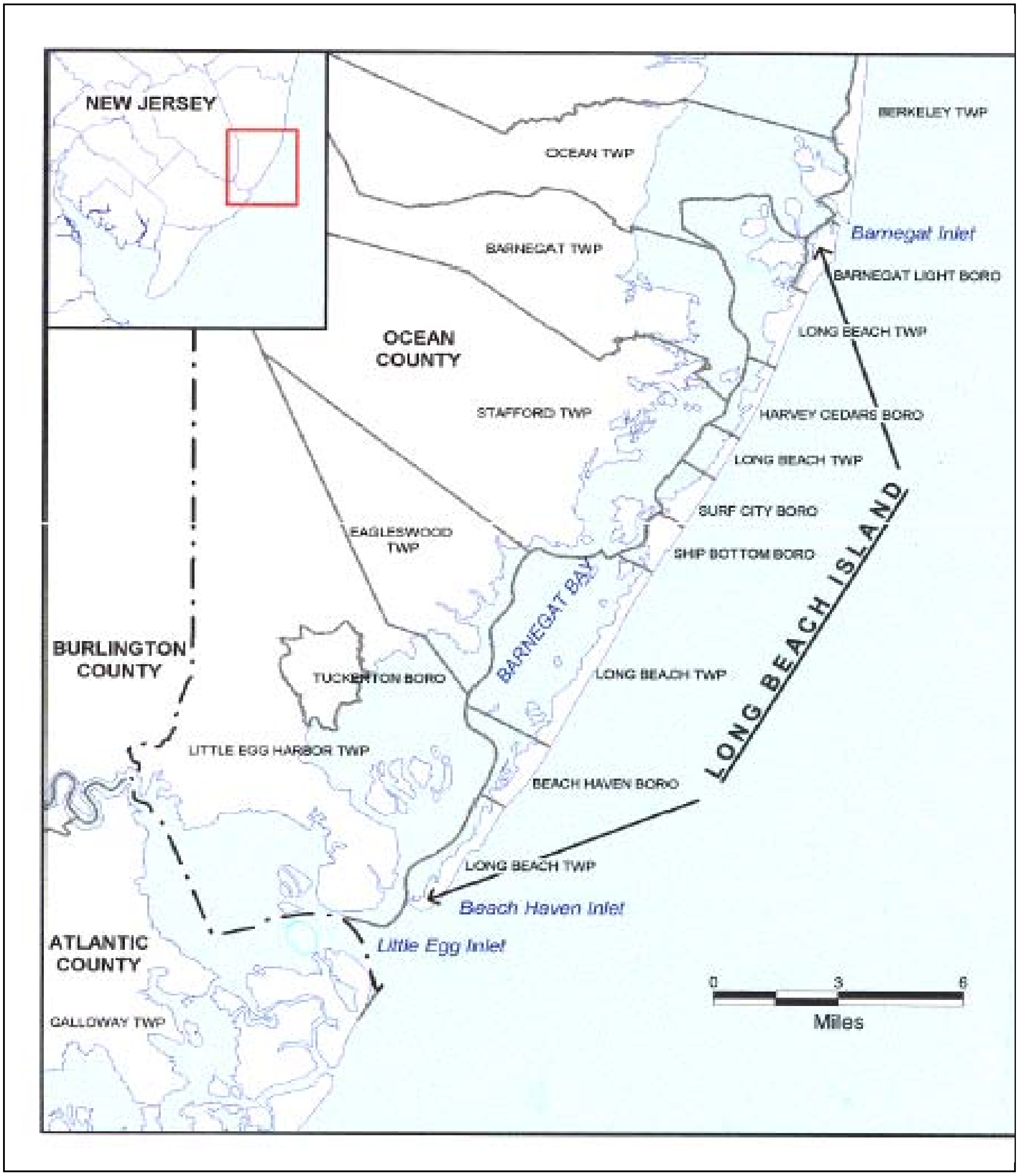


Figure 2-1 Regional Location Map

Figure 2-2 Beach Term Depiction

extends for approximately 18 miles from the lower part of Island Beach State Park to Holgate at the southern tip of Long Beach Island and lies entirely within the barrier beach section.

Barrier Beaches – The New Jersey barrier beaches belong to a landform susceptible to comparatively rapid changes. In this study area the barrier islands range in width from 600 feet to approximately 5,000 feet. Landward of the barrier beaches and inlets of the study area are tidal bays, which range from 3 to 5 miles in width. Natural processes have filled these bays until much of their area is covered with tidal marshes. The remaining water area consists of smaller bays connected by watercourses called thoroughfares. Four geologic processes are considered to be responsible for the detritus (loose material) in the bay area:

- Stream sedimentation contributing a small amount of upland material.
- Waves washing over the barrier during storms.
- Direct wind action blowing beach and dune sand into the lagoon.
- The work of tidal currents, which bring sediments in suspension from the ocean into the inland bay on flood tide.

The vegetation of the lagoon, both in marsh and bay, serves to trap and retain the sediments.

Drainage of the Coastal Plain – The stream drainage system of the New Jersey Coastal Plain was developed at a time when sea level was lower than at present. The subsequent rise in sea level has drowned the mouth of coastal streams where tidal action takes place. This tidal effect extends up the Delaware River to Trenton, New Jersey, a distance of 134 miles. The formation of the barrier beaches removed all direct stream connection with the ocean between Barnegat Bay and Cape May. These streams now flow into the lagoons formed in the back of these barrier beaches and their waters reach the Atlantic Ocean by way of the inlets. The significance of these features of the drainage system to the problem area is that the coastal plain streams, whose upper courses carry little sediment, lose that little sediment in their estuaries and in the lagoons, and supply virtually no beach nourishment to the ocean front.

Surficial Deposits – The New Jersey Coastal Plain consists of beds of gravel, sand, and clay, which dip gently toward the southeast, and fossils show them to be of the Cretaceous, Tertiary, and Quaternary ages. The older and lower layers appear at the surface along the northwest margin of the coastal plain and pass beneath successively younger strata in the direction of their dip. The parallel outcrops of successive strata make this a "belted coastal plain." Since the formations dip toward the southeast, successively younger layers appear along the shore and progress southward. Between Bay Head and Cape May City, the coastal lagoons, tidal marshes, and barrier beaches fringe the coast. These formations have contributed to the sands of the present beaches. During Quaternary time, changes in sea level caused the streams alternately to spread deposits of sand and gravel along drainage outlets, and later to remove, rework, and redeposit the material over considerable areas, concealing earlier marine formations. The Cape May formation consists largely of sand and gravel deposited during the last interglacial stage, when the sea level stood 30 to 40 feet higher than at present. The material was deposited along valley bottoms, grading into the estuarine and marine deposits of the former shoreline. In most places along the New Jersey coast, there is a capping of a few feet of Cape May formation. This capping is of irregular thickness and distribution, but generally forms a terrace about 25 to 35 feet above sea level. The barrier beaches, being of relatively recent origin, are generally composed of the same material as that found on the offshore bottom.

The soils of the Public Beaches at Surf City and Ship Bottom, New Jersey, are predominantly composed of medium-grain sand with trace amounts of coarse sands, gravel, and shell.

Subsurface Geology – The Atlantic Coastal Plain consists of sedimentary formations overlying a crystalline rock mass known as the "basement." Well drilling logs indicate the basement surface slopes at about 75 ft per mile, to a depth of more than 6,000 ft near the coast. Geophysical investigations have corroborated well-log findings and have permitted determination of the profile seaward to the edge of the continental shelf. A short distance offshore, the basement surface drops abruptly but rises again gradually near the edge of the continental shelf. Overlying the basement are semiconsolidated beds of lower Cretaceous sediments. The beds vary greatly in thickness, increasing seaward to a maximum thickness of 13,000 ft, then decreasing to 8,000 ft near the edge of the continental shelf. On top of the semiconsolidated material lie unconsolidated sediments of Upper Cretaceous and Tertiary formation. The materials are in relatively thin beds on the land portion of the coastal plain. The thickness increases to a maximum of 5,000 ft near the edge of the continental shelf.

Geologic History – The sea successively advanced and retreated across the 150-mile width of the Coastal Plain during the Cretaceous and Quaternary time. Many sedimentary formations were deposited, exposed to erosion, submerged again, and buried by younger sediments. The types of sorting, the stratification, and the fossil types in the deposits indicate that deposition took place offshore as well as in lagoons, estuaries, and on beaches and bars. Considerable changes in sea level continued to take place during the Pleistocene time. Glacial periods brought a lowering in sea level as water was locked up in the huge ice masses. As the sea level fell to a beach line miles seaward of the present shoreline, Pleistocene sediments were deposited in valleys cut into older formations. The water released through glacial melt during interglacial periods brought a rising of sea level, and beaches were formed far inland of the present shore.

2.3 CLIMATE

The Atlantic Ocean to the east has a moderating effect on the climate. Temperatures below zero or above 100 degrees Fahrenheit are a rarity. The average high temperature of 85.3 degrees happens in the month of July, while the average low of 19.8 degrees takes place during the month of January. Precipitation is fairly evenly distributed throughout the year with maximum amounts during the late summer. Much of the summer rainfall is from local thunderstorms. The maximum average precipitation of 4.6 inches occurs in July and August. The prevailing wind direction is from the east at an average 8 knots. Climatological data for the area are summarized in Table 2-1. Data were collected at Toms River, Ocean County, New Jersey.

Table 2-1
Climatological Data at Toms River, Ocean County, NJ

Month	Temperature		Precipitation Average (inches)
	Average Minimum (ºF)	**Average Maximum (ºF)**	
January	19.8	40.3	3.6
February	21.7	42.4	3.3
March	30.0	51.4	3.9
April	37.9	61.2	4.2
May	48.4	71.4	3.9
June	57.6	80.8	3.5
July	62.6	85.3	4.6
August	61.3	83.8	4.6
September	53.8	77.4	3.7
October	41.9	67.1	3.7
November	34.0	56.8	4.0
December	25.0	45.5	4.1
Average	**41.2**	**63.7**	**3.9**

2.4 SHORELINE VARIATION

The oceanfront beaches of Surf City and Ship Bottom, though relatively stable when compared to other locations on Long Beach Island, have experienced a general retreat of shoreline position over the last 50 years. The normal seasonal profile adjustment ranges between 30 and 70 feet of shoreline change over its mean position throughout the year. Typically, during the more energetic storm and wave activity of the winter and spring months, the beaches tend to retreat or erode, steepen, and build large nearshore bars. During the typically lower energy periods of the summer and fall months, the beaches tend to recover or accrete, and flatten.

3.0 TIME-CRITICAL REMOVAL ACTION

3.0.1 A TCRA was immediately implemented to reduce the explosive hazard presented to individuals due to presence of DMM on the Public Beaches in Surf City and Ship Bottom, New Jersey. The objective of the TCRA (Phase I) was to safely locate, identify, and dispose of DMM items to instrument detection depth on the oceanfront beach before Memorial Day. The removal of the DMM was performed in accordance with the Work Plan (Weston, May 2007).

3.0.2 Geophysical survey equipment located potential DMM items as described in the Geophysical Prove-Out Report (Weston, May 2007). The geophysical survey data was analyzed to select the buried anomalies (suspect DMM items) that warranted intrusive investigation (excavation). Excavation of the anomaly of interest resolved the item as DMM or cultural scrap (metallic scrap).

3.0.3 While the geophysical survey of the oceanfront beach was being conducted, the TCRA Action Memorandum, dated 26 April 2007, was prepared and approved. The TCRA (Phase I) was completed by May 18, and removed DMM to the depth of instrument detection over the entire beach - Berm, Surf Zone and Dune. The TCRA Final Report (Weston, June 2007) describes the work performed to safely locate, identify, and dispose of the DMM items.

3.0.4 Over 1,100 DMM items were recovered from the beach by the TCRA (Phase I) investigation including those that were turned-in by citizens. Appendix B provides a summary of the distribution of the DMM items found by the TCRA investigation across the project site according to the street grid designations. These items included unfired, fuzed, low explosive loaded (black powder) Mark I - 37mm projectiles, Mark II and III Boosters, and Mark I and II Point Detonating Fuzes.

3.0.5 The TCRA (Phase I) substantially lowered the likelihood that the public will encounter the DMM. Additionally, the type of military munitions recovered, along with extensive public information about the potential presence of munitions on the beach, and what to do should a munition be discovered, reduces the potential for an explosive incident to occur. However, there remains the potential for DMM to be present below the depth of instrument detection, and beach instability and weather may cause the DMM to surface. Erosion and wave action may also cause DMM to migrate into the areas previously investigated or beyond the project limits. Very little erosion of the dune is expected, except in the case of a major weather event, such as a Nor'easter or hurricane. Also, DMM possibly present offshore, and outside the area of the surf zone investigated, could potentially be moved into the surf zone or berm during periods of heavy wave action.

3.0.6 Subsequent to the TCRA (Phase I), a Public Information Plan with Land Use Controls (Phase II) was approved by the stakeholders and implemented as documented in the Statement of Response to Munitions and Explosives of Concern, dated 17 May 2007, and is currently in place to ensure public safety.

3.0.6.1 The USACE implemented the Public Information Plan to reduce the potential for DMM to be encountered on the beach during recreational activities. This plan included MEC Recognition and Safety Training of police, lifeguards, beach pass inspectors, and beach maintenance staff, and provided for the presence of a USACE Ordnance and Explosives Safety Specialist during the summer Phase II beach monitoring period, as needed, to provide DMM contingency response.

3.0.6.2 Within the Public Information Plan, the USACE recommended the following Land Use Controls be implemented and/or maintained:

- Public information signs addressing the 3Rs (Recognize, Retreat, Report) of explosives safety be posted at public and private access points.
- Public information brochures be distributed.
- The use of metal detectors on the beach be prohibited.
- A dig restriction -- no digging below a depth of one-foot – be implemented.
- The dune (except at crossover areas) be restricted from public access with fences and signage.
- A private crossover construction policy be implemented to ensure that DMM is not encountered during construction.

3.0.7 Following completion of posting the public information signs, the Public Beaches in Surf City and Ship Bottom were reopened before Memorial Day. The USACE distributed public information brochures, constructed fenced private dune crossovers, and provided MEC Recognition and Safety Training to municipal workers.

3.0.8 As of 5 December 2007, fourteen more DMM items have been recovered during the Phase II beach monitoring by the USACE Ordnance and Explosive Safety Specialist, or as reported by municipal workers and citizens.

4.0 SOURCE, NATURE, AND EXTENT OF DMM

4.0.1 The source of the DMM is suspected to be from undocumented disposal at-sea. Sand containing DMM was dredged from an offshore borrow area in the Atlantic Ocean located approximately three miles northeast of Surf City.

4.0.2 Over 1,100 DMM items were recovered from the beach by the TCRA investigation including those that were turned-in by citizens. Appendix B provides a summary of the distribution of the DMM items found by the TCRA investigation across the project site according to the street grid designations. These items included unfired, fuzed, low explosive loaded (black powder) Mark I - 37mm projectiles, Mark II and III Boosters, and Mark I and II Point Detonating Fuzes. Appendix A presents the ordnance data sheets that describes each of these DMM items.

4.0.2.1 The munition with the greatest unbarricaded fragmentation distance (MGFD) for this site is designated as a Mark 1 - 37mm Projectile with a corresponding Hazardous Fragment Distance (HFD) of 67 feet.

4.0.2.2 Munitions and Explosives of Concern (MEC) is defined as specific categories of military munitions that may pose unique explosives safety risks. The term MEC includes unexploded ordnance (UXO), discarded military munitions (DMM), and munition constituents (e.g., trinitrotoluene [TNT]) present in high enough concentrations to pose an explosive hazard.

4.0.3 Due to the location where the military munitions were dredged, and the configuration of the items (fuzed and unfired projectiles, fuzes with boosters, and boosters by themselves), these items are considered to be discarded military munitions (DMM).

4.0.4 Military munitions are manufactured to withstand a certain amount of rough handling such as transport, soldier maneuvers, and a significant jolt when fired. Consequently, the probability of detonation of the DMM items due to human contact would be extremely low. The problem occurs not with the contact, but with the actions after contact. Explosives may detonate when exposed to "heat, friction or shock" or any combination of the three.

4.0.5 Munition Constituents (e.g., TNT, or the explosive chemicals within the DMM) are not expected to be present on the beach. Nearly all DMM were recovered as intact items. Any potential DMM fragments (metallic scrap) were placed on the beach with the dredged sand material, and were not produced from detonation of a DMM during sand placement. Consequently, sampling the beach sand for munition constituents was not conducted.

5.0 IDENTIFICATION OF FUTURE COURSE-OF-ACTION ALTERNATIVES

5.0.1 **Alternative A**. No Further Action.

Beach remains open to public access without prevention to digging in the sand below the depth of one-foot, or the use of metal detectors. Land Use Controls are discontinued, and there is no additional clearance of DMM.

5.0.2 **Alternative B**. Close Beach.

Barricade all public access to the beach with a chain-link fence around the northern, western, and southern boundaries of the 8,100 linear feet of the flat beach. Post "Beach Closed" signs. Engage a security firm to enforce the beach closure. There is no additional clearance of DMM.

5.0.3 **Alternative C**. Continue Land Use Controls (LUCs) for five years.

Beach is open to the public, but LUCs will not permit digging in the sand below the depth of one-foot, and will prohibit the use of metal detectors on the beach. New Jersey law prohibits dune access. LUCs of warning signs and fences will further restrict access to the dune. There is no additional clearance of DMM.

5.0.4 **Alternative D**. Annual Repetition of Phase I Surface and Subsurface Clearance to Instrument Detection Depth with Continued Land Use Controls for five years.

Beach is open to the public, although LUCs will not permit digging in the sand below the depth of one-foot, and will prohibit the use of metal detectors on the beach. New Jersey law prohibits dune access. LUCs of warning signs and fences will further restrict access to the dune. Each year the quantity of buried DMM will be reduced as more items are located and removed within the depth of the instrument detection.

However, there remains the potential for DMM to be present below the depth of instrument detection, and beach instability and weather may cause the DMM to surface. Erosion and wave action may also cause DMM to migrate into the areas previously investigated, or beyond the project limits. Very little erosion of the dune is expected, except in the case of a major weather event, such as a Nor'easter or hurricane. Also, DMM possibly present offshore, and outside the area of the surf zone investigated, could potentially be moved into the surf zone or berm during periods of heavy wave action.

5.0.5 **Alternative E**. Sieve Berm and Surf Zone to the Depth of the Sand Placement Project. Continue Land Use Controls on the Dune for five years.

Beach is open to the public, and will allow digging in the sand and the use of metal detectors. New Jersey law prohibits dune access. LUCs of warning signs and fences will further restrict access to the dune. Sifting will remove buried DMM from over 60% of the sand placement project, and clear more than 70% of the beach area, but DMM is likely to be present in the dune below instrument detection depth.

Very little erosion of the dune is expected, except in the case of a major weather event, such as a Nor'easter or hurricane, which may cause the DMM in the dune to surface or migrate into the areas previously sieved, or beyond the project limits. Informational signs are also required due to the residual uncertainty of clean-up, and the fact that DMM possibly present offshore, and outside the area of the surf zone investigated, could potentially be moved into the surf zone or berm during periods of heavy wave action.

5.0.6 **Alternative F**. Sieve Entire Beach - Berm, Surf Zone, and Dune to the Depth of the Sand Placement Project.
Maintain informational signs for five years.

Beach is open to the public, and will allow digging in the sand and the use of metal detectors. Informational signs are required due to the residual uncertainty of clean-up, and the fact that DMM possibly present offshore, and outside the area of the surf zone investigated, could potentially be moved into the surf zone or berm during periods of heavy wave action.

6.0 **RISK EVALUATION**

6.0.1 A Hazard Analysis qualitatively evaluated future course-of-action alternatives to address the residual risk to the public from DMM inadvertently placed on public beach areas during a recently completed coastal storm damage reduction project. The Hazard Analysis, dated 6 June 2007, is presented in Appendix C.

6.0.2 The alternative that presents the highest potential for an explosive event is Alternative A, *No Further Action*, where the beach remains open without Land Use Controls, and no additional DMM clearance. The beach likely contains hazardous munitions that may be accessible in the subsurface, with migration potential for surface exposure of the DMM to the public.

6.0.3 The alternative that presents the lowest potential for an explosive event even under high-intensity recreational activities is Alternative F, S*ieve entire beach* - Berm, Surf, and Dune to remove the buried DMM from the beach and public access.

7.0 ANALYSIS OF FUTURE COURSE-OF-ACTION ALTERNATIVES

7.0.1 This EE/CA judges the future course-of-action alternatives with specific criteria. The three general categories are effectiveness, implementability, and cost.

7.1 INTRODUCTION TO EVALUATION CRITERIA

7.1.1 The USEPA provides specific criteria to judge future course-of-action alternatives within EE/CAs in their document *Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA* EPA/540-R-93-057 (USEPA, 1993). Each future course-of-action alternative is evaluated in three general categories of effectiveness, implementability, and cost. For effectiveness, the ranking considers protection of public safety, compliance with Applicable or Relevant and Appropriate Requirements (ARARs), and long-term and short-term effectiveness. For implementability, the alternatives are ranked by technical and administrative feasibility, regulator and community acceptance, and availability of services and materials. Cost considerations are made using detailed costing assumptions.

7.2 EVALUATION CRITERIA: EFFECTIVENESS

7.2.0.1 Effectiveness is a measure of an alternative's ability to reduce the potential for exposure to DMM. It is generally a measure of an alternative's ability to meet the criteria of protecting public safety and compliance with identified Applicable or Relevant and Appropriate Requirements**.** Effectiveness is also evaluated in terms of long-term and short-term practicability.

7.2.1 Protection of Public Safety

7.2.1.1 This criterion is a measure of how well the alternative reduces public exposure to DMM, the reduction in terms of possible injury or death, and protection of the environment. This criterion considers the following:

- The net reduction in DMM;
- The estimated quantity of residual DMM;
- The expected depth of residual DMM;
- The potential human exposure pathway to DMM; and
- The potential for individual interaction with DMM once an exposure occurs.

7.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

7.2.2.1 This criterion is a measure of how well the alternative meets the identified chemical-specific, location-specific and action-specific, Applicable or Relevant and Appropriate Requirements (Federal, state, and local). Currently, no Applicable or Relevant and Appropriate Requirements have been identified for the Public Beaches in Surf City and Ship Bottom, New Jersey.

7.2.3 Long-Term Effectiveness

7.2.3.1 This criterion is a measure of how well the alternative protects public safety once it has been implemented. The remaining potential for exposure or interaction with DMM is characterized by the following factors:

- The magnitude of potential exposures and interaction following implementation of the selected alternative;
- The permanence of the exposure and interaction reduction due to implementation of the selected alternative; and
- The reliability of the controls and maintenance measures in managing residual DMM following implementation of the selected alternative.

7.2.4 Short-Term Effectiveness

7.2.4.1 This criterion is a measure of how well the alternative meets the exposure and interaction reduction during its implementation. This includes:

- The ability of the alternative to reduce risk during implementation;
- The potential for adverse effects on the environment during the alternative's implementation;
- The time required to implement the alternative; and
- The potential for adverse effects on the public, including the community and personnel involved in implementation of the alternative.

7.3 EVALUATION CRITERIA: IMPLEMENTABILITY

7.3.0.1 Implementability is a measure of whether a course of action alternative can be physically and administratively implemented, such as the ability to construct, excavate, or demolish. It is also a measure of the availability of the services and materials needed to implement the alternative. Other considerations regarding implementability include state agency and community acceptance of a given alternative. An interpretation of the criteria governing implementability is as follows:

7.3.1 Technical Feasibility

7.3.1.1 This criterion refers to the following:

- The reliability of the action with regard to implementation;
- The actual ease of field implementation (e.g., construction, removal action);
- The ease in undertaking future actions related to the initial undertaking; and
- The ability to monitor the effectiveness of the action.

7.3.2 Administrative Feasibility

7.3.2.1 This criterion is a measure of the ease with which an alternative can be implemented in terms of permits and rights-of-entry, coordination of services to support the action (e.g., legal services), or the arrangement of delivery of security services.

7.3.3 Availability of Services and Materials

7.3.3.1 This criterion is a measure of the availability of various services and materials required to support implementation of the alternative. Examples of this criterion include the availability of specialized personnel (e.g., munitions safety specialists) and equipment (e.g., geophysical instruments), availability of explosives for demolition purposes, availability of a suitable disposal facility for the ordnance (i.e., proximity of local scrap metal recycling facility), and the condition of the existing infrastructure to allow ingress and egress of personnel and material to and from the project site.

7.3.4 Regulatory Acceptance

7.3.4.1 This criterion deals with the acceptance of the alternative by applicable Federal, state, county, and city regulatory agencies, as expressed by representatives of the agency. Agency acceptance has been established based on information gathered during meetings and interaction with Federal and state agency representatives to date. Input received from stakeholders during the public comment period for this EE/CA will be incorporated into the Final EE/CA and may affect the evaluation of the alternatives.

7.3.5 Community Acceptance

7.3.5.1 This criterion relates to the degree of acceptance of the alternative by the community, including owners of properties adjacent to the area. Public sentiment expressed during meetings is a means of determining community acceptance. Community acceptance will also be established as a result of community meetings and the public comment period held for this EE/CA. Community concerns will be incorporated into the Final EE/CA and may affect the evaluation of the alternatives.

7.4 EVALUATION CRITERIA: COST

7.4.1 The cost of implementing each course-of-action alternative has been estimated. A detailed summary of these costs and costing assumptions is presented in Appendix D. Included in the cost calculation is an estimate of time necessary to complete the proposed alternative. For the Land Use Controls, the costs include those associated with access controls (e.g., warning signs), community awareness outreach programs (e.g., periodic community awareness meetings, informational pamphlets, DMM safety awareness training), construction support, and the administration and maintenance costs associated with these activities.

7.5 EVALUATION OF ALTERNATIVES

7. 5.1 **Alternative A**. No Further Action.
Beach remains open to public access without prevention to digging in the sand below the depth of one-foot, or the use of metal detectors. Land Use Controls are discontinued, and there is no additional clearance of DMM.

7.5.1.1 Effectiveness: Alternative A, *No Further Action,* would not protect the public. Site conditions present a higher potential for public contact with DMM and the possibility of an explosive event. The beach has full accessibility with many hours for potential exposure to DMM. The site likely contains hazardous munitions that may be accessible in the subsurface, with migration potential for surface exposure of the DMM. This alternative would not be effective in removing the public exposure to DMM in the short-term, or long-term.

7.5.1.2 Implementability: Alternative A, *No Further Action,* though implementable, will be technically ineffective, and administratively impossible. The regulators will not accept this alternative. No services or materials will be required to implement this alternative

7.5.1.3 Cost: There are no costs associated with the Alternative A, *No Further Action.*

7.5.1.4 Conclusion: Alternative A, *No Further Action,* will not be further evaluated because it fails the effectiveness and implementability criteria.

7.5.2 **Alternative B**. Close Beach.
Barricade all public access to the beach with a chain-link fence around the northern, western, and southern boundaries of the 8,100 linear feet of the flat beach. Post "Beach Closed" signs. Engage a security firm to enforce the beach closure. There is no additional clearance of DMM.

7.5.2.1 Effectiveness: Alternative B, *Close Beach*, presents a somewhat lower potential for public exposure to DMM and the possibility of an explosive event. The beach has very limited accessibility with very few hours for potential contact with DMM. The site likely contains hazardous munitions that may be accessible in the subsurface, with migration potential for surface exposure of the DMM. This alternative may be effective in the short-term, but the long-term effectiveness is difficult to ensure the practicability of protecting public safety.

7.5.2.2 Implementability: Alternative B, *Close Beach*, is technically feasible to control access to the beach. The administrative feasibility is less certain as it would require the cooperation of the residents and beach-goers. The business community will not accept this alternative. The services and materials required to implement this alternative are available.

7.5.2.3 Cost: Costs associated with the Alternative B, *Close Beach*, are approximately $9,700,000 over five years.

7.5.2.4 Conclusion: Alternative B, *Close Beach*, will not be further evaluated because it fails the effectiveness and implementability criteria.

7.5.3 **Alternative C**. Continue Land Use Controls (LUCs) for five years.
Beach is open to the public, but LUCs will not permit digging in the sand below the depth of one-foot, and will prohibit the use of metal detectors on the beach. New Jersey law prohibits dune access. LUCs of warning signs and fences will further restrict access to the dune. There is no additional clearance of DMM.

7.5.3.1 Effectiveness: Alternative C, *Continue LUCs*, regulates public exposure to the DMM. The site presents a moderate potential for public contact with DMM and the possibility of an explosive event. The beach has full public accessibility, however the LUCs reduce the opportunity to encounter DMM. The site likely contains hazardous munitions that may be accessible in the subsurface, with migration potential for surface exposure of the DMM. This alternative may be effective in the short-term with the cooperation and understanding of the residents and beach-goers, but the long-term effectiveness is difficult to ensure without the presence of enforcement personnel.

7.5.3.2 Implementability: Alternative C, *Continue LUCs*, is technically feasible for field implementation to limit public access to the DMM. The administrative feasibility is less certain as it would require the cooperation of the beach-goers with enforcement personnel. The regulators are not likely to accept this alternative that does not remove DMM. The services and materials required to implement this alternative are available.

7.5.3.3 Cost: Costs associated with the Alternative C, *Continue LUCs*, are approximately $380,000 annually, or $1,900,000 in five years.

7.5.3.4 Conclusion: Alternative C, *Continue LUCs,* will not be further evaluated because it fails the effectiveness and implementability criteria.

7.5.4 **Alternative D**. Annual Repetition of Phase I Surface and Subsurface Clearance to Instrument Detection Depth with Continued Land Use Controls for five years.

Beach is open to the public, although LUCs will not permit digging in the sand below the depth of one-foot, and will prohibit the use of metal detectors on the beach. New Jersey law prohibits dune access. LUCs of warning signs and fences will further restrict access to the dune. Each year the quantity of buried DMM will be reduced as more items are located and removed within the depth of the instrument detection.

However, there remains the potential for DMM to be present below the depth of instrument detection, and beach instability and weather may cause DMM to surface. Erosion and wave action may also cause DMM to migrate into the areas previously investigated, or beyond the project limits. Very little erosion of the dune is expected, except in the case of a major weather event, such as a Nor'easter or hurricane. Also, DMM possibly present offshore, and outside the area of the surf zone investigated, could potentially be moved into the surf zone or berm during periods of heavy wave action.

7.5.4.1 Effectiveness: Alternative D, *Clearance to Detection Depth,* results in a somewhat lower potential to encounter DMM on the public beaches and the possibility of an explosive event even under high-intensity recreational activities. The beach has full public accessibility, but the site is still likely to contain hazardous munitions, although fewer each year, that may be accessible in the subsurface, with migration potential for surface exposure of the DMM. The short-term time to implement this alternative is estimated to require ten weeks each year over five years (50 weeks altogether). However, over the long-term, there remains the potential for DMM to be present below the depth of instrument detection, and beach instability and weather may cause surface exposure of the DMM.

7.5.4.2 Implementability: Alternative D, *Clearance to Detection Depth,* is technically feasible, although specifically trained and qualified personnel are required to locate, identify, and dispose of the DMM each year. Administrative feasibility requires more logistical and management support of the clearance crews than sifting. The regulators and community may consider this alternative as an acceptable alternative. The services and materials required to implement this alternative are available.

7.5.4.3 Cost: Costs associated with the Alternative D, *Clearance to Detection Depth,* are approximately $3,900,000 annually, or $19,500,000 in five years.

7.5.4.4 Conclusion: Alternative D, *Clearance to Detection Depth*, will be further evaluated.

7.5.5 **Alternative E**. Sieve Berm and Surf Zone to the Depth of the Sand Placement Project. Continue Land Use Controls on the Dune for five years.

Beach is open to the public, and will allow digging in the sand and the use of metal detectors. New Jersey law prohibits dune access. LUCs of warning signs and fences will further restrict access to the dune. Sifting will remove buried DMM from over 60% of the sand placement project, and clear more than 70% of the beach area, but DMM is likely to be present in the dune below instrument detection depth.

Very little erosion of the dune is expected, except in the case of a major weather event, such as a Nor'easter or hurricane, which may cause the DMM in the dune to surface or migrate into the areas previously sieved, or beyond the project limits. Informational signs are also required due to the residual uncertainty of clean-up, and the fact that DMM possibly present offshore, and outside the area of the surf zone investigated, could potentially be moved into the surf zone or berm during periods of heavy wave action.

7.5.5.1 Effectiveness: Alternative E, *Sieve Berm and Surf Zone*, results in a lower potential to encounter DMM on the public beaches and the possibility of an explosive event even under high-intensity recreational activities. The beach has full public accessibility, although the dune is likely to contain hazardous munitions that may be accessible in the subsurface, with migration potential for surface exposure of the DMM. The short-term time to implement this alternative is estimated to require twenty weeks. However, over the long-term, there remains the potential for DMM to be present in the dune below the depth of instrument detection, and the weather may cause surface exposure of the DMM.

7.5.5.2 Implementability: Alternative E, *Sieve Berm and Surf Zone*, is technically and administratively feasible for field implementation. Sifting requires less effort, and is easier to coordinate services to implement, than subsurface investigations with detection instruments. The regulators and community are likely to consider this alternative as an acceptable alternative. The services and materials required to implement this alternative are available.

7.5.5.3 Cost: Costs associated with the Alternative E, *Sieve Berm and Surf Zone*, are approximately $17,700,000.

7.5.5.4 Conclusion: Alternative E, *Sieve Berm and Surf Zone*, will be further evaluated.

7.5.6 **Alternative F**. Sieve Entire Beach - Berm, Surf Zone, and Dune to the Depth of the Sand Placement Project.
Maintain informational signs for five years.

Beach is open to the public, and will allow digging in the sand and the use of metal detectors. Informational signs are required due to the residual uncertainty of clean-up, and the fact that DMM possibly present offshore, and outside the area of the surf zone investigated, could potentially be moved into the surf zone or berm during periods of heavy wave action.

7.5.6.1 Effectiveness: Alternative F, *Sieve Entire Beach*, results in a lower potential to encounter DMM on the public beaches and the possibility of an explosive event even under high-intensity recreational activities. The beach has full public accessibility. The short-term time to implement this alternative is estimated to require thirty weeks. This alternative would be effective in removing the public exposure to DMM in the long-term.

7.5.6.2 Implementability: Alternative F, *Sieve Entire Beach*, is technically feasible, but the effort to remove DMM from the dune is difficult, especially with the close proximity of residences to the dune. Administrative feasibility of sifting is easier to implement than subsurface investigations with detection instruments. The regulators and community will likely consider this alternative as an acceptable alternative. The services and materials required to implement this alternative are available.

7.5.6.3 Cost: Costs associated with the Alternative F, *Sieve Entire Beach*, are approximately $27,000,000.

7.5.6.4 Conclusion: Alternative F, *Sieve Entire Beach*, will be further evaluated.

8.0 COMPARATIVE ANALYSIS OF FUTURE COURSE-OF-ACTION ALTERNATIVES

8.0.1 Based on the individual analysis of alternatives evaluated in Section 7, the remaining alternatives include:

- **Alternative D**. Annual Repetition of Phase I Surface and Subsurface Clearance to Instrument Detection Depth with Continued Land Use Controls for five years.
- **Alternative E**. Sieve Berm and Surf Zone to the Depth of the Sand Placement Project. Continue Land Use Controls on the Dune for five years.
- **Alternative F**. Sieve Entire Beach - Berm, Surf Zone, and Dune to the Depth of the Sand Placement Project. Maintain informational signs for five years.

8.0.2 The three other alternatives identified in Section 7 were eliminated during the individual evaluation due to lack of effectiveness and implementability. This section presents a comparative analysis of the remaining alternatives to determine their relative performance in relation to each of the criteria. The purpose of this analysis is to identify the advantages and disadvantages of the remaining alternatives relative to one another so that key factors that would affect the future course-of-action selection can be identified. Table 8-1 presents a summary of the comparative analysis.

8.1 RANKING SYSTEM

8.1.1 Under the system used to rank the future course-of-action alternatives, each alternative is ranked as shown in Table 8-1. Each alternative is ranked according to the criteria presented in Sections 7.2, 7.3, and 7.4. The alternative that is determined to be the best alternative when assessed with the criteria receives a numerical ranking of 1. The second best alternative receives a numerical ranking of 2, and so forth. Once the numerical ranking has been determined for the three criteria (effectiveness, implementability, and cost) the overall score is determined by adding up the individual numerical rankings for each alternative. An alternative ranked “2” for effectiveness, “1” for implementability, and “3” for cost would have an overall score of “7”. The overall scores are used to arrange the alternatives in rank order, with the lowest score being ranked the highest.

Table 8-1

EE/CA Ranking

Phase III Alternatives

Criteria	D Open LUC DGM/Mag	E Open LUC Berm Sift	F Open No LUC All Sift
Effectiveness			
Public Safety	3	2	1
Long-Term	3	2	1
Short-Term	1	2	3
Score	7	6	5
Rank	3	2	1
Implementability			
Technical Feasibility	3	1	2
Administrative Feasibility	3	1	2
Services and Materials	3	1	2
Regulatory Acceptance	3	2	1
Community Acceptance	3	2	1
Score	15	7	8
Rank	3	1	2
Cost			
Investment (in thousands)	$19,495	$17,630	$26,944
Rank	2	1	3
Overall Score	8	4	6
Overall Rank	3	1	2

Note: Ranking from best to worst; best = 1.

8.2 EFFECTIVENESS

8.2.1 Protection of Public Safety

8.2.1.1 Alternative F, *Sieve Entire Beach*, results in a lower potential to encounter DMM on the public beaches and the possibility of an explosive event even under high-intensity recreational activities, and is ranked 1 (best) for protection of public safety. Alternative E, *Sieve Berm and Surf Zone*, is ranked 2 because the dune is likely to contain hazardous munitions that may be accessible in the subsurface, and the weather may cause surface exposure of the DMM. Alternative D, *Clearance to Detection Depth*, is ranked 3 (last) because there remains the potential for DMM to be present below the depth of instrument detection, and beach instability and weather may cause surface exposure of the DMM.

8.2.2 Long-Term Effectiveness

8.2.2.1 Alternative F, *Sieve Entire Beach*, would be effective in removing the public exposure to DMM, and is ranked 1 (best) for long-term effectiveness. Alternative E, *Sieve Berm and Surf Zone*, is ranked 2 because the dune is likely to contain hazardous munitions that may be accessible in the subsurface, and the weather may cause surface exposure of the DMM. Alternative D, *Clearance to Detection Depth*, is ranked 3 (last) because there remains the potential for DMM to be present below the depth of instrument detection, and beach instability and weather may cause surface exposure of the DMM.

8.2.3 Short-Term Effectiveness

8.2.3.1 Alternative D, *Clearance to Detection Depth*, is ranked 1 (best) for short-term effectiveness because the time to implement this alternative is estimated to require ten weeks each year over five years (50 weeks altogether). Alternative E, *Sieve Berm and Surf Zone*, is ranked 2, requiring an estimated twenty weeks to implement this alternative. Alternative F, *Sieve Entire Beach*, is ranked 3 (last) with an estimated thirty weeks to implement this alternative.

8.2.4 Overall Effectiveness Ranking

8.2.4.1 Alternative F, *Sieve Entire Beach*, is ranked 1 in terms of the effectiveness criteria of protection of public safety, and long-term and short-term effectiveness. Alternative E, *Sieve Berm and Surf Zone*, is ranked 2, and Alternative D, *Clearance to Detection Depth*, is ranked 3.

8.3 IMPLEMENTABILITY

8.3.1 Technical Feasibility

8.3.1.1 Alternative E, *Sieve Berm and Surf Zone*, is ranked 1 (best) for technical feasibility with sifting being easier to implement than subsurface investigations with detection instruments. Alternative F, *Sieve Entire Beach*, is ranked 2 because the effort to remove DMM from the dune is difficult, especially with the close proximity of residences to the dune. Alternative D, *Clearance to Detection Depth*, is ranked 3 (last) requiring specifically trained and qualified personnel to locate, identify, and dispose of the DMM each year to implement this alternative.

8.3.2 Administrative Feasibility

8.3.2.1 Alternative E, *Sieve Berm and Surf Zone*, is ranked 1 (best) for administrative feasibility with sifting being easier to coordinate services to implement than subsurface investigations with detection instruments. Alternative F, *Sieve Entire Beach*, is ranked 2 because the sifting includes the dune, and therefore, requires more administrative effort. Alternative D, *Clearance to Detection Depth,* is ranked 3 (last) because this alternative requires more logistical and management support of the clearance crews than sifting.

8.3.3 Availability of Services and Materials

8.3.3.1 Alternative E, *Sieve Berm and Surf Zone,* is ranked 1 (best) because sifting requires less specialized personnel and equipment than subsurface investigations with detection instruments. Alternative F, *Sieve Entire Beach*, is ranked 2 because the sifting includes the dune, and therefore, requires more personnel and equipment. Alternative D, *Clearance to Detection Depth*, is ranked 3 (last) because this alternative requires more specifically trained and qualified personnel and equipment than sifting.

8.3.4 Regulatory and Community Acceptance

8.3.4.1 Alternative F, *Sieve Entire Beach*, is ranked 1 (best) for acceptance by the regulators and community of the alternative that results in a lower potential to encounter DMM on the public beaches and the possibility of an explosive event even under high-intensity recreational activities. Alternative E, *Sieve Berm and Surf Zone,* is ranked 2 because the dune is likely to contain hazardous munitions that may be accessible in the subsurface, and the weather may cause surface exposure of the DMM. Alternative D, *Clearance to Detection Depth*, is ranked 3 (last) for regulator and community acceptance of the alternative because there remains the potential for DMM to be present below the depth of instrument detection, and beach instability and weather may cause surface exposure of the DMM.

8.3.5 Overall Implementability Ranking

8.3.5.1 Alternative E, *Sieve Berm and Surf Zone*, is ranked 1 in terms of the implementability criteria of technical and administrative feasibility, services and material needed to implement the alternative, and acceptance by the regulators and community. Alternative F, *Sieve Entire Beach*, is ranked 2, and Alternative D, *Clearance to Detection Depth*, is ranked 3.

8.4 COST

8.4.1 Investment

8.4.1.1 Alternative E, *Sieve Berm and Surf Zone*, is ranked 1 (best) for least costs ($17,700,000) to implement the alternative. The Alternative D, *Clearance to Detection Depth*, is ranked 2 ($19,500,000 over five years). The Alternative F, *Sieve Entire Beach*, is ranked 3 (last) for most costs ($27,000,000) to implement the alternative.

8.4.1.2 DMM disposal costs may be less if the U.S. Army Explosives and Ordnance Disposal (EOD) team at Fort Monmouth provides off-site disposal of the recovered DMM during this Non-Time Critical Removal Action. Cost savings, if disposal is provided by EOD, is estimated to be $2,000,000 for Alternative E, *Sieve Berm and Surf Zone*; $100,000 annually, or $500,000 in five years for Alternative D, *Clearance to Detection Depth*; and $3,000,000 for Alternative F, *Sieve Entire Beach.*

8.4.1.3 The estimated costs for each alternative includes a contingency cost of approximately 30 percent of the construction contract cost. The contract contingency cost is estimated to be $3,900,000 for Alternative E, *Sieve Berm and Surf Zone*; $3,500,000 for Alternative D, *Clearance to Detection Depth*; and $6,000,000 for Alternative F, *Sieve Entire Beach.*

9.0 RECOMMENDED FUTURE COURSE OF ACTION

9.0.1 Based on the evaluation of the individual alternatives in Section 7, and the comparative analysis in Section 8, the recommended future course of action is:

> **Alternative E.** Sieve Berm and Surf Zone to the Depth of the Sand Placement Project. Continue Land Use Controls on the Dune for five years.

9.0.2 The beach has full public accessibility, and will allow digging in the sand and the use of metal detectors. New Jersey law, natural barriers, and Land Use Controls of warning signs and fences will restrict access to the dune. Sifting will remove buried DMM from over 60% of the sand placement project, and clear more than 70% of the beach area, but DMM is likely to be present in the dune below instrument detection depth.

9.0.3 Very little erosion of the dune is expected, except in the case of a major weather event, such as a Nor'easter or hurricane, which may cause the DMM in the dune to surface or migrate into the areas previously sieved, or beyond the project limits. Construction support must be provided during construction of new dune crossovers.

9.0.4 Informational signs are also required due to the residual uncertainty of clean-up, and the fact that DMM possibly present offshore, and outside the area of the surf zone investigated, could potentially be moved into the surf zone or berm during periods of heavy wave action.

9.0.5 Although there remains the potential for DMM to be present in the dune below the depth of instrument detection, and the weather may cause surface exposure of the DMM, Alternative E, *Sieve Berm and Surf Zone*, results in a lower potential to encounter DMM on the public beaches and the possibility of an explosive event even under high-intensity activities, including the recreational activities of fishing, surfing, swimming, sunbathing, walking, and other leisure activities. An estimated twenty weeks is required to implement this alternative.

9.0.6 Alternative E, *Sieve Berm and Surf Zone*, is technically and administratively feasible for field implementation. Sifting requires less effort, and is easier to coordinate services to implement, than subsurface investigations with detection instruments. The regulators and community are likely to consider this alternative as an acceptable alternative. The services and materials required to implement this alternative are available, and sifting requires less specialized personnel and equipment than subsurface investigations with detection instruments.

9.0.7 The costs associated with the Alternative E, *Sieve Berm and Surf Zone,* are estimated to be $17,700,000.

9.0.8 As an interim measure, while funding for the selected alternative is procured, Phase II beach monitoring will continue to be performed from Memorial Day through the first week of October. The annual costs associated with this interim measure are approximately $300,000.

9.0.9 Following stakeholder and public review, and the incorporation of their comments into the Final EE/CA, an Action Memorandum will be prepared to document the selected alternative.

9.0.10 Under CERCLA, upon completion of the selected removal action, there will be a requirement to return to the remedial process and complete at a minimum, a Remedial Investigation and Feasibility Study (RI/FS), Proposed Plan (PP), and the Decision Document (DD) to finish remediation of the site.

10.0 REFERENCES

USACE, Baltimore District, 26 April 2007 Action Memorandum

USACE, Baltimore District, 17 May 2007 Statement of Response to Munitions and Explosives of Concern

USACE, Philadelphia District, 17 May 2007 Public Information Plan

USEPA December 1993 Conducting Non-Time-Critical Removal Actions Under CERCLA

USEPA November 2006 Munitions and Explosives of Concern Hazard Assessment Guidance Version 4

Weston Solutions, Inc. May 2007 Work Plan, MEC Time Critical Removal Action, Public Beach, Boroughs of Surf City and Ship Bottom, Ocean County, New Jersey

Weston Solutions, Inc. May 2007 Geophysical Prove-Out Report, MEC Time Critical Removal Action, Public Beach, Boroughs of Surf City and Ship Bottom, Ocean County, New Jersey

Weston Solutions, Inc. June 2007 Final Report, MEC Time Critical Removal Action, Public Beach, Boroughs of Surf City and Ship Bottom, Ocean County, New Jersey

APPENDIX A

Ordnance Data Sheets

COAST ARTILLERY SCHOOL

FORT MONROE, VIRGINIA

October 31, 1918.

The following "Notes on Ammunition," prepared under the immediate supervision of the Commandant, is published for use as a text book in the Coast Artillery School and in the universities giving preliminary military training, and supersedes all bulletins heretofore published on this subject.

By order of Colonel Welshimer,

C. L. Kilburn,

Lt. Colonel, C. A.

Secretary.

2. ANY FUZE WHICH, IN SPITE OF THIS PROHIBITION, HAS BEEN DISMANTLED, MUST BE DESTROYED. FIRING IT RISKS BURSTING THE GUN. HANDLING IT INVITES SERIOUS ACCIDENTS.

3. ANY FUZE THAT HAS BEEN FIRED AND FAILED TO FUNCTION IS DANGEROUS, BECAUSE IT IS ARMED AND LIABLE TO DETONATE AT THE SLIGHTEST JAR. IT IS ABSOLUTELY FORBIDDEN TO TOUCH IT WHETHER IT IS SEPARATE OR ATTACHED TO THE SHELL.

4. TO DESTROY A SHELL OR A FUZE PLACE A CHARGE OF HIGH EXPLOSIVE IN CONTACT WITH IT, COVER OVER WITH EARTH AND SET OFF THE EXPLOSIVE WITH AN ELECTRIC PRIMER.

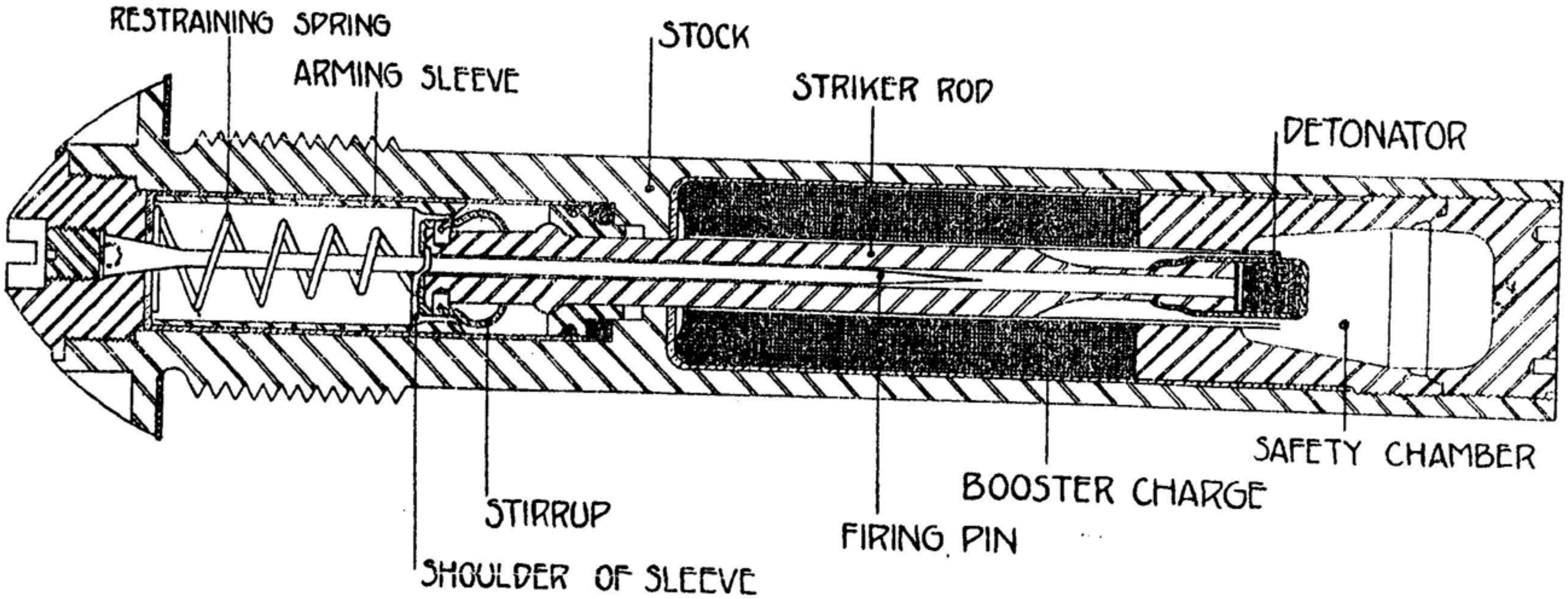
DETAILED DESCRIPTION OF FUZES.

MARK I—CLASSIFICATION.

Country of Design—Russia	Safety Devices—
Method of Arming—Inertia	safety chamber
Location in Projectile—Point	arming sleeve
Time of Action—Non-delay	creep spring
	Booster—self-contained

This is a modified Russian fuze and is used in steel shells for 3″ field guns.

POINT DETONATING FUZE, MARK I - RUSSIAN TYPE



DESCRIPTION.

This fuze has what is known as the *detonator safety feature*. Before arming, the detonator is surrounded by an air chamber in such a manner that if the detonator should become ignited prematurely, either in storage or in the bore of the gun, the gases can expand into the safety chamber and not cause the booster charge to explode and ignite the bursting charge of the shell.

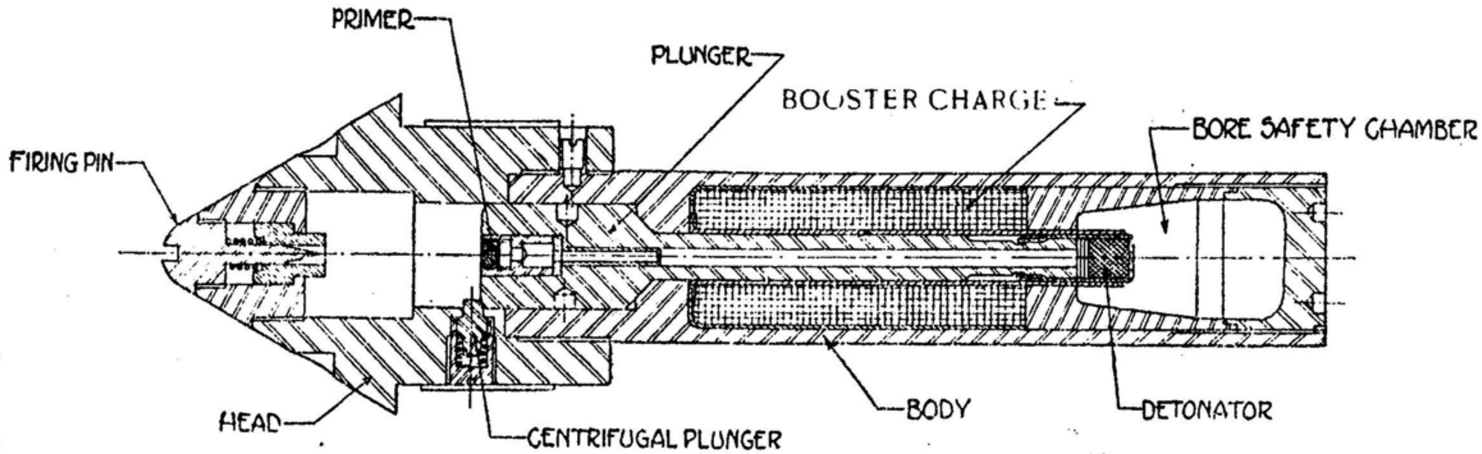
In action, the detonator is located in the safety chamber until the striker rod moves forward on impact of the projectile carrying the detonator opposite the booster charge and impinging it on the firing pin. The striker rod is held in the rearward position during transportation and storage by means of the arming sleeve and stirrups. When the projectile is accelerated in the bore of the gun the sleeve sets back over the stirrups, bringing them in front of the shoulder on the sleeve. The striker rod is now held to the rear only by the restraining spring which is compressed as the striker rod goes forward on impact.

This fuze differs from the types previously used in that the firing pin explodes the detonator by direct impact with it, rather than by means of a separate primer.

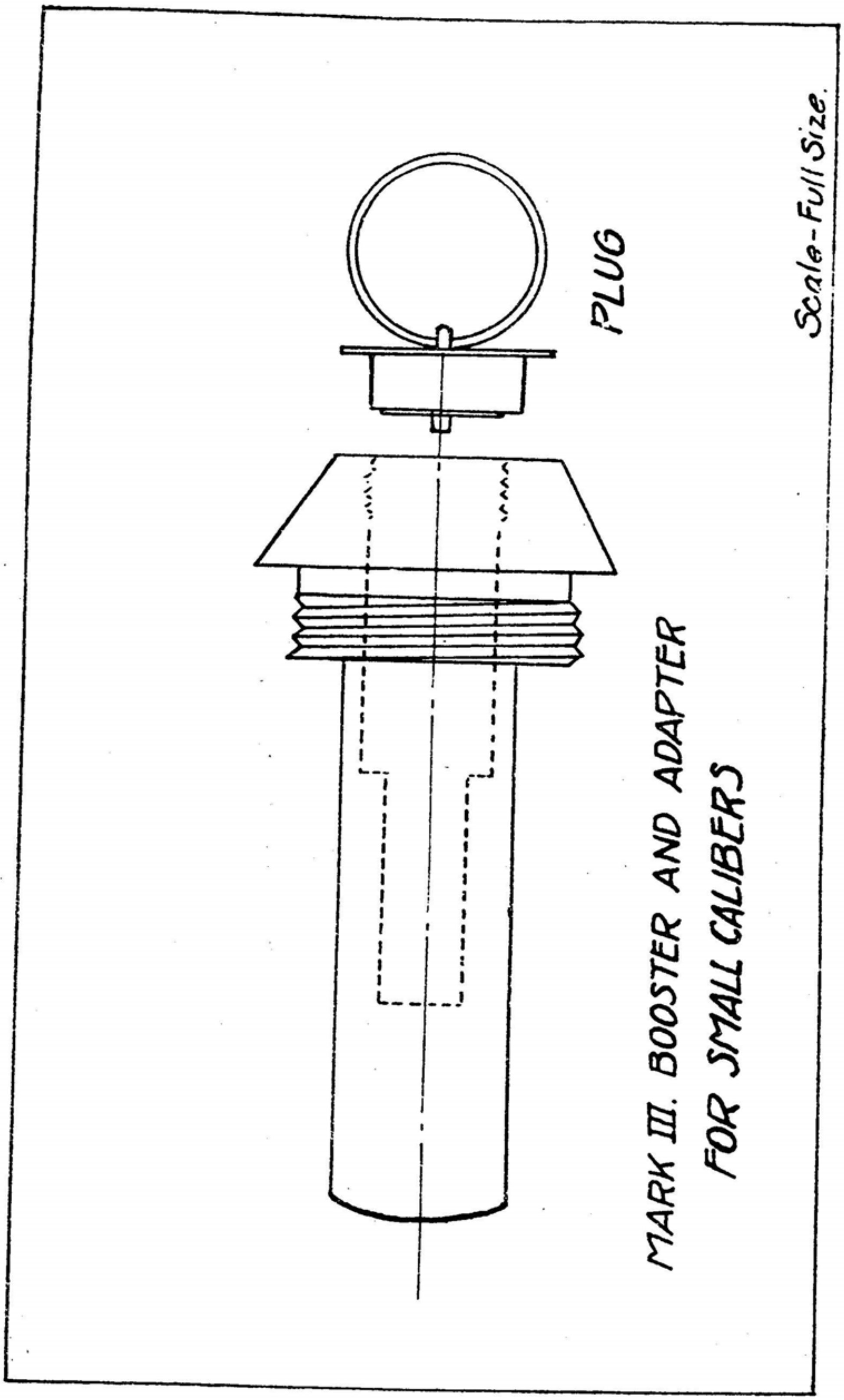
MARK II—CLASSIFICATION.

Country of Design—Russia
Method of Arming—Centrifugal Force
Location in Projectile—Point
Time of Action—Delay or Non-delay

Safety Devices—3 centrifugal plungers, safety chamber, and firing pin bushing and restraining spring.
Booster—self-contained.

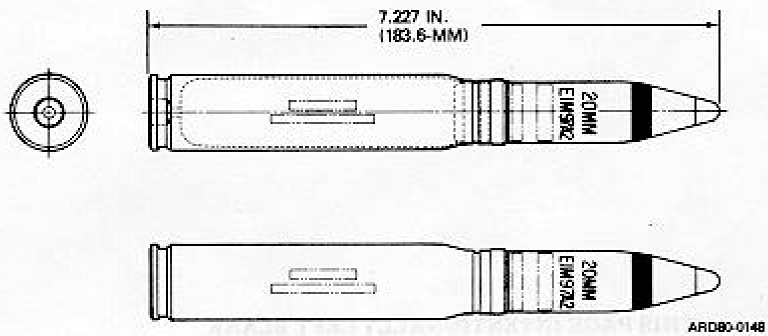


POINT DETONATING FUZE MARK II



MARK III. BOOSTER AND ADAPTER FOR SMALL CALIBERS

CARTRIDGE, 20-MM, HEI, M97A2



Type Classification:

Std - AMCTC 4376

Use:

Gun, 20-MM, M24A1.

Description:

HIGH EXPLOSIVE with INCENDIARY Cartridge. The projectile has a hollow body filled with an incendiary composition and a high explosive (RDX). The base of the projectile has a base cover and the forward end has a point detonating fuze.

Purpose:

When the primer is initiated, the propellant ignites. Ignition of the propellant provides hot gases to propel the projectile from the weapon. Upon impact, the PD fuze functions, initiating the HE filler and dispersing the incendiary composition.

Tabulated Data:

DODAC------------------------------1305-A845
Weight------------------------------4000 grain
Length------------------------------7.227 inch
Tracer------------------------------NA
Primer------------------------------Electric M52A3B1
Fuze--------------------------------Point Detonating, M505A3

Explosive:
Type------------------------------H 761
Weight---------------------------- 120 grain
Propellant:
Type------------------------------WC 875 or IMR 7013
Weight---------------------------- MBR

Performance:

Chamber pressure------------------51,000 psi
Velocity----------------------------2680 fps, 78 ft from muzzle

Shipping and Storage Data:

Quantity-distance class/SCG---- 1.2E
Storage code-------------------------Class V
DOT shipping class---------------- A
DOT designation-------------------AMMUNITION FOR SMALL ARMS WITH EXPLOSIVE PROJECTILE
Drawing number------------------ 7259063

References:

TM 9-1300-206
SB 700-20

ARTILLERY AMMUNITION

301. SHELL, FIXED, PRACTICE, MK. IIA1, W/FUZE, BASE, PRACTICE, M38, 37-MM SUBCALIBER GUN, M1916 (fig. 150), is limited standard for use only in M1916 Gun for subcaliber purposes. A service cartridge case, primer and propelling charge are used in the round. The explosive filler consists of graphite (15 percent) and black powder and serves as a spotting charge. This round is not to be fired over the heads of troops, and no personnel in the vicinity of the gun are to be forward of a line perpendicular to the muzzle.

DATA

Weight of complete round	1.61 lb	Width of rotating band	0.74 in.
Length of complete round	6.92 in.	Radius of ogive	2.24 cal.
Length of fuzed projectile	4.60 in.	Muzzle velocity	1,276 ft per sec
Length of cartridge case	3.64 in.	Maximum range	4,915 yd

FIXED AND SEMIFIXED ROUNDS AND SEPARATE-LOADING PROJECTILES

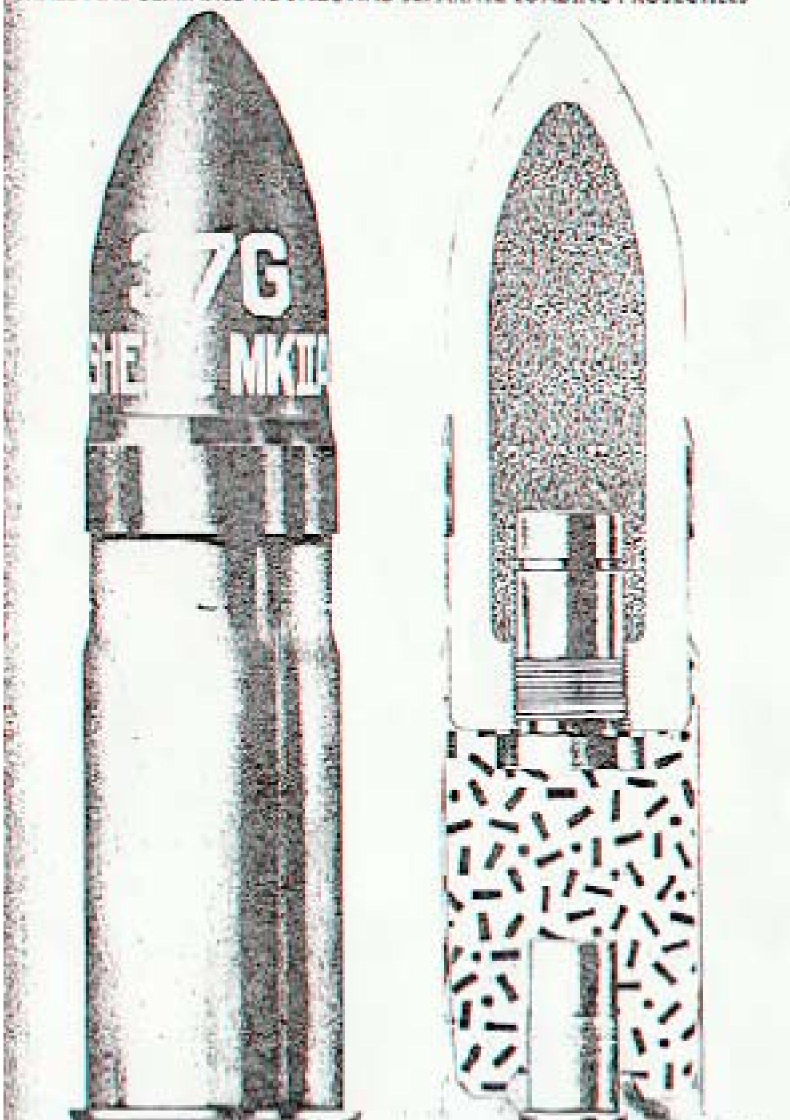


Figure 150 — SHELL, Fixed, Practice, Mk. IIA1, w/FUZE, Base, Practice, M38, 37-mm Subcaliber Gun, M1916

APPENDIX B

Table of TCRA Results by Street Grid

Table 5-1

MEC Summary by Street Grid

Street Block	Base Detonating Fuze - 1906	MKI Booster	MKII Booster	MKIII Booster	Projectile 37 mm	Projectile 20 mm	Total
N-25TH	0	0	0	0	0	0	0
N-24TH	0	0	0	3	1	0	4
N-23TH	0	0	2	0	0	0	2
N-22TH	0	0	2	2	0	0	4
N-21TH	0	0	3	8	0	0	11
N-20TH	0	0	5	7	0	0	12
N-19TH	0	0	10	6	0	0	16
N-18TH	0	0	16	20	1	1	38
N-17TH	0	0	10	8	0	0	18
N-16TH	0	0	14	14	0	0	28
N-15TH	1	0	25	83	0	0	109
N-14TH	3	0	32	38	3	0	76
N-13TH	1	0	60	65	1	0	127
N-12TH	0	0	4	9	1	0	14
N-11TH	0	0	22	86	4	0	112
N-10TH	4	0	96	99	14	0	213
N-9TH	0	0	7	59	3	0	69
N-8TH	0	0	10	5	1	0	16
N-7TH	0	0	1	0	0	0	1
N-6TH	0	0	1	5	0	0	6
N-5TH	0	0	2	7	0	0	9
N-4TH	0	1	4	7	0	0	12
N-3RD	1	0	4	30	0	0	35
N-2ND	0	0	9	6	0	0	15
N-1ST	1	0	13	13	5	0	32
D-DIV	0	0	22	22	4	0	48
S-1ST	0	0	4	2	0	0	6
S-2ND	0	0	2	10	1	0	13
S-3RD	0	0	2	0	3	0	5
S-4TH	0	0	0	1	0	0	1
S-5TH	0	0	11	9	2	0	22
S-6TH	0	0	0	4	0	0	4
S-7TH	0	0	0	0	0	0	0
S-8TH	0	0	0	0	0	0	0
S-9TH	0	0	0	0	0	0	0
S-10TH	0	0	0	0	0	0	0
S-11TH	0	0	0	0	0	0	0
S-12TH	0	0	0	0	0	0	0
Total	**11**	**1**	**393**	**628**	**44**	**1**	**1078**

APPENDIX C

Hazard Analysis

HAZARD ANALYSIS
(PHASE III)

DISCARDED MILITARY MUNITIONS

Surf City and Ship Bottom
Public Beaches
6 June 2007

1. Introduction

1.1 An explosive safety risk exists if a person can come near, or in contact with, a Munitions and Explosives of Concern (MEC) item and interact with it to cause a detonation.

1.2 This Hazard Analysis qualitatively evaluates six future course of action alternatives to address the residual risk to the public from discarded military munitions (DMM) inadvertently placed on public beach areas during a recently completed storm damage reduction project.

1.3 MEC is defined as specific categories of military munitions that may pose unique explosives safety risks. The term MEC includes unexploded ordnance (UXO), discarded military munitions (DMM), and munition constituents (e.g., TNT) present in high enough concentrations to pose an explosive hazard.

2. Description of Site

2.1 The storm damage reduction project (approximately 71-acre site) included placement of about 800,000 cubic yards of sand over 8,100 linear feet of flat beach to approximate depths of eight feet from North 25th Street in Surf City, New Jersey, to South 5th Street in Ship Bottom, New Jersey. The flat portion of the beach (berm) was constructed 80-feet wide with an additional 160-feet wide section tapering into the ocean. A pre-existing dune was supplemented to create a project dune of 6,600 linear feet with a crest elevation of + 22 feet NAVD, a 30-feet wide flat top, sloping down seaward 70 feet to the flat beach. The storm damage reduction project also included the surf zone, or the underwater area adjacent to the beach to a water depth of four feet at low tide, from North 25th Street in Surf City to South 11th Street in Ship Bottom.

2.2 The public beaches are owned in combination between the Boroughs of Surf City and Ship Bottom. Private ownership is limited to portions of the dunes. The site is currently a construction site under US Army Corps of Engineers (USACE) jurisdiction. In the future, the Boroughs of Surf City and Ship Bottom will operate and maintain the beaches.

3. **Site Background**

3.1 The storm damage reduction project of the beaches in Surf City and Ship Bottom, New Jersey, was completed in February, 2007. Sand dredged from an off-shore borrow area three miles northeast of Surf City was pumped onto the Surf City and Ship Bottom beaches.

3.2 Between March 2nd and 5th, 2007, five Mark II Point Detonating Fuzes with attached booster, were recovered from the beach in the area between 24th Street and 17th Street in Surf City. These items were recovered by local residents using metal detectors. The beach was closed to the public at that time.

3.3 On 12 March 2007, the dredging contractor encountered eight booster assemblies while installing sand fencing (to prevent access to the dune) and replacing dune crossover structures at the crest of the protective dune. The eight booster assemblies were reported to have been lying on the surface of the sand. A stop work order was issued for that activity. All access points are barricaded with construction fencing (orange plastic) and "beach closed" signs are posted. A number of local residents are ignoring these controls.

3.4 A private security firm was contracted to enforce the beach closure 24/7 starting on 17 March 2007.

3.5 In April 2007, geophysical surveys of the beach areas were completed A Time-Critical Removal Action was immediately implemented to reduce the explosives safety hazard presented to individuals due to presence of DMM on the public beaches in Surf City and Ship Bottom, New Jersey, by Memorial Day (Phase I).

3.6 Prior to conducting the Time Critical Removal Action (Phase I), a Geophysical Prove-Out study was performed in a test plot on the Surf City beach. A variety of geophysical instrumentation was used to determine the maximum detection depth for the type and size of munitions expected to be encountered. The study concluded that Digital Geophysical Mapping (DGM) using an EM-61 towed array of four coils can detect 98% of the buried metallic targets at detection depths ranging from 0 to 30 inches below the ground surface, and 95% of the buried metallic targets at detection depths ranging from 0 to 36 inches below the ground surface. The EM-61 towed array is also capable of detecting some buried metallic targets at depths below 36 inches. The handheld Schonstedt Magnetometer proved to locate buried metallic targets at detection depths ranging from 0 to 18 inches below the ground surface. The Mk 26 Forester Ordnance Locator proved to locate buried metallic targets at detection depths ranging from 0 to 36 inches below the ground surface.

3.7 The Time Critical Removal Action (Phase I) investigated the following five beach areas for DMM to eliminate public exposure to detection depth.

3.7.1 The 6,600 linear feet of Dune Top was investigated by Digital Geophysical Mapping (DGM) using an EM-61 towed array of four coils. All anomalies were analyzed and those that provided a signature indicative of DMM were intrusively investigated and resolved to the detection depth.

3.7.2 The 6,600 linear feet of Dune Slope was investigated and resolved for DMM using Mag and Dig techniques with the handheld Schonstedt Magnetometer. The 18-inch detection depth was considered sufficient because the dune is restricted to pedestrian traffic, with crossovers and pedestrian access points provided.

3.7.3 All 24 pedestrian crossovers, 3 vehicle access areas (N. 5th St., N. 12th St, and N.18th St.), and the handicap ramp (N. 12th St.) located in the 6,600 linear feet of the Dune Top and the Dune Slope were investigated and resolved for DMM using the Mk 26 Forester Ordnance Locator to the detection depth.

3.7.4 The 8,100 linear feet of the berm area was investigated for MEC from the toe of the Dune Slope out to the mean low water mark by DGM using the EM-61 towed array. All anomalies were analyzed and those that provided a signature indicative of DMM were intrusively investigated and resolved to the detection depth.

3.7.5 The surf zone was investigated and resolved for DMM using the Mk 26 Ordnance Locator from the low tide mark out to 150 feet or 4 feet of water depth, which ever occurred first. If an offshore sandbar was present, the trough between the berm and the sandbar, and the entire sandbar to the ocean-side edge was investigated and resolved for MEC using the handheld Schonstedt Magnetometer.

4. Description of Hazards at the Site

4.1 Due to the location they were dredged from, and the configuration of the MEC items (fuzes with boosters, and boosters by themselves), these items are considered to be discarded military munitions (DMM).

4.2 To date, over 1,100 items have been recovered from the beach or turned in by citizens. These items include unfired, fuzed, low explosive loaded Mark I 37mm projectiles, Mark II and III booster assemblies, and Mark II Point Detonating Fuzes.

4.3 The munition with the greatest fragmentation distance (MGFD) for this site is designated as a Mark I 37mm Projectile with a corresponding Hazardous Fragment Distance (HFD) of 67 feet.

5. Future Course of Action Alternatives

5.1 Following the completion of the TCRA (Phase I) by Memorial Day, implementation of Land Use Controls and a Public Information Plan (Phase II), and the intensive recreational use of the beach through Labor Day, this Hazard Analysis qualitatively evaluates the following six future course of action alternatives:

- Alternative A. No further action.

Beach is open to the public, digging in the sand, and the use of metal detectors. New Jersey law prohibits dune access. Land Use Controls are discontinued, and there is no additional clearance of DMM.

- Alternative B. Close beach.

Barricade all public access points to the beach. Post "Beach Closed" signs. Engage a security firm to enforce the beach closure. There is no additional clearance of DMM.

- Alternative C. Continue Land Use Controls (LUCs).

Beach is open to the public; however LUCs will not permit digging in the sand below the depth of one-foot and prohibit the use of metal detectors on the beach. New Jersey law prohibits dune access. LUCs of warning signs and fences will further restrict access to the dune. There is no additional clearance of DMM.

- Alternative D. Repeat the Phase I Beach Surface and Subsurface Clearance to Detection Depth each year.
  Continue Land Use Controls (LUCs).

Beach is open to the public; however LUCs will not permit digging in the sand below the depth of one-foot and prohibit the use of metal detectors on the beach. New Jersey law prohibits dune access. LUCs of warning signs and fences will further restrict access to the dune. Each year the quantity of buried MEC will be reduced as more DMM is located and removed.

- Alternative E. Sieve Berm and Surf Zone to the Depth of the Sand Placement Project.
  Dune Surface and Subsurface Clearance to Detection Depth.
  Continue Land Use Controls (LUCs) on the Dune.

Beach is open to the public, digging in the sand, and the use of metal detectors. New Jersey law prohibits dune access. LUCs of warning signs and fences will further restrict access to the dune. Sifting will remove buried DMM from over 60% of the sand placement project, and clear more than 70% of the beach area.

- Alternative F. Sieve Entire Beach - Berm, Surf, and Dune to the Depth of the Sand Placement Project. Discontinue Land Use Controls

Beach is open to the public, digging in the sand, and the use of metal detectors. New Jersey law prohibits dune access.

6. Munitions and Explosives of Concern Hazard Assessment Guidance (MEC HA)

6.1 The US Environmental Protection Agency is currently developing the MEC HA guidance. Version 4 of the Public Review Draft of the Guidance was printed in November 2006. The MEC HA qualitatively compares the level of protectiveness and potential for harm as a result of implementing each response action. Each response action alternative is assigned a hazard level representing the relative impact of the response action alternative.

6.2 These judgments are captured in the numeric weights assigned to each input. *These numbers have meaning only in relation to one another, and should not be construed as absolute measures of explosive hazard.*

6.3 The MEC HA evaluates a site according to nine input factors:

6.3.1. Energetic Material Type

The type of energetic material is the primary determinant of the severity of the explosive hazard. To address residual uncertainty, the score for this input factor does not change with cleanup. The only time Energetic Material Type will change is when new information indicates that the selected type of energetic material is incorrect.

6.3.2. Location of Additional Human Receptors

It is possible that additional human receptors, beyond the individual who causes an item to detonate, may be exposed to overpressure and/or fragmentation hazards from the detonation of MEC. The scores do not change with cleanup because cleanup does not impact the presence or absence of places where people might congregate.

6.3.3. Site Accessibility

The Site Accessibility input factor describes the ease with which casual users (e.g., trespassers or people taking shortcuts) can access the beach. This differs from the Potential Contact Hours input factor, which describes the total number of hours associated with site users' participation in planned activities on the beach. Different Site Accessibility scores reflect the effects of Land Use Controls (LUCs). The scores do not change with cleanup, since cleanup does not affect site accessibility.

6.3.4. Potential Contact Hours

This factor captures the effect of human receptors intentionally performing activities at a site when they might come into contact with MEC. This contact may either deliberately or accidentally initiate an explosive incident. Both the number of receptors and the amount of time each receptor spends on the beach contribute to the likelihood of a receptor encountering MEC. Cleanup lowers the scores. This decrease reflects the reduced likelihood that human receptors will come into contact with MEC after cleanup is performed. Changes in assumptions about the use of LUCs bring about changes in the score for this input factor. The application of engineering controls, such as fencing or barriers, may reduce the potential contact hours at the beach.

6.3.5. Amount of MEC

The greater the quantity of MEC items, the greater the likelihood that MEC may be encountered. The scores become lower with the increased level of cleanup at the beach. The reduction in scores reflects both the reduction in the amount of MEC and the lower likelihood that human receptors will come into contact with MEC after cleanup.

6.3.6. Minimum MEC Depth Relative to the Maximum Intrusive Depth

This factor is used to indicate whether MEC items are at depths that can be reached by expected human receptor activity. The results of site-specific geophysical investigations and digging of target anomalies are the best source of information on the depths of MEC. The scores will change when the relationship between the minimum MEC depth and the maximum intrusive depth changes. The minimum MEC depth will only change when a subsurface cleanup is evaluated. Alternatives where the minimum MEC depth after cleanup remains above the maximum intrusive depth help evaluate subsurface cleanup alternatives.

6.3.7. Migration Potential

This factor addresses the likelihood that MEC items can be moved by natural processes (e.g., beach erosion or wave action). The movement or exposure of MEC items by natural processes can increase the likelihood that receptors will encounter the items. If subsurface cleanup of MEC occurs, MEC is less likely to be exposed.

6.3.8. MEC Category

This input factor describes how easily an initiating receptor might detonate MEC. The DMM can be either fuzed or unfuzed. The MEC Classification will not change unless additional information indicates that the selected classification is incorrect.

6.3.9. MEC Size

This factor indicates the ease with which MEC can be moved by a receptor. A receptor is more likely to pick up or interact with a small item. For example, an individual is more likely to pickup or accidentally kick a grenade than a large bomb. "Small" and "Large" are the categories used to describe this input factor. Large MEC is equal to or greater than 90 pounds (e.g., a 155mm projectile). The scores do not change with clean-up. The MEC Size will not change unless additional information indicates that the selected size is incorrect.

6.4 In determining input factor weights, it was useful to categorize the input factors in terms of the degree to which it was likely that an input factor score would change after a response action. Scores for some of the input factors will always stay the same, scores for others will change after cleanup, and others will change depending on land use activities including those affected by land use controls.

6.4.1 Factors with scores that will not change.

6.4.1.1 The input factor scores that will not change after cleanup are Energetic Material Type, MEC Classification, and MEC Size. This is structured in this manner to address the lack of certainty that all MEC items can be found with current technologies.

- The Energetic Material Type score for a Mark I 37mm Projectile is 100.
- The MEC Category score for fuzed DMM is 55.
- The small MEC Size score for a Mark I 37mm Projectile is 40.

6.4.1.2 For a public beach, it is possible that additional human receptors, beyond the individual who causes an item to detonate, may be exposed to overpressure and/or fragmentation hazards from the detonation of MEC.

- The Location of Additional Human Receptors score for a public beach with buried MEC is 30.

6.4.2 Factors with scores affected by change with Land Use Controls.

6.4.2.1 These input factor scores are the ones that will change if land use activities change. These factors are Site Accessibility and Potential Contact Hours.

- The Land Use Control specifically impacting the exposure to MEC in the berm and surf zone of the public beach is the enforcement of the digging in the sand that is restricted to less than one-foot deep.

- New Jersey law prohibits dune access. Also, the dune has natural barriers with the terrain slopes and grasses. The Land Use Controls will post warning signs and maintain a physical fence barrier at public and private access points.

6.4.3 Factors with scores affected by cleanup activities.

6.4.3.1 These input factor scores will change after either a surface or subsurface cleanup has occurred. These can also be used to assess the effects of future surface or subsurface cleanup. The input factors in this group are Potential Contact Hours, Amount of MEC, Minimum MEC Depth Relative to the Maximum Receptor Intrusive Depth, and Migration Potential.

6.5 All the explosive hazard components (severity, accessibility, and sensitivity) are considered in the development of the Hazard Level Score for each response action alternative. The Hazard Level assesses the MEC, intrusiveness of activities, and the opportunity for human receptors to come into contact with a MEC item.

6.6 To support the evaluation of each alternative, a composite or proportional score has been calculated according to the respective proportion each beach area contributes to the overall hazard reduction of the entire beach.

- Alternative A - No further action.

Beach Open, No Land Use Controls, No additional MEC Clearance.
Proportional MEC HA score: 754. Hazard Level 2. Site conditions present a high potential for an explosive event. The beach has full public accessibility with many potential contact hours. The law and natural barriers will provide moderate accessibility to the dune. The site contains hazardous munitions that may become accessible on the surface and subsurface with possible migration potential for surface exposure of the DMM.

- Alternative B - Beach Closed.

Beach Closed, Land Use Controls, No additional MEC Clearance.
Proportional MEC HA score: 594. Hazard Level 3. Site conditions present a moderate potential for an explosive event. The beach has very limited public accessibility with very few potential contact hours. However, the site contains hazardous munitions that may become accessible on the surface and subsurface with possible migration potential for surface exposure of the DMM.

- Alternative C. Continue Land Use Controls.

Beach Open, Land Use Controls, No additional MEC Clearance.
Proportional MEC HA score: 699. Hazard Level 3. Site conditions present a moderate potential for an explosive event. The beach has full public accessibility with some potential contact hours. Land Use Controls will not permit digging in the sand and the use of metal detectors on the beach. However, lifeguards and beach-tag enforcement personnel will not be present during the off-season between Labor Day and Memorial Day. The law, natural barriers, Land Use Controls of warning signs and fences will provide limited accessibility to the dune. Construction support must be provided during construction of new dune crossovers. The site contains hazardous munitions that may become accessible on the surface and subsurface with possible migration potential for surface exposure of the DMM.

- Alternative D. Repeat the Phase I Beach Surface and Subsurface Clearance to Detection Depth each year. Continue Land Use Controls.

Beach Open, Land Use Controls, Additional MEC Clearance.
Proportional MEC HA score: 490. Hazard Level 4. Site conditions present a low potential for an explosive event even under high-intensity activities. The beach has full public accessibility with many potential contact hours. Land Use Controls will not permit digging in the sand and the use of metal detectors on the beach. However, lifeguards and beach-tag enforcement personnel will not be present during the off-season between Labor Day and Memorial Day. The law, natural barriers, Land Use Controls of warning signs and fences will provide limited accessibility to the dune. Construction support must be provided during construction of new dune crossovers. The site still contains hazardous munitions, although fewer each year, that may become accessible in the subsurface with possible migration potential for surface exposure of the DMM.

However, there remains the potential for DMM to be present below the depth of detection. Besides the residual uncertainty of clean-up, beach instability and weather may cause DMM to surface, as may erosion and wave action cause DMM to migrate into the areas previously investigated or beyond the project limits. Very little erosion of the Dune Top and Dune Slope is expected, except in the case of a major climatic event, such as a hurricane. The DMM potentially present offshore, and outside the areas of the surf zone investigated, could potentially be moved into the surf zone during periods of heavy wave action.

- Alternative E. Sieve Berm and Surf Zone to the Depth of the Sand Placement Project.
  Dune Surface and Subsurface Clearance to Detection Depth.
  Continue Land Use Controls on the Dune.

Beach Open, Land Use Controls, Additional MEC Clearance.
Proportional MEC HA score: 408. Hazard Level 4. Site conditions present a low potential for an explosive event even under high-intensity activities. The beach has full public accessibility with many potential contact hours. Land Use Controls will not permit digging in the sand and the use of metal detectors on the beach. However, lifeguards and beach-tag enforcement personnel will not be present during the off-season between Labor Day and Memorial Day. The law, natural barriers, Land Use Controls of warning signs and fences will provide limited accessibility to the dune. Construction support must be provided during construction of new dune crossovers. The dune still contains hazardous munitions that may become accessible in the subsurface with possible migration potential for surface exposure of the DMM.

However, there remains the potential for DMM to be present in the dune below the depth of detection. Besides the residual uncertainty of clean-up, beach instability and weather may cause DMM to surface, as may erosion and wave action cause DMM to migrate into the areas previously investigated or beyond the project limits. Very little erosion of the Dune Top and Dune Slope is expected, except in the case of a major climatic event, such as a hurricane. The DMM potentially present offshore, and outside the areas of the surf zone investigated, could potentially be moved into the surf zone during periods of heavy wave action.

- Alternative F. Sieve Entire Beach - Berm, Surf, and Dune to the Depth of the Sand Placement Project. Discontinue Land Use Controls.

Beach Open, No Land Use Controls, Additional MEC Clearance.
Proportional MEC HA score: 368. Hazard Level 4. Site conditions present the lowest potential for an explosive event even under high-intensity activities. The beach has full public accessibility with many potential contact hours. The law and natural barriers will provide moderate accessibility to the dune.

Besides the residual uncertainty of clean-up, the DMM potentially present offshore, and outside the areas of the surf zone investigated, could potentially be moved into the surf zone during periods of heavy wave action.

7. **Discussion**

7.1 The MEC HA addresses the residual uncertainty of surface and subsurface cleanup. The current methods for detection, discrimination and removing MEC cannot ensure that all MEC are removed during a cleanup. Detection of MEC is a function of size, depth, and orientation of the object. In general, small MEC is more difficult to detect at depth than larger MEC. The MEC HA scores address this residual uncertainty by not reducing scores in several of the input factor categories in the "Surface Cleanup" and "Subsurface Cleanup" columns. It is important to keep in mind that some level of uncertainty exists with any environmental investigation. Realistic but conservative assumptions can reduce uncertainty.

7.2 The MEC HA addresses the NCP direction for site-specific assessment of risks to human health and the environment. As with any CERCLA-based cleanup process, several different alternatives may be protective of human health and the environment. The results of the MEC HA will provide input into the CERCLA remedy evaluation and selection process.

7.3 Under the CERCLA remedial process, site investigations are undertaken and the evaluation and selection of remedial action alternatives is documented. Each alternative is evaluated using the CERCLA nine-criteria to select the alternative that best meets the statutory requirements. The statute requires that the selected remedy be protective of human health and the environment; can be implemented; and be cost-effective. The MEC HA supports these analyses and supports remedy selection. However, the MEC HA score alone is not the decision tool for remedy selection.

APPENDIX

MEC HA Hazard Level Scores

APPENDIX

Proportional Hazard Level Scores

ENTIRE BEACH

Alternative

Hazard Level Scores	A Open No LUC No clear	B Closed LUC No clear	C Open LUC No clear	D Open LUC DGM/Mag	E Open LUC Berm Sift	F Open No LUC All Sift
Berm - 64%	477	362	445	291	234	240
Surf Zone - 9%	77	61	73	61	36	36
Dune Top - 9%	59	49	52	34	34	31
Dune Slope - 18%	141	122	129	104	104	61
Proportional Hazard Level Scores	754	594	699	490	408	368
Hazard Level	2	3	3	4	4	4

APPENDIX

MEC HA Hazard Level Scores

BERM ONLY

Alternative

	A Open No LUC No clear	B Closed LUC No clear	C Open LUC No clear	D Open LUC DGM	E Open LUC Sift	F Open No LUC Sift
Type / Mark I 37mm Projectile	100	100	100	100	100	100
MEC Category / fuzed DMM	55	55	55	55	55	55
MEC Size / Small Projectile	40	40	40	40	40	40
Location of Additional Humans	30	30	30	30	30	30
Site Accessibility						
Full Accessibility	80		80	80	80	80
Moderate Accessibility						
Limited Accessibility						
Very Limited Accessibility		5				
Potential Contact Hours						
Many Hours	120					30
Some Hours			70	20	20	
Few Hours						
Very Few Hours		15				
Amount of MEC						
Munitions dumped at sea						
Surface Clearance						
Subsurface Clearance	140	140	140	25		
Sifting					5	5
Min MEC Depth to Max Intrusive Depth						
Surface & Subsurface						
Surface Clearance						
Subsurface Clearance	150	150	150	95		
Sifting					25	25
Migration Potential						
Possible	30	30	30	10	10	10
Unlikely						
Hazard Level Score	745	565	695	455	365	375
Hazard Level	2	3	2	4	4	4
Berm is about 64% of entire beach Hazard Level Score	477	362	445	291	234	240

APPENDIX

MEC HA Hazard Level Scores

SURF ZONE ONLY

	Alternative					
	A Open No LUC No clear	B Closed LUC No clear	C Open LUC No clear	D Open LUC Mag	E Open LUC Sift	F Open No LUC Sift
Type / Mark I 37mm Projectile	100	100	100	100	100	100
MEC Category / fuzed DMM	55	55	55	55	55	55
MEC Size / Small Projectile	40	40	40	40	40	40
Location of Additional Humans	30	30	30	30	30	30
Site Accessibility						
Full Accessibility	80		80	80	80	80
Moderate Accessibility						
Limited Accessibility						
Very Limited Accessibility		5				
Potential Contact Hours						
Many Hours	120					30
Some Hours			70	50	20	
Few Hours						
Very Few Hours		15				
Amount of MEC						
Munitions dumped at sea						
Surface Clearance	165	165	165	140		
Subsurface Clearance						
Sifting					10	10
Min MEC Depth to Max Intrusive Depth						
Surface & Subsurface	240	240	240			
Surface Clearance				150		
Subsurface Clearance						
Sifting					50	50
Migration Potential						
Possible	30	30	30	30	10	10
Unlikely						
Hazard Level Score	860	680	810	675	395	405
Hazard Level	1	3	2	3	4	4
Surf zone is about 9% of entire beach Hazard Level Score	77	61	73	61	36	36

APPENDIX

MEC HA Hazard Level Scores

DUNE TOP ONLY

Alternative

	A	B	C	D	E	F
	Open No LUC No clear	Closed LUC No clear	Open LUC No clear	Open LUC DGM	Open LUC BermSift	Open No LUC Sift
Type / Mark I 37mm Projectile	100	100	100	100	100	100
MEC Category / fuzed DMM	55	55	55	55	55	55
MEC Size / Small Projectile	40	40	40	40	40	40
Location of Additional Humans	30	30	30	30	30	30
Site Accessibility						
Full Accessibility						
Moderate Accessibility	55					55
Limited Accessibility			15	15	15	
Very Limited Accessibility		5				
Potential Contact Hours						
Many Hours						
Some Hours	70					20
Few Hours			40	10	10	
Very Few Hours		15				
Amount of MEC						
Munitions dumped at sea						
Surface Clearance						
Subsurface Clearance	140	140	140	25	25	
Sifting						5
Min MEC Depth to Max Intrusive Depth						
Surface & Subsurface						
Surface Clearance						
Subsurface Clearance	150	150	150	95	95	
Sifting						25
Migration Potential						
Possible						
Unlikely	10	10	10	10	10	10
Hazard Level Score	650	545	580	380	380	340
Hazard Level	3	3	3	4	4	4
Dune top is about 9% of entire beach Hazard Level Score	59	49	52	34	34	31

APPENDIX

MEC HA Hazard Level Scores

DUNE SLOPE ONLY

	Alternative					
	A	B	C	D	E	F
	Open No LUC No clear	Closed LUC No clear	Open LUC No clear	Open LUC Mag	Open LUC BermSift	Open No LUC Sift
Type / Mark I 37mm Projectile	100	100	100	100	100	100
MEC Category / fuzed DMM	55	55	55	55	55	55
MEC Size / Small Projectile	40	40	40	40	40	40
Location of Additional Humans	30	30	30	30	30	30
Site Accessibility						
Full Accessibility						
Moderate Accessibility	55					55
Limited Accessibility			15	15	15	
Very Limited Accessibility		5				
Potential Contact Hours						
Many Hours						
Some Hours	70					20
Few Hours			40	20	20	
Very Few Hours		15				
Amount of MEC						
Munitions dumped at sea						
Surface Clearance	165	165	165	140	140	
Subsurface Clearance						
Sifting						5
Min MEC Depth to Max Intrusive Depth						
Surface & Subsurface	240	240	240			
Surface Clearance				150	150	
Subsurface Clearance						
Sifting						25
Migration Potential						
Possible	30	30	30	30	30	10
Unlikely						
Hazard Level Score	785	680	715	580	580	340
Hazard Level	2	3	3	3	3	4
Dune slope is about 18% of entire beach						
Hazard Level Score	141	122	129	104	104	61

APPENDIX D

Costs Summary

Surf City

ESTIMATED COSTS
(rounded up to thousands)

Phase III Alternatives

Estimated Costs	A Open No LUC No clear	B Closed LUC No clear	C Open LUC No clear	D Open LUC DGM/Mag	E Open LUC Berm Sift	F Open No LUC All Sift
Contract Cost (without contingency)	0	$6,537	$332	$11,719	$12,871	$19,882
Contract Contingency Cost	0	$1,960	$99	$3,516	$3,861	$5,965
NAB MM Design Center Costs	0	$6	$236	$1,760	$248	$247
NAP PM Costs	0	$1,200	$1,200	$2,500	$650	$850
Total Estimated Costs	0	$9,703	$1,867	$19,495	$17,630	$26,944

Surf City

ESTIMATED COSTS
(rounded up to thousands)

Phase III Alternatives

Estimated Costs	A Open No LUC No clear	B Closed LUC No clear	C Open LUC No clear	D Open LUC DGM/Mag	E Open LUC Berm Sift	F Open No LUC All Sift
Contract Cost (without contingency)						
Contract Contingency Cost						
NAB MM Design Center Costs						
EE SS / George	0			70	140	210
Year 2				72		
Year 3				74		
Year 4				76		
Year 5				79		
ESS/plan & report review		5	5	20	20	20
Year 2				5		
Year 3				5		
Year 4				5		
Year 5				5		
Construction Support			60	300	60	
Contingency Response			160	800		
DGM / Tom	0	0	0	26	11	
Year 2				27		
Year 3				28		
Year 4				29		
Year 5				30		
RID / Dennis	0	0	0			
Plan & Report review				25	5	5
Total HTRW	0	5	225	1676	236	235
Design Center	0	1	11	84	12	12
Total NAB Costs	0	6	236	1760	248	247

Rough Order-of-Magnitude Cost Estimates for MEC EE/CA
Alternatives A - G
Surf City and Ship Bottom, NJ

Alternative	Year	Description	Duration (wks)	Excavation	MEC Clearance	Crossovers	LUC	PM, Site Supervision & Incidentals (20%)	Total Cost	Contingency (30%)	Total Cost
A		No Action		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
B	1	Close Beach. Install Chain Link Fence Around the Perimeter, 24-Hour Security and LUC Support.		$ -	$ -	$ -	$ 1,256,000	$ 251,200	$ 1,507,200	$ 452,160	$ 1,959,360
B	2	24-Hour Security, LUC Support.		$ -	$ -	$ -	$ 991,000	$ 198,200	$ 1,189,200	$ 356,760	$ 1,545,960
B	3	24-Hour Security, LUC Support.		$ -	$ -	$ -	$ 1,020,730	$ 204,146	$ 1,224,876	$ 367,463	$ 1,592,339
B		**Totals for Alternative B:**		**$ -**	**$ -**	**$ -**	**$ 3,267,730**	**$ 653,546**	**$ 3,921,276**	**$ 1,176,383**	**$ 5,097,659**
C	1	Continue LUCs.		$ -	$ -	$ -	$ 52,000	$ 10,400	$ 62,400	$ 18,720	$ 81,120
C	2	Continue LUCs.		$ -	$ -	$ -	$ 53,560	$ 10,712	$ 64,272	$ 19,282	$ 83,554
C	3	Continue LUCs.		$ -	$ -	$ -	$ 55,167	$ 11,033	$ 66,200	$ 19,860	$ 86,060
C	4	Continue LUCs.		$ -	$ -	$ -	$ 56,822	$ 11,364	$ 68,186	$ 20,456	$ 88,642
C	5	Continue LUCs.		$ -	$ -	$ -	$ 58,526	$ 11,705	$ 70,232	$ 21,070	$ 91,301
C		**Totals for Alternative C:**		**$ -**	**$ -**	**$ -**	**$ 276,075**	**$ 55,215**	**$ 331,290**	**$ 99,387**	**$ 430,677**
D	1	Beach Surface & Subsurface Clearance to Detection Depth Each Year and LUC Support.	10	$ -	$ 1,828,024	$ -	$ 52,000	$ 376,005	$ 2,256,029	$ 676,809	$ 2,932,837
D	2	Beach Surface & Subsurface Clearance to Detection Depth Each Year and LUC Support.	10	$ -	$ 1,831,365	$ -	$ 53,560	$ 376,985	$ 2,261,910	$ 678,573	$ 2,940,483
D	3	Beach Surface & Subsurface Clearance to Detection Depth Each Year and LUC Support.	10	$ -	$ 1,886,306	$ -	$ 55,167	$ 388,294	$ 2,329,767	$ 698,930	$ 3,028,697
D	4	Beach Surface & Subsurface Clearance to Detection Depth Each Year and LUC Support.	10	$ -	$ 1,942,895	$ -	$ 56,822	$ 399,943	$ 2,399,660	$ 719,898	$ 3,119,558
D	5	Beach Surface & Subsurface Clearance to Detection Depth Each Year and LUC Support.	10	$ -	$ 2,001,182	$ -	$ 58,526	$ 411,942	$ 2,471,650	$ 741,495	$ 3,213,145
D		**Totals for Alternative D:**		**$ -**	**$ 9,489,771**	**$ -**	**$ 276,075**	**$ 1,953,169**	**$ 11,719,015**	**$ 3,515,705**	**$ 15,234,720**
E	1	Sieve Berm & Surf Zone to Depth of Sand Placement, Construction Support for Crossovers and Continue LUCs.	20	$ 5,163,000	$ 5,078,000	$ 208,000	$ 52,000	$ 2,100,200	$ 12,601,200	$ 3,780,360	$ 16,381,560
E	2	Continue LUCs.		$ -	$ -	$ -	$ 53,560	$ 10,712	$ 64,272	$ 19,282	$ 83,554
E	3	Continue LUCs.		$ -	$ -	$ -	$ 55,167	$ 11,033	$ 66,200	$ 19,860	$ 86,060
E	4	Continue LUCs.		$ -	$ -	$ -	$ 56,822	$ 11,364	$ 68,186	$ 20,456	$ 88,642
E	5	Continue LUCs.		$ -	$ -	$ -	$ 58,526	$ 11,705	$ 70,232	$ 21,070	$ 91,301
E		**Totals for Alternative E:**		**$ 5,163,000**	**$ 5,078,000**	**$ 208,000**	**$ 276,075**	**$ 2,145,015**	**$ 12,870,090**	**$ 3,861,027**	**$ 16,731,117**
F	1	Sieve Entire Beach to Depth of Sand Placement.	30	$ 8,812,000	$ 7,756,000	$ -	$ -	$ 3,313,600	$ 19,881,600	$ 5,964,480	$ 25,846,080
F		**Totals for Alternative F:**		**$ 8,812,000**	**$ 7,756,000**	**$ -**	**$ -**	**$ 3,313,600**	**$ 19,881,600**	**$ 5,964,480**	**$ 25,846,080**

APPENDIX E

Responsiveness Summary

To be completed upon receipt of public comments.