Discarded Military Munitions Management Plan

TERMINAL 91: SEDIMENT REGRADING

Prepared for:

Port of Seattle
PO Box 1209
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August 2015

Prepared by

AECOM

Exhibit H

Discarded Military Munitions Management Plan
(AECOM, Aug. 2015)

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1.0 INTRODUCTION

The Port of Seattle's Terminal 91 (T-91), Pier 91 requires sediment regrading in order to maintain navigational access (Figure 1). The last dredging event in 2008 at Pier 91 addressed the western berth. A portion of the eastern berth of Pier 91 is currently proposed for sediment regrading by the Port of Seattle (Port).

Sediment regrading is proposed for this area based on complications that make traditional dredging impractical. T-91 was an active U.S. Department of the Navy supply terminal during World War II. As a result of former Naval operations, discarded military munitions (DMM) have been identified in the vicinity of Pier 91 East by the U.S. Army Corps of Engineers (USACE 2013). The potential presence of DMM in sediment complicates dredging and disposal options. The current plan involves repositioning shoal material a short distance to adjacent downslope areas (DOF 2015).

This DMM Management Plan assesses the hazards of encountering DMM during the underwater regrading project, as well as how any DMM that are identified during post-project dive inspections will be managed. Contents of this plan were prepared following Department of Defense (DoD) and USACE safety requirements, similar to an Explosives Safety Submission (ESS) for the DoD (DoD 2010, USACE 2008, USACE 2014).

Site Information:

- Facility Name: Port of Seattle
- Site Name: Terminal 91, Pier 91 East
- Location: Smith Cove, northern end of Elliott Bay
- State: Washington
- Project: Sediment regrading activities

2.0 ANTICIPATED START DATE

The anticipated start date for the underwater regarding activities is December 2015.

3.0 PURPOSE

The purpose of the project is to maintain safe navigational access in the east berth of Pier 91 by relocating (i.e., regrading) between 250 and 500 cubic yards (cy) of shoaled material consisting primarily of shell hash, fractured rock, and cobble. A small portion of the nearshore area is shoaled above water depths needed for berthing (Figure 2). Following regrading, the project area will be inspected for DMM that may be visible at the surface.[1] DMM are defined as "Military munitions that have been abandoned without proper disposal or removed from storage in a

[1] Sediment sampling activities completed prior to regrading did not require a DMM Management Plan. Activities were completed using anomaly avoidance protocols.

military magazine or other storage area for the purpose of disposal" (10 United States Code 2710(e)(2)).

4.0 SITE BACKGROUND AND CURRENT CONDITIONS

T-91 is located at the north end of Elliott Bay at 2001 West Garfield Street, in Seattle, Washington. T-91 includes Piers 90 and 91, about 35 acres of adjacent water area, and about 72 acres of yard area north of the Magnolia Bridge.

T-91 supports marine uses such as a cruise ship terminal; cargo handling facilities for high-value, high-employment commodities (e.g., fish products); a factory trawler homeport and support facility; major cold storage warehouses, distribution, and a seafood processing plant; and short- and long-term moorage for tugs, barges, and other large vessels.

Shoaled sediment requires regrading and relocation in support of cruise ship terminal operations. Underwater regrading work using derrick and clamshell equipment will relocate infilled material (shoals) to adjacent deeper water in order to provide navigational access at the project elevation of -35 feet Mean Lower Low Water (MLLW).

The Required Regrade Area at T-91, Pier 91E (STA 0-20 to STA 8+50) includes a shoal length of approximately 370 feet (STA 0-20 to 3+50) and a second smaller shoal of 20 feet in length (STA 5+50) offset 11 feet from the face of the fender pile system. The shoals are of varying width up to approximately 10 to 15 feet. The primary and secondary relocation areas (Figure 3) are adjacent to the shoaled areas. The post-regrade slope may be vertical based on the geometry of the clamshell bucket. The Work Area may be adjusted, based on shoal conditions in the pre-regrade survey.

A Remedial Investigation (RI) (USACE 2013) completed for the T-91 area identified 20 millimeter (mm), 40 mm, 3-inch, and 5-inch projectiles, all of which were DMM. The 5-inch projectile was the largest DMM item identified for the site, so it is used as the munition with the greatest fragmentation distance (MGFD). DMM items were identified as having Explosive D filler, a relatively insensitive high explosive. Chapter 8 of the RI included an assessment of potential hazards of DMM to various receptors at T-91, including "topside construction workers" such as those who would be employed to conduct the regrading project. The risk is reported as "N/A" because there is no exposure pathway.

Field investigations and removal actions undertaken as part of the RI in 2010 and 2011 removed 25 pieces of DMM that were at or near the surface of the seabed. With the exception of one shell casing, the DMM items were located well outside of the shoal area at Pier 91. Based on the size of the project area, the volume of material being moved, and the nature of the shoal material, it is unlikely that DMM items will be encountered during regrading.

5.0 EXECUTING AGENCIES

a. Port of Seattle – Facility owner/operator

b. Washington State Department of Ecology – Regulatory lead

c. United States Environmental Protection Agency – Additional regulatory support

d. Dalton Olmsted Fuglevand (DOF) – Sediment regrading design contractor

e. AECOM – DMM/unexploded ordnance (UXO) contractor

6.0 SCOPE OF INVESTIGATIVE ACTION

a. Regrading/Relocation of Sediment (Construction) – Following the sediment regrading and relocation activities, Port of Seattle police divers will inspect the project area for surficial evidence of DMM. The Port Police Department Dive Unit routinely performs thorough surveys of both the east and west berths at Pier 91, including inspection of the seabed, piling, and underpier area for security purposes. These dives occur in early April before the summer cruise season begins. The Dive Unit is aware of the potential to discover DMM items in the berths and has a standard operating procedure (SOP) in place should any be discovered. In the past, discovered DMM items have been removed in accordance with their SOP, which includes coordination with explosive ordnance disposal personnel at Joint Base Lewis-McChord (JBLM) for transport and disposal at their permitted facility. If the regrading project were to expose DMM items, they would likewise be identified and removed by the Port's Dive Unit during their pre-cruise security dives and transferred to JBLM personnel. However, as referenced above, based on the nature, location, and volume of the shoal material, it is extremely unlikely that DMM items would be exposed by the regrading.

b. Table 6-1 identifies the different areas to be investigated within this project location. Figures 1 through 7 in the *Underwater Regrading Plan* (DOF 2015) show the areal extent of the proposed regrading and relocation areas for sediment.

TABLE 6-1. REGRADING AND RELOCATION AREAS

Proposed Sediment Area	Description	Total Acreage of Area
Shoaled Regrading Area	Area of shoaling approximately 390 feet long, 10 to15 feet wide, and 1.25 feet thick along eastern edge of Pier 91E.	0.045 ac
Relocation Area	Deposition area located approximately 27 to 82 feet east of Pier 91E (primary and secondary).	0.55 ac

7.0 SAFETY CRITERIA

Characteristics of the munition with the greatest fragmentation distance (MGFD) (i.e., 5-inch projectile) selected for this project are shown in Table 7-1. The MGFD was based on available historical information and findings during previous projects (see Appendix A for Fragmentation Data Review Form). The minimum separation distances (MSDs) for surface workers are also

listed in Table 7-1. However, assuming a depth of at least 22 feet of water cover during the regrading activities, the effects of over-pressurization and fragmentation will be mitigated by the presence of the water column. As shown in Table 7-2, in accordance with the underwater component of buried explosion module (BEM) listed in the DoD Explosives Safety Board (DDESB) Technical Paper (TP) 16 Chapter 6, BEM Procedures (DDESB 2012), there is no fragmentation or blast withdrawal hazard below 22 feet MLLW (see Appendix A for the BEM output form). However, as an additional safety measure, a default MSD of 100 feet will be established for non-essential personnel during regrading activities.

TABLE 7-1. MINIMUM SEPARATION DISTANCES

DMM	Minimum Separation Distance (feet)			
	Unintentional Detonations		Intentional Detonations	
	HFD	Team Separation Distance (K40)	Without Engineering Controls (MFD-H)	Using Sandbag Mitigation
5-inch 54 Caliber Mark (Mk) 81, 82, and 83	343[a]	84	2,652	Not Permitted

Notes:
See Appendix A for fragmentation data review forms.
Source: DDESB 2004.
[a] Hazardous fragment distance (HFD) will be based on the 5-inch 38 Caliber Mk 35 projectile.
K40 – Inhabited Building Distance (1.2 pounds per square inch).
MFD-H – Maximum Fragment Distance, Horizontal.
Intentional Detonation – planned explosive demolition (not anticipated at T-91).
Unintentional Detonation– interaction with the material (i.e., handling) causes it to function.

TABLE 7-2. BURIED EXPLOSION MODULE SUMMARY

Depth of Water (feet)	MFD-H (feet of water cover)
	5-inch Mark (Mk) 28 (Explosive D filled)
22	20.1[a]

Notes:
See Appendix A for Buried Explosion Module (BEM) output form.
[a] Maximum Fragment Distance, Horizontal (MFD-H) will be based on the 5-inch Mk 28 (Explosive D filled) projectile.

8.0 METHODS OF DISPOSAL

The contractor will not conduct disposal operations. The Port of Seattle Bomb Disposal Unit will take custody of any DMM discovered during the pre-cruise dive inspection. Custody of DMM will then be transferred to JBLM for disposal and final disposition at their permitted site. This DoD military installation is located approximately 9 miles southwest of Tacoma, Washington and operates under the jurisdiction of the United States Army Joint Base Garrison. DMM will be transported in accordance with applicable local, state, and federal regulations (i.e., bracing, blocking, segregation of incompatible explosives, and appropriate notifications).

9.0 REFERENCES

DDESB, 2004. *Technical Paper (TP) 18. Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel.* December 20.

DDESB, 2012. *Technical Paper (TP) 16. Methodologies for Calculating Primary Fragment Characteristics. Revision 4*. August.

DoD, 2010. DoD Manual (DoDM) 6055.09-M, *Ammunition and Explosives Safety Standards*. Prepared by the U.S. Department of Defense. August 4.

DOF, 2015. *Terminal 91 – Pier 91E Underwater Regrading Plan 201, Draft Figures*. Prepared for the Port of Seattle. Prepared by Dalton Olmstead Fuglevand, Seattle, WA.

USACE, 2008. *Explosives Safety and Health Requirements Manual.* EM 385-1-97 (including Errata 1 through 6 dated June and July 2009, April 2010, and May 2013, and Change 1 dated June 2013). Prepared by the U.S. Army Corps of Engineers. Last revision dated June 2013.

USACE, 2013. *Draft Final Remedial Investigation Report, Former Seattle Naval Supply Depot, Piers 90 and 91, Port of Seattle*. Formerly Used Defense Site #F10WA012501. Prepared by the U.S. Army Corps of Engineers, Seattle, WA. September.

USACE, 2014. *Safety and Health Requirements Manual.* EM 385-1-1. Prepared by the U.S. Army Corps of Engineers. November.

Port of Seattle Proposed T91 P91E Regrading Project	DALTON OLMSTED FUGLEVAND
VICINITY MAP	**FIGURE 1** February 19, 2015

T-91 Project Elevations							
Begin STA	End STA	Project Elevation (ft MLLW)	Allowance for Cover (ft)	Required Regrading Elevation (ft MLLW)	Allowable Overdepth (ft)	Allowable Regrade Overdepth (ft MLLW)	Post-Regrading Sand and Gravel Cover Thickness (ft)
-0+20	8+50	-35	1.3	-36.3	2	-38.3	0.5

T-91 Project Quantities					
Station		Estimated Material Quantity (CY)			
Begin	End	A	B	C	A+B+C
-0+20	8+50	120	180	150	450

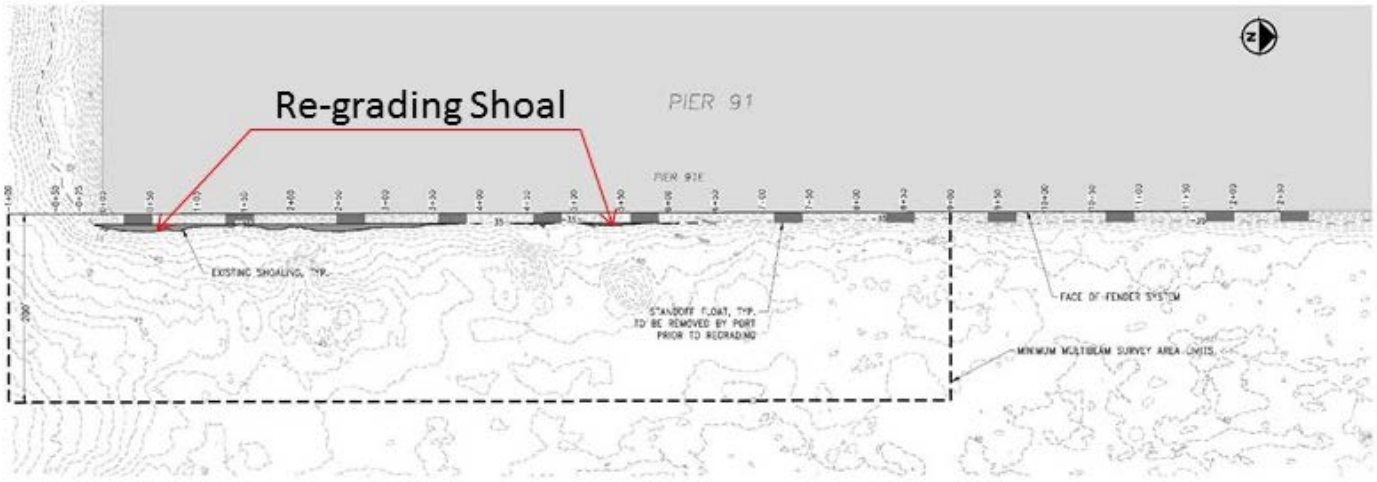
NOTES:
1. SEE SHEET G03 FOR DEFINITIONS OF A, B & C MATERIAL TYPES.
2. VOLUMES SHOWN ABOVE ARE ESTIMATES BASED ON CONDITIONS AT THE TIME OF THE SURVEY AND MAY CHANGE DURING THE PERIOD PRIOR TO COMMENCING WORK. A CONDITION SURVEY WILL BE PERFORMED PRIOR TO COMMENCEMENT OF WORK AS STATED IN THE SPECIFICATIONS.
3. NUMBERS ARE ROUNDED UP TO THE NEAREST 50 CY.

FOR REVIEW ONLY

THESE DRAWINGS HAVE BEEN PREPARED PRIOR TO PROJECT PERMITS BEING ISSUED. DRAWINGS MAY REQUIRE SUBSEQUENT REVISIONS IN ORDER TO BE CONSISTENT WITH ISSUED PERMITS.

GENERAL NOTE:

1. SEE NOTES ON SHEET G02.



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NOTE: THIS PLAN SET IS FORMATTED TO BE PRINTED AT FULL SCALE (22"x34").

SITE MAP

SCALE: 1" = 50'

1"=50'-0" Scale

50 0 50 100 Feet

DOF DALTON OLMSTED FUGLEVAND

REVISIONS

Port of Seattle

PROJECT: TERMINAL 91 - PIER 91E UNDERWATER REGRADING 2014

SHEET TITLE: T-01 REGRADING CALCULATION PLAN

100% REVIEW SET

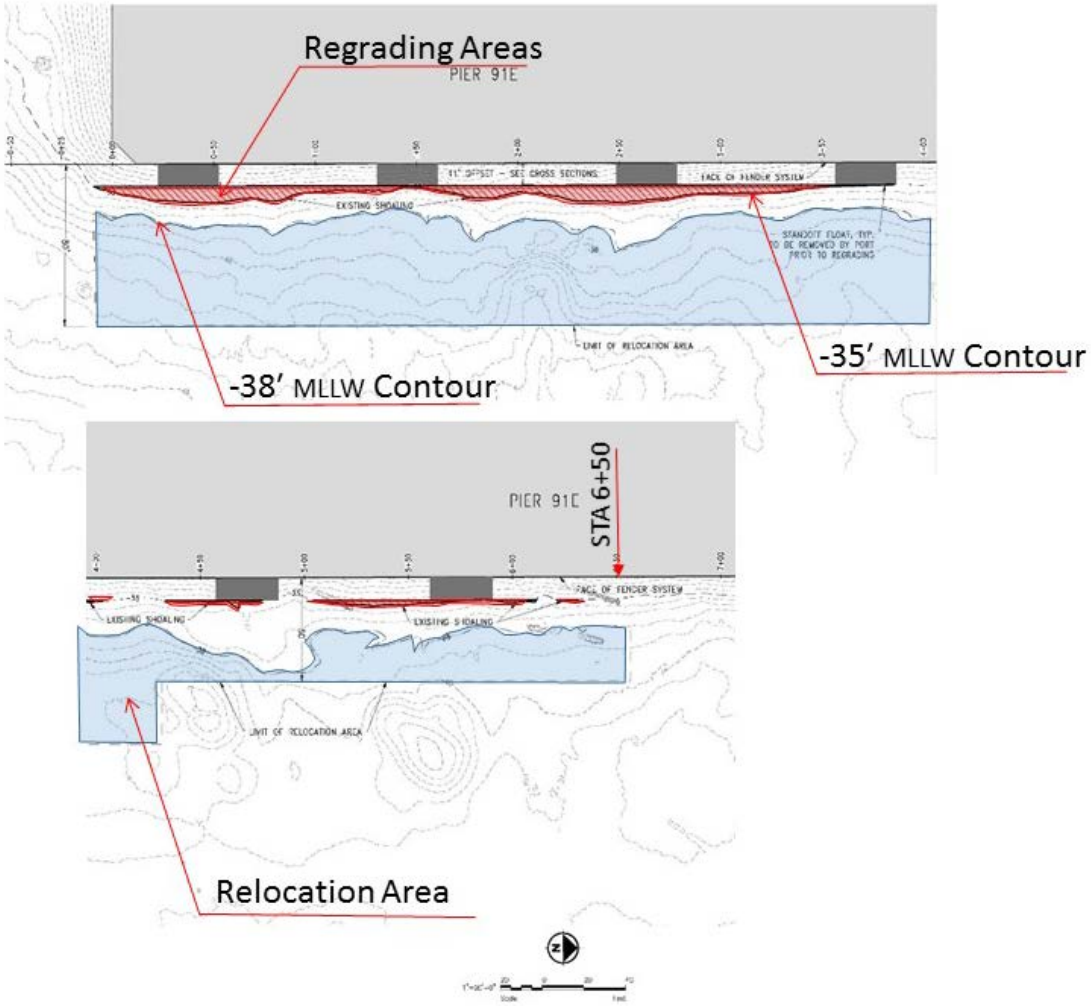
Port of Seattle Proposed T91 P91E Regrading Project

PROPOSED REGRADING PROJECT

DOF DALTON OLMSTED FUGLEVAND

FIGURE 2

February 19, 2015



Port of Seattle Proposed T91 P91E Regrading Project

PROPOSED REGRADING & RELOCATION AREAS

DALTON OLMSTED FUGLEVAND

FIGURE 3

February 19, 2015

Fragmentation Data Review Forms
Buried Explosion Module (BEM) Output Form

Fragmentation Data Review Form

Database Revision Date 8/21/2014

Category:	Surface-Launched HE Rounds
Munition:	5 in 38 Caliber Mk 35
Case Material:	Steel, Mild
Fragmentation Method:	Naturally Fragmenting
Secondary Database Category:	Projectile
Munition Case Classification:	Robust

DODIC:	
Date Record Created:	1/11/2008
Record Created By:	MC
Last Date Record Updated:	9/14/2011
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Explosive D
Explosive Weight (lb):	7.55
Diameter (in):	5.0000
Cylindrical Case Weight (lb):	29.81237
Maximum Fragment Weight (Intentional) (lb):	0.3380
Design Fragment Weight (95%) (Unintentional) (lb):	0.0667
Critical Fragment Velocity (fps):	3409

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	0.81
TNT Equivalent Weight - Impulse (lbs):	6.116
Kinetic Energy 10^6 (lb-ft²/s²):	1.9634

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	36
Expected Max. Throw Distance (ft):	220
Minimum Separation Distance (ft):	220

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	275
Water Containment System:	1100 gal tank

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	343
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	2131
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1613

Overpressure Distances

TNT Equivalent (Pressure):	0.85
TNT Equivalent Weight - Pressure (lbs):	6.418
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	33
Public Traffic Route Distance (2.3 psi); K24 Distance:	45
Inhabited Building Distance (1.2 psi), K40 Distance:	74
Intentional MSD (0.0655 psi), K328 Distance:	610

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	8.80	4.49
Mild Steel:	1.71	0.87
Hard Steel:	1.40	0.71
Aluminum:	3.37	1.79
LEXAN:	8.19	5.49
Plexi-glass:	6.62	3.89
Bullet Resist Glass:	5.85	3.26

Item Notes

Fragmentation Data Review Form

Database Revision Date 8/21/2014

Category:	Surface-Launched HE Rounds
Munition:	5 in 54 Caliber Mk 81, 82, and 83
Case Material:	Steel, Mild
Fragmentation Method:	Naturally Fragmenting
Secondary Database Category:	Projectile
Munition Case Classification:	Robust

DODIC:	D340, D343, D346
Date Record Created:	10/14/2011
Record Created By:	SDH
Last Date Record Updated:	4/15/2013
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	PBXN-106
Explosive Weight (lb):	6.25
Diameter (in):	5.0000
Cylindrical Case Weight (lb):	46.75802
Maximum Fragment Weight (Intentional) (lb):	0.6690
Design Fragment Weight (95%) (Unintentional) (lb):	0.1825
Critical Fragment Velocity (fps):	3933

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1.3
TNT Equivalent Weight - Impulse (lbs):	8.125
Kinetic Energy 10^6 (lb-ft²/s²):	4.8135

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	36
Expected Max. Throw Distance (ft):	220
Minimum Separation Distance (ft):	220

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	275
Water Containment System:	1100 gal tank

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	326
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	2652
MFD-V [Maximum Fragment Distance, Vertical] (ft):	2024

Overpressure Distances

TNT Equivalent (Pressure):	1.46
TNT Equivalent Weight - Pressure (lbs):	9.125
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	38
Public Traffic Route Distance (2.3 psi); K24 Distance:	50
Inhabited Building Distance (1.2 psi), K40 Distance:	84
Intentional MSD (0.0655 psi), K328 Distance:	685

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	12.71	6.81
Mild Steel:	2.46	1.33
Hard Steel:	2.02	1.09
Aluminum:	4.74	2.65
LEXAN:	10.24	7.00
Plexi-glass:	8.91	5.38
Bullet Resist Glass:	8.12	4.64

Item Notes

Corrected values utilized for determining sandbag and water mitigation requirements resulted sandbag and water mitigation being permitted for use with this item.

BURIED EXPLOSION MODULE

(Version 6.3.1)

Based on DDESB Technical Paper 16 Revision 4, EARTHEX software, and NSWCDD/TR-92/196

(ENGLISH UNITS)

SELECT BURIAL MEDIUM	Water	SELECT ITEM DESCRIPTION	5 in Mk 28 (Explosive D filled)
If underwater, ignore soil type	Dry Sand		

USER INPUTS

ENTER TOTAL NUMBER OF ITEMS	1
ENTER TOTAL WEIGHT OF ALL DONOR CHARGES (lbs)	0.10
ENTER DONOR CHARGE EXPLOSIVE TYPE	Explosive D

VALUES USED IN BEM CALCULATIONS

SINGLE ITEM NEW (lbs)	7.33
ITEM DIAMETER (in)	4.930
SINGLE ITEM MAXIMUM FRAGMENT WEIGHT (lbs)	0.3955
FRAGMENT WEIGHT USED IN CALCULATIONS (lbs)	0.3955
SINGLE ITEM MAXIMUM FRAGMENT VELOCITY (ft/s)	3,031
FRAGMENT VELOCITY USED IN CALCULATIONS (ft/s)	3,031
TOTAL TNT WEIGHT USED (lbs)	6.32
WEIGHT USED IN UNDEX WEIGHT CALCULATIONS (lbs)	7.58
WEIGHT USED IN UNDEX VELOCITY CALCULATIONS (lbs)	5.61

USER INPUTS

ENTER DEPTH OF WATER (ft)	22.00
ENTER HORIZONTAL RANGE (for pressure calculation) (ft)	100

BURIED EXPLOSION MODULE OUTPUTS

UNDERWATER

NO CRATER

0

FRAGMENT EXIT VELOCITY (ft/s)	0.0	MIN. FRAGMENT LAUNCH ANGLE (°)	90.0
MAXIMUM FRAGMENT DISTANCE - HORIZONTAL (ft)	0.0		

Distance at which pressure is 0.066 psi = Blast Withdrawal Distance (buried/undex) (ft)			20.1	
Open Air Withdrawal Distance, K328 (ft)	606.3	Fragment Hazard Distance (ft)	0.0	See Note 2
		Pressure at Fragment Hazard Distance (psi)	-N/A-	See Note 3
		Pressure at Fragment Hazard Distance (dB)	-N/A-	See Note 3
		Fragment Hazard Distance = max (MFD-H, Soil Ejecta Distance)		
		Pressure at Range Entered (psi)	0.0000	See Note 4
		Pressure at Range Entered (dB)	0.0	See Note 4

Note 2: Water too deep--no fragments expected

Note 3: No overpressure is produced at this depth

Note 4: No overpressure is produced at this depth