This document is part of Appendix A, and includes Mine Countermeasures Equipment Lubrication: Nature of Discharge for the "Phase I Final Rule and Technical Development Document of Uniform National Discharge Standards (UNDS)," published in April 1999. The reference number is EPA-842-R-99-001.

Phase I Final Rule and Technical Development Document of Uniform National Discharge Standards (UNDS)

Mine Countermeasures Equipment Lubrication: Nature of Discharge

April 1999

NATURE OF DISCHARGE REPORT

Mine Countermeasures Equipment Lubrication

1.0 INTRODUCTION

The National Defense Authorization Act of 1996 amended Section 312 of the Federal Water Pollution Control Act (also known as the Clean Water Act (CWA)) to require that the Secretary of Defense and the Administrator of the Environmental Protection Agency (EPA) develop uniform national discharge standards (UNDS) for vessels of the Armed Forces for "...discharges, other than sewage, incidental to normal operation of a vessel of the Armed Forces, ..." [Section 312(n)(1)]. UNDS is being developed in three phases. The first phase (which this report supports), will determine which discharges will be required to be controlled by marine pollution control devices (MPCDs)—either equipment or management practices. The second phase will develop MPCD performance standards. The final phase will determine the design, construction, installation, and use of MPCDs.

A nature of discharge (NOD) report has been prepared for each of the discharges that has been identified as a candidate for regulation under UNDS. The NOD reports were developed based on information obtained from the technical community within the Navy and other branches of the Armed Forces with vessels potentially subject to UNDS, from information available in existing technical reports and documentation, and, when required, from data obtained from discharge samples that were collected under the UNDS program.

The purpose of the NOD report is to describe the discharge in detail, including the system that produces the discharge, the equipment involved, the constituents released to the environment, and the current practice, if any, to prevent or minimize environmental effects. Where existing process information is insufficient to characterize the discharge, the NOD report provides the results of additional sampling or other data gathered on the discharge. Based on the above information, the NOD report describes how the estimated constituent concentrations and mass loading to the environment were determined. Finally, the NOD report assesses the potential for environmental effect. The NOD report contains sections on: Discharge Description, Discharge Characteristics, Nature of Discharge Analysis, Conclusions, and Data Sources and References.

2.0 DISCHARGE DESCRIPTION

This section describes the mine countermeasures discharge and includes information on: the equipment that is used and its operation (Section 2.1), general description of the constituents of the discharge (Section 2.2), and the vessels that produce this discharge (Section 2.3).

2.1 Equipment Description and Operation

The Navy is the only branch of the Armed Forces with a mine countermeasures mission. To accomplish this mission, mine countermeasures vessels use towed sonar and video arrays, cable cutters, and mine detonation equipment. During training exercises, the mine countermeasures equipment is deployed and towed behind the ship as it practices sweeping the area for mines.

Specific types of mine countermeasures equipment are:

- devices to detonate acoustic mines, such as acoustic hammers and vibrating diaphragms;
- robotic devices (mine neutralization vehicles) which locate and destroy mines;
- devices which generate magnetic fields to explode magnetic mines;
- minehunting sonar; and
- cables fitted with mechanical or explosive cutters to cut the cables of moored mines.

Mine countermeasures equipment is normally located at the stern or fantail portion of mine countermeasures vessels. Most equipment is non-magnetic, and winches and cranes are hydraulically powered. Brief descriptions of the specific mine countermeasures equipment used by the Navy are presented below:[1]

A-MK4-V and A-MK6-B mine detonators use vibrating diaphragms and acoustic hammers, respectively, to generate noise and detonate acoustic mines. When deployed, both types of acoustic detonators are towed astern on buoyant 1,600-foot-long cables. Both types of detonators are not deployed simultaneously but rather, one detonator type is selected for a given minesweeping event, depending on the type of mine targeted.

Magnetic minesweeping cables float, are trailed astern of the ship, and generate large electric currents through the water. This creates a magnetic field around the cable which detonates magnetic mines. Several cable configurations are used and all are carried on a common cable reel drum with three sections. Cable lengths range from 450 to 1,800 feet for the various configurations.

AN/SLQ-48 mine neutralization vehicles (MNVs) are cable-controlled, unmanned robotic devices used to locate and destroy mines. They contain closed-circuit television cameras and close-range sonar for locating mines, that are then destroyed using cable cutters or small explosive charges. A crane with a lifting cable is used to deploy and recover the AN/SLQ-48 MNV on some vessels. A 5,000-foot-long cable is used to supply power.

AN/SQQ-32 sonar tow cables and reels are used to tow and supply power to AN/SQQ-32 variable-depth, mine-hunting sonars.

AN/SQQ-30 sonar tow cable and reels are used to tow and supply power to older, less-capable mine hunting sonars used on some ships. These systems will eventually be replaced with AN/SQQ-32 sonars.

O-type mechanical gear is used to sweep moored mines. It consists of wire cables towed through the water at depths where it can strike the mine's mooring. The mooring slides along the cable until it contacts mechanical or explosive cutters, which sever the mooring. The mines then bob to the surface where they are detonated by gunfire.

A typical layout of mine countermeasures equipment on the fantail of a mine countermeasures ship is provided in Figure 1. Figure 2 shows a schematic of an O-type setup used to sweep moored mines.[1]

2.2 Releases to the Environment

This discharge consists of the lubricating grease and oil removed by the mechanical action of seawater as the equipment is towed. Greases and oils are used externally on wetted equipment (e.g., blocks, swivels, and cutters) to minimize wear and to prevent the mine countermeasures equipment from binding as it is deployed.[2] Tow cables are made of stainless steel and are not lubricated, with the exception of the lifting cable on the crane of MHC 51 Class vessels, which is grease-lubricated.[3,4] Grease and oil application procedures are discussed in Section 3.

Lubricants used on mechanical components inside the water-tight compartments of towed acoustic and electromagnetic devices are not released from the devices to the sea. Neither are leaks and spills of lubricants to the deck from non-wetted, on-board mine countermeasures equipment; these are cleaned-up and contained using rags or other sorbents.[5]

2.3 Vessels Producing the Discharge

Mine countermeasures equipment is found on only two classes of Armed Forces vessels: the Navy's Osprey (MHC 51) Class, and the Navy's Avenger (MCM 1) Class.[1] The nine MHC 51 Class coastal minehunters perform harbor clearing, channel clearing, and deep-water coastal mine countermeasures. The MCM 1 Class has 14 vessels designed to locate and destroy mines that cannot be countered by conventional minesweeping techniques. Table 1 shows the vessels producing the mine countermeasures equipment lubrication discharge.[1]

Both the MCM and the MHC classes are equipped with a hull-mounted, variable-depth sonar (VDS) (either a SQQ-30 or a newer SQQ-32) as their primary means of mine detection, and a cable-controlled and powered SLQ-48 Mine Neutralization Vehicle (MNV) for the examination and clearing of mines.

MHC 51 Class vessels are equipped only with the SLQ-48 MNV and the SQQ-32 sonar. The SQQ-32 is retained in its hull-mounted position unless the vessel is actually engaged in minehunting, when it may be towed. An MHC conducts minehunting operations at speeds of five to seven knots. At these speeds, depending upon its deployed depth, the 7,846-pound towed body of the SQQ-32 tows directly beneath or sometimes slightly astern of the MHC.[6] To sweep or neutralize mines, the SLQ-48 is deployed. It is a self-propelled vehicle, controlled and powered through a 5,000-ft cable, and is remotely 'piloted' by an operator on the MHC.

In addition to a SQQ sonar and a SLQ-48 MNV, MCM 1 class vessels are equipped with the O-type mechanical gear, magnetic minesweeping cables, and A-MK4-V and A-MK6-B mine detonators described in Section 2.1.[7] Like the MHCs, MCMs retain their SQQ sonar in the hull-mounted position unless the vessel is engaged in minehunting. MCMs generally deploy their gear based on the type of mine being targeted: the SLQ-48 MNV for deep bottom mines, O-type mechanical sweep gear for shallow moored mines, and acoustic and magnetic detonators for acoustic and magnetic mines.

The SQQ sonar is mostly operated in the hull-mounted position. It is not towed while any of the sweeping gear is deployed. The MNV is usually deployed by itself. However, because it is controlled and can remain clear of streamed gear whenever it must be deployed, it can be deployed with any of the other gear.[6] Although they may be streamed together, the O-type and magnetic-acoustic gear are usually streamed individually. The O-type gear fans out when streamed (see Figure 2), while the magnetic-acoustic gear streams directly astern in the absence of current. The only chance for interference between O-type and magnetic-acoustic gear, when streamed together, is during ship's turns, which must be wide and slow.

3.0 DISCHARGE CHARACTERISTICS

This section contains qualitative and quantitative information that characterizes the discharge. Section 3.1 describes where the discharge occurs with respect to harbors and near-shore areas, Section 3.2 describes the rate of the discharge, Section 3.3 lists the constituents in the discharge, and Section 3.4 gives the concentrations of the constituents in the discharge.

3.1 Locality

Discharges from mine countermeasures equipment incidental to normal operations occur only during training exercises usually held between five and 12 n. m. from shore, and sometimes as far as 20 to 50 n. m. from shore.[8]

3.2 Rate

This discharge is not a flow; rather, it is the release of lubricant to the surrounding seawater by mechanical erosion or dissolution when equipment is towed. During training exercises, the conventional mine countermeasures equipment is deployed and towed behind the ship as it sweeps the area.[2] Based on information from the Naval Undersea Warfare Center and on planned maintenance system (PMS) requirements, small amounts of lubricants are applied to various parts of the towed equipment.[2,9] Thus, there is a potential for these lubricants to be released to the surrounding waters.

Due to differences in equipment and mission assignments between the two vessel classes, the discharges produced by the MHC 51 and MCM 1 Class vessels are different. For this reason, the two vessel classes are discussed individually, and producing the greatest discharge scenarios are developed for each vessel class. Calculations are based on all mine countermeasures vessels operating in U.S. waters (i.e., none are under repair or deployed overseas).

3.2.1 MHC 51 Class Vessels

An MHC 51 Class vessel averages about five training days per month, with a maximum of four two-hour exercises each training day.[10] Thus, for a given ship, the total number of exercises per year is equal to:

(5 days/month)(4 exercises/day)(12 months/year) = 240 exercises per year for each ship

For the nine existing MHC 51 Class vessels (Section 2.3), this is a total of 2,160 exercises per year.

MHC 51 Class vessels are equipped with SQQ-32 sonar and the SLQ-48 MNV. The sonar has no lubricated areas exposed to seawater during operation and, as discussed in Section 2.2, tow cables are not greased. Therefore, there is no potential for grease being released during SQQ sonar deployment.

The SLQ-48 MNV has two arms which are controlled by a remote operator, or “pilot”, to do work. Each arm has a cavity which receives approximately 2 ounces of DOD-G-24508 grease to prevent equipment binding.[11] A conservative assumption, however, is that all of the grease in the cavities is washed out during deployment (i.e., 4 ounces per deployment).

The lifting cable used for deploying the SLQ-48 MNV is lubricated with approximately 3 ounces of MIL-G-18458 grease. This cable is in contact with the water only during the vehicle's launching and recovery, during which time the vessel is stationary. Equipment experts estimate that during deployment this cable is in the water less than 1 minute, and during recovery for 3 to 5 minutes.[12] Therefore, the total amount of time the lift cable is in contact with seawater is approximately 5 minutes during each exercise.

The specification for the lift cable grease requires conformance with several chemical and physical standards, one of which is an adhesion test. In this test, grease is applied to a concave disk of known weight. The greased disk is then weighed to determine the weight of grease applied. The disk is submerged in 151°F water for 15 minutes, and then rotated at approximately 150 revolutions per minute for an additional 15 minutes. The disk is then weighed to determine the quantity of grease which has either eroded or dissolved. To pass this test, a minimum of 95% of the applied grease must remain on the disk as determined by the final weight of the disk after the test.[13]

For the deployment of the SLQ-48 MNV, the grease on the lift cable is exposed to comparatively milder conditions. The water temperature will be lower, the exposure time will be less, and because the vessel is stationary, there will be little or no mechanical erosion. The maximum estimate of the grease discharged from the lift cable is 5 percent of the applied grease. This would be equal to 0.15 ounces of grease discharged per deployment.

3.2.2 MCM 1 Class Vessels

MCM 1 Class vessel training exercises consist either of a sweeping or a hunting task, and the dimensions of the exercise area vary with each exercise. For example, an assigned area may measure as much as 30 by 90 miles. Each MCM is assigned one sweeping and one hunting task each month. Thus, as a conservative estimate, each MCM on average deploys various combinations of its countermeasures equipment 24 times a year, and performs each type of operation 12 times per year. Unless some problem is experienced with the equipment while deployed, it remains in the water for the duration of the exercise, which may last 24 hours a day for up to 5 days.[10,11]

For minehunting, the MCM Class 1 vessels use the same equipment as the MHC 51 Class vessels; the SQQ sonar and the SLQ-48 MNV. However, the MCMs use non-greased nylon lifting cables when launching and recovering the SLQ-48 MNV, so no potential exists for the release of cable grease to the surrounding water.[12]

The MCM mine neutralization vehicle hoist arrangement provides three weight-bearing cables to handle the 2,750 pound vehicle. This allows nylon cables to handle the load. The crane of the MHC 51 Class vessel attaches to the vehicle with only a single cable, which precludes the use of a nylon cable.

Neither the SQQ-30 nor the SQQ-32 sonar expose lubricants to the surrounding seawater. As noted previously, the largest discharge is a four ounce discharge of DOD-G-24508 grease from the arms of the SLQ-48 MNV during each of the 12 exercises conducted annually.

For minesweeping operations, either O-type gear is deployed, or magnetic and acoustic detonators are deployed. For the 12 sweeping exercises conducted annually, operational experience shows that O-type gear is deployed half of the time (six out of 12) and magnetic and acoustic detonators are deployed half of the time (six out of 12). In an O-type gear double sweep array, there are cables, chains, and wires, which are not lubricated. In addition, there are eight cutters, two snatch blocks, three shackles, and 13 swivels that are lubricated. The swivels have fittings through which MIL-G-23549 grease is applied; each swivel is then wiped clean. Only the threads of the shackles are greased. The bearing surfaces of the snatch block rollers are given a light coat of MIL-L-3150 oil. Since the bearing surfaces are recessed within the block, they are minimally exposed to seawater turbulence while being towed. The cutters are fabricated of a non-ferrous alloy. When retrieved, they are washed with freshwater, dried, and given a light coat of MIL-L-9000 oil before being stowed. No additional lubrication is applied before they are re-deployed.[14]

An estimate of the amount of lubricant (combined oil and grease) that is discharged is 1 ounce for each component, or 26 ounces during each of the six exercises using O-type gear.

8 cutters + 2 snatch blocks + 3 shackles + 13 swivels = 26 components total

For the six magnetic and acoustic exercises conducted each year, the MCM streams the magnetic minesweeping cable and either a high frequency A-MK4-V or a low frequency A-MK6-B acoustic detonator.[6] The only lubricant exposed to the turbulence of the seawater while streaming the magnetic and acoustic detonators is on the 30-inch diaphragm of the A-MK4-V detonator, which is coated with about 4 ounces of DOD-G-24508 grease.[8,15] The A=-MK6-B low frequency detonator does not have a diaphragm that requires grease. The magnetic minesweeping cable and the power cable to the acoustic detonators are buoyant; however, the streamed acoustic detonator does require a large O-type float in order to stream properly. A wire pendant of the desired length secures each acoustic detonator to its large float by a swivel whose zerk fitting has about 1 ounce of MIL-G-23549 grease pumped into it.[10] Therefore, when a high frequency acoustic detonator is streamed with the magnetic minesweeping cable, approximately five ounces of grease (four from the diaphragm and one from the swivel) are exposed to the sea. When the low frequency acoustic detonator is used, the amount of grease that could be released is one ounce (from the detonator's swivel to its buoy float).

3.3 Constituents

Several types of lubrication oils and greases are used on wetted mine countermeasures equipment based on information in maintenance requirements cards. Table 2 shows a list of the lubricant types and the lubrication schedules for the mine countermeasures equipment.[9] The greases are made from lubricating stocks generated during petroleum fractionation. These fractions contain organic compounds each generally having more than seventeen carbon atoms. Lubricating oils are composed of aliphatic, olefinic, naphthenic (cycloparaffinic), and aromatic hydrocarbons depending on their specific use. Lubricating oil additives include antioxidants, bearing protectors, wear resistors, dispersants, detergents, viscosity index improvers, pourpoint depressors, and antifoaming and rust-resisting agents.[16]

Until recently, lead was contained in the MIL-G-18458B grease procured by the Navy to lubricate the MHC's lift cable which deploys and recovers the SLQ-48 MNV. However, Amendment 5 to MIL-G-18458B dated 26 March, 1996, prohibits heavy metals (including lead) and salts of heavy metals as constituents of MIL-G-18458B grease.[13] As such, the Navy is no longer procuring grease containing lead or any heavy metals for use in lubricating mine countermeasures equipment. Consequently, lead will not be considered a constituent of this discharge.

There are no known bioaccumulators in this discharge.

3.4 Concentrations

Table 3a shows the percentages of the constituents in oils and greases used on the mine countermeasures wetted equipment. The total of the base constituents of oils and greases (i.e., the hydrocarbons -- mineral oils through the asphalts and waxes (e.g., the heavy paraffinic distillates)) range in concentration from approximately 25% to greater than 90%, with additives making up the balance of these lubricants. Tables 3b through 3d show the maximum concentrations from SLQ-48 arms, O-gear and cutters, and acoustic and magnetic devices, respectively.

4.0 NATURE OF DISCHARGE ANALYSIS

Based on the discharge characteristics presented in Section 3.0, the nature of the discharge and its potential impact on the environment can be evaluated. The estimated mass loadings are presented in Section 4.1. In Section 4.2, the concentrations of discharge constituents after release to the environment are estimated and compared with the water quality standards. In Section 4.3, the potential for the transfer of non-indigenous species is discussed.

4.1 Mass Loadings

The estimated annual lubricant mass loading shown in Table 4 is based upon the discharge scenarios described in Section 3.2, the number of exercises performed annually, and the number of vessels involved.

4.2 Environmental Concentrations

The estimated quantities of lubricant released to the environment during each mine countermeasures training exercise are shown in Table 4. The concentration after dilution in the environment can be estimated using the mass loadings from Table 4 and estimates of the volumes of water through which the equipment is towed during various exercises. These estimates are provided in Sections 4.2.1 through 4.2.4 for each of the source/vessel combinations identified in Section 3.2 and Table 4. Section 4.2.5 provides information on applicable water quality standards.

4.2.1 SLQ-48 MNV Arms

As shown in Table 4 and discussed in Section 3.2, the estimated maximum amount of grease discharged from the SLQ-48 MNV is 4 ounces (0.25 pounds (lbs)). This assumes that the screws that seal both cavities come unscrewed and fallout undetected, allowing all of the applied grease to be released. While this is based on equipment failure and does not reflect typical operating conditions, it does provide a conservative assumption regarding the amount of grease released during operations.

For MHC 51 Class vessels, minehunting operations are performed at a speed of 5 knots (30,381 feet per hour (ft/hr)) for a duration of 2 hours.[14] The calculated concentration of lubricant in the environment from SLQ-48 MNV arms assumed that:

- the SLQ 48 MNV creates a nine square feet (three feet by three feet) area of turbulence in the wake of the vehicle, as determined by dimensions of the vehicle's cross-sectional area;
- the discharge rate of grease is uniform throughout the exercise;
- the grease is uniformly dispersed throughout the traversed water volume

Based upon operational experience, it was determined that the SLQ-48 MNV generates a wake in the same manner as a surfaced submarine. Thus the frontal area of the vehicle, as determined by the dimensions of its cross-sectional area, creates a ninesquare feet (three feet by three feet) area of turbulence[17] where complete mixing occurs. Therefore, an area of nine square feet was used in the following formula to calculate the mixing and dispersion of oil and grease caused by the turbulence of the vehicle's wake rather than the frontal area of the arms.

The volume of water through which the equipment operates during a single exercise was calculated using the following formula:

Volume = (Area)(Time)(Speed)
Volume = (9 square feet)(2 hours)(30,381 ft/hr)
Volume = 546,858 cubic feet (ft^3) of water

Based on the assumptions listed above and the volume of water through which the equipment operates, the lubricant concentration in the environment was estimated as follows:

Mass lubricant	= (0.25 lbs lubricant)(453.6 grams (g)/lb)(1000 milligrams/g)
	= 113,400 milligrams (mg) lubricant
Volume of water	= (546,858 ft^3)(28.32 liters (L)/ft^3) = 15,487,019 L
Concentration	= 113,400 mg lubricant/15,487,019 L
	= 0.0073 mg/L, or 7.3 micrograms per liter (µg/L)

The calculated value of 7.3 µg/L is three orders of magnitude less than the most stringent state water quality criteria of 5,000 µg/L (Florida).

4.2.2 SLQ-48 MNV Lift Cable

From Table 4 and the discussion in Section 3.2.1, the maximum amount of grease released from the lift cable during each deployment of the SLQ-48 MNV is 0.15 ounce (0.0094 lbs). The grease would be released to the water in the immediate vicinity of the lift cable during deployment/retrieval of the SLQ-48 MNV since the vessel is stationary. The potential for environmental impact from this operation was estimated by determining the volume of water into which the grease would have to be dispersed to attain a concentration equal to the most stringent state water quality criteria: Florida's criteria of 5,000 μg/L, or 5 mg/L.

The calculated volume required for dilution of lubricant in the environment from the SLQ-48 MNV lift cable was based on the following assumptions:

- the top of the vehicle is covered by one foot of water during launching;
- the grease released is directly above the vehicle; and
- the lubricant disperses only in the horizontal plane; that is, the body of the vehicle prevents vertical dispersion

Based on these assumptions, the distance from the source beyond which the concentration is less than the most stringent water criteria (Florida), was estimated as follows:

1) (0.0094 lbs grease)(453.6 g/lb) = 4.3 g; equal to 4300 mg grease
2) 4300 mg ÷ (Vol.) = 5.0 mg/L; Vol. = 860 L required
3) (860 L)(1 ft^3/28.32 L) = 30.36 ft^3
4) 30.36 ft^3 = (1 ft)(π)(r^2); rearranging and solving for r, r = 3.1 feet

At a distance of approximately 3 feet beyond the lifting cable, the concentration of the grease is less than the most stringent water quality criteria.

4.2.3 O-type Mechanical Gear

From Table 4 and the discussion in Section 3.2, the maximum amount of lubricant released from O-type mechanical gear is 26 ounces (1.63 lbs). Each lubricated component (26 total components) of the O-type gear is a separate discharge point, has a cross-section of 48 in^2 (0.33 ft^2), and sweeps a volume of water equal to its cross-section multiplied by the distance towed through the water at seven knots. Operations with O-type gear deployed are limited to speeds of 7 to 8 knots (42,533 to 48,609 ft/hr).[14]

The equipment may remain deployed for several days (Section 3.2). Thus, the lubricants that are released from the equipment to the environment during minesweeping exercises with O-type mechanical gear will be dispersed over several miles.

An estimate of the concentration of lubricant in the environment was made based on the following assumptions:

- the equipment is deployed for 1 day; or 24 hours
- the rate of lubricant discharge is uniform throughout the exercise;
- the lubricant is uniformly dispersed throughout the traversed water volume

At 7 knots (42,533 feet per hour), the volume of water swept by the equipment during the training exercise was estimated as follows:

Volume = (# of components)(Cross-sectional area of each component)(Time)(Speed) Volume = (26)(0.33 square feet)(24 hours)(42,533 ft/hr) Volume = 8.76×10^6 cubic feet (ft^3) of water

Based on the assumptions listed above and the volume of water through which the equipment is towed, the lubricant concentration in the environment was estimated as follows:

Mass lubricant	= (1.625 lbs lubricant)(453.6 g/lb)(1000 mg/g)
	= 737,100 mg lubricant
Volume of water	= (8.76×10^6 ft^3)(28.32 L/ft^3) = 2.48×10^8 L
Concentration	= 737,100 mg/2.48×10^8 L
	= 2.97×10^{-3} mg/L; or 2.97 µg/L in a 24-hour period

This concentration is three orders of magnitude less than Florida's discharge standard of 5,000 µg/L and is based on the conservative assumption that the equipment is in the water for only 24 hours.

4.2.4 Acoustic and Magnetic Mine Detonators

Volume = (Number of components)(Cross-sectional area of each component)(Time)(Speed) Volume = (26 components)(0.33 ft)(24 hours)(42,533 ft/hr) Volume = 8.76×10^6 ft^3 of water

From Table 4 and the discussion in Section 3.2, the maximum amount of lubricant released from acoustic and magnetic mine detonation devices is five ounces (0.3125 pound). Operations are usually performed at speeds of 7 to 8 knots (42,533 to 48,609 ft/hr).[14] As with the O-type mechanical gear, the equipment may remain deployed for several days. Thus, any lubricant removed from the equipment will be dispersed into a large volume of water.

An estimated lubricant concentration was made based on the following assumptions:

- the equipment is deployed for 1 day; or 24 hours
- the rate of lubricant discharge is uniform throughout the exercise;
- the lubricant is uniformly dispersed throughout the traversed water volume;
- the acoustic device has a frontal area equivalent to a 36-inch diameter disk (7.07 square feet) (this assumption is based on allowing space for the housing around

the acoustic device), plus a 2- by 4-inch (0.055 ft^2) swivel.

At 7 knots (42,533 ft/hr), the volume of water swept by the equipment during the training exercise was estimated as follows:

$$\text{Volume} = (\text{Area})(\text{Time})(\text{Speed})$$
$$\text{Volume} = (7.07 + 0.055 \text{ square feet})(24 \text{ hours})(42{,}533 \text{ ft/hr})$$
$$\text{Volume} = 7.27 \times 10^6 \text{ ft}^3 \text{ of water}$$

Based on the assumptions listed above and the volume of water through which the equipment is towed, the lubricant concentration in the environment was estimated as follows:

Mass lubricant	= (0.3125 lbs lubricant)(453.6 g/lb)(1000 mg/g)
	= 141,750 mg lubricant
Volume of water	= (7.27×10^6 ft^3)(28.32 L/ft^3) = 205,886,400 L
Concentration	= 141,750 mg/205,886,400 L
	= 6.88×10^{-4} mg/L; or 0.688 μg/L

This estimated concentration of 0.688 μg/L is three orders of magnitude below the most stringent water quality criteria.

4.2.5 Water Quality Criteria and Discharge Standards

Table 5 shows water quality criteria and discharge standards that are relevant to the mine countermeasures equipment lubrication discharge and the estimated environmental concentrations of the constituents of the discharge.

4.3 Potential for Introducing Non-indigenous Species

Mine countermeasures operations do not result in water being transported from one geographical region to another. Any non-indigenous species which may become attached to countermeasures equipment while deployed are removed during equipment retrieval operations or subsequent preventive maintenance activities. For example, automatic cable layers remove virtually all of the water from the cable(s) as they are retrieved, and maintenance procedures require freshwater washdowns of the retrieved equipment such as cutters and swivels. Further, it is unlikely that any attached aquatic species would survive while the countermeasures equipment is stored on deck. Therefore, there is no significant potential for transporting non-indigenous species.

5.0 CONCLUSIONS

Mine countermeasures equipment lubrication discharge has little potential for causing adverse environmental effects because the small amounts of lubricants that are released disperse into very large volumes of water. The resulting concentrations are below the most stringent water quality criteria.

Further, most discharges from mine countermeasures equipment occur beyond 5 n.m. from shore in high-energy waters (i.e., those with significant wave energy to rapidly and widely disperse releases) and are unlikely to affect more sensitive coastal environments.

This conclusion is based on estimated environmental concentrations of lubricants resulting from each of the mine countermeasures operations. For each operation, the estimated concentration was below the most stringent water quality criteria. Estimates were based on either the volume of water through which mine countermeasures equipment operates, or the volume required to dilute the discharge to levels below the most stringent water quality criteria.

Finally, for mine countermeasures operations there is no potential for transporting non-indigenous species.

6.0 DATA SOURCES AND REFERENCES

To characterize this discharge, information from various sources was obtained, reviewed, and analyzed. Process information and assumptions were used to estimate the rates of discharge. Based on these estimates, the concentrations of lubricants in the environment resulting from this discharge were then estimated. Table 6 shows the sources of data used to develop this NOD report.

<u>Specific References</u>

1. UNDS Equipment Expert Meeting Minutes - Mine Countermeasures Equipment Lubrication. 5 September 1996.

2. BM2 Hamilton , USS Champion (MCM 4), Information on Oil and Grease Lubrication Procedures, 23 July 1997, Jim O'Keefe, MR&S.

3. CDR Burdon, OPNAV Mine Warfare Branch (N852), Information on Mine Countermeasure Training Areas and Operations, 6 August 1997, Jim O'Keefe, MR&S.

4. UNDS Round 2 Equipment Expert Meeting Minutes, Mine Countermeasures Equipment Lubrication, 6 March 1997.

5. LCDR Sentlinger, XO on an MCM 1 Class Ship Based in Ingleside, TX, Information on Lubrication Procedures, 19 March 1997, Sanjay Chandra, Versar Inc.

6. LCDR Shaun Gillilland, OPNAV, Mine Warfare Branch, Information on SQQ Sonars and Acoustic Detonator Operations, 20 January 1999, Jim O'Keefe, MR&S.

7. Polmar, Norman. The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet, 16th ed., Naval Institute Press, 1997, Chapter 22.

8. Andy Tatem, Naval Undersea Warfare Center, Panama City, FL, Information on Oil and Grease Lubrication Procedures, 24 July 1997, Jim O'Keefe, MR&S.

9. Maintenance Requirements Cards (MRCs) for Minesweeping Systems 4761.

    a. MRC Control No. 47 8GGD N - Clean, inspect, and lubricate snatch blocks.
    b. MRC Control No. 47 8GGE N - Clean, inspect, and lubricate swivels.
    c. MRC Control No. 47 8GGF N - Clean, inspect, and lubricate shackles.
    d. MRC Control No. 47 4MNR N - Inspect A Mk 4 (V) acoustic device diaphragm.
    e. MRC Control No. 86 2WTT N - Clean cutter assembly.
    f. MRC Control No. 86 2WTR N - Clean, inspect, and lubricate cutter.
    g. MRC Control No. 86 2WTQ N - Clean and inspect cutter assembly.

10. STG1 Kelly, Fleet Liaison Office, Naval Surface Warfare Center (NSWC), Coastal Systems Station, Panama City, Florida, Information on Oil and Grease Lubrication Procedures, 12 August 1997, Jim O'Keefe, MR&S.

11. William Coffman, NSWC, Coastal Systems Station, Panama City, Florida, Information on Mine Neutralization Vehicle, 12 August 1997, Jim O'Keefe, MR&S.

12. CDR Piper, OPNAV Mine Warfare Branch (N852), Information on Mine Neutralization Vehicle, 6 August 1997, Jim O'Keefe, MR&S.

13. Military Specification MIL-G-18458B; "Grease Wire Rope, and Exposed"; March 1981, Revision B, Amendment 5; and March 1996 Revision B.

14. STG1 Kelly, Fleet Liaison Office, NSWC, Coastal Systems Station, Panama City, Florida, Information on Oil and Grease Lubrication Procedures, 13 August 1997, Jim O'Keefe, MR&S.

15. Andy Tatem, NSWC, Coastal Systems Station, Panama City, Florida, Information on Oil and Grease Lubrication Procedures, 23 July 1997, Jim O'Keefe, MR&S.

16. Patty's Industrial Hygiene and Toxicology, Volume IIB, 3rd. ed., John Wiley & Sons, 1981, pp. 3369, 3397.

17. Quang Tran, NAVSEA Equipment Expert, Information on Mine Neutralization Vehicle, 20 August 1997, George Heiner, Malcolm Pirnie Inc.

General References

USEPA. Toxics Criteria for Those States Not Complying with Clean Water Act Section 303(c)(2)(B). 40 CFR Part 131.36.

USEPA. Interim Final Rule. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; States' Compliance – Revision of Metals Criteria. 60 FR 22230. May 4, 1995.

USEPA. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants. 57 FR 60848. December 22, 1992.

USEPA. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California, Proposed Rule under 40 CFR Part 131, Federal Register, Vol. 62, Number 150. August 5, 1997.

Connecticut. Department of Environmental Protection. Water Quality Standards. Surface Water Quality Standards Effective April 8, 1997.

Florida. Department of Environmental Protection. Surface Water Quality Standards, Chapter 62-302. Effective December 26, 1996.

Georgia Final Regulations. Chapter 391-3-6, Water Quality Control, as provided by The Bureau of National Affairs, Inc., 1996.

Hawaii. Hawaiian Water Quality Standards. Section 11, Chapter 54 of the State Code.

Mississippi. Water Quality Criteria for Intrastate, Interstate and Coastal Waters. Mississippi Department of Environmental Quality, Office of Pollution Control. Adopted November 16, 1995.

New Jersey Final Regulations. Surface Water Quality Standards, Section 7:9B-1, as provided by The Bureau of National Affairs, Inc., 1996.

Texas. Texas Surface Water Quality Standards, Sections 307.2 - 307.10. Texas Natural Resource Conservation Commission. Effective July 13, 1995.

Virginia. Water Quality Standards. Chapter 260, Virginia Administrative Code (VAC) , 9 VAC 25-260.

Washington. Water Quality Standards for Surface Waters of the State of Washington.   Chapter 173-201A, Washington Administrative Code (WAC).

Committee Print Number 95-30 of the Committee on Public Works and Transportation of the House of Representatives, Table 1.

The Water Quality Guidance for the Great Lakes System, Table 6A. Volume 60 Federal Register, p. 15366. March 23, 1995.

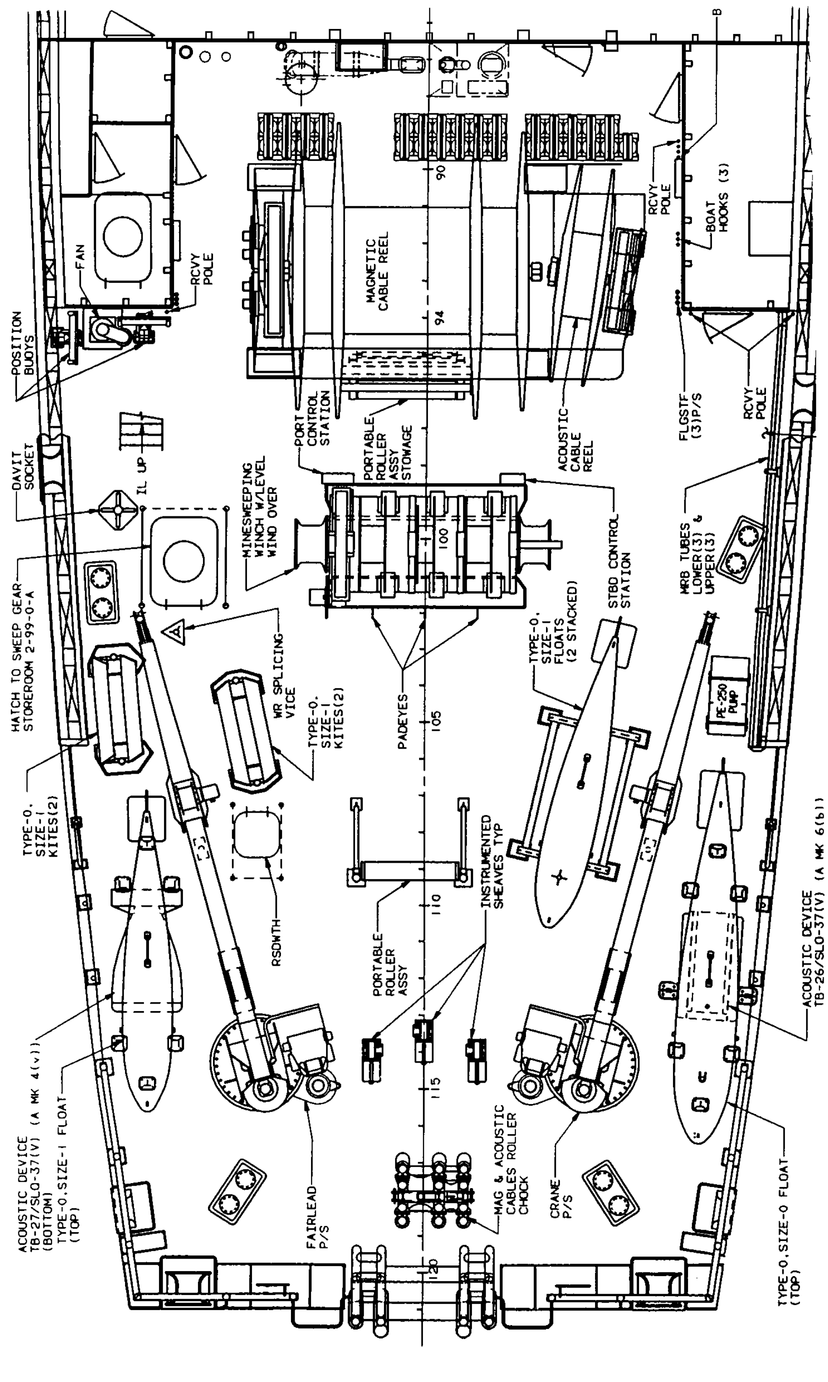

Figure 1. Mine Countermeasures Equipment on Deck

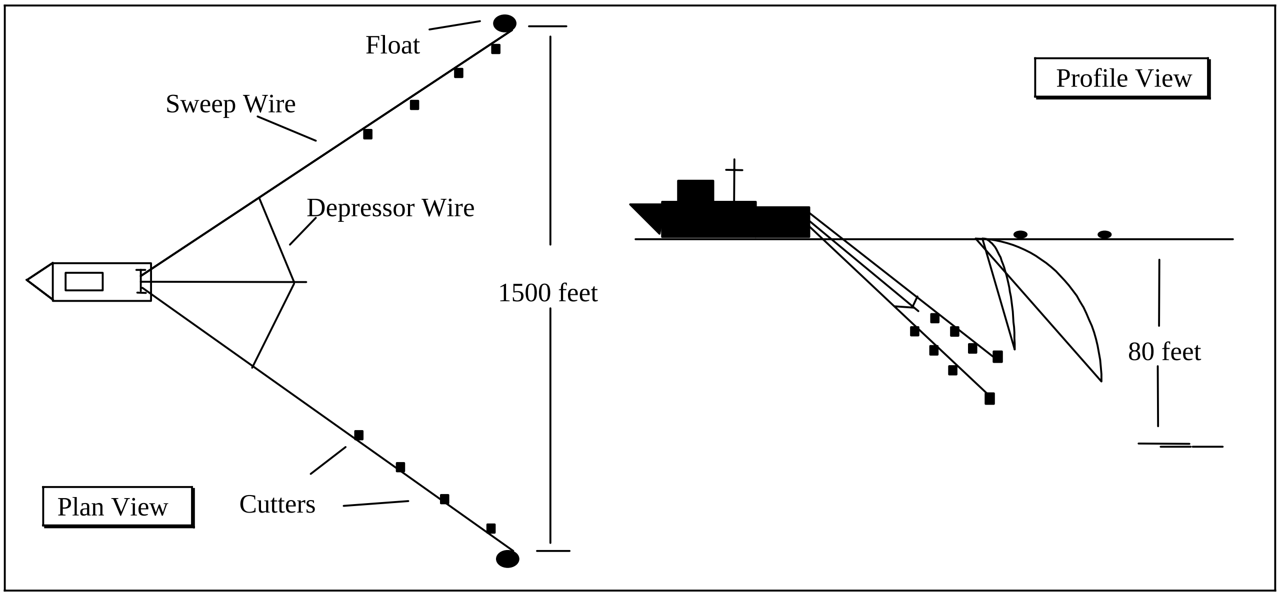

Figure 2. Overview of "O"-Type Minesweeping Operations

Table 1. Vessels Producing Mine Countermeasures Equipment Lubrication Discharge

Ship Class	Mission	Number of Vessels
MHC 51 (Osprey)	Harbor and channel clearing; deep water coastal minehunting	9
MCM 1 (Avenger)	Non-conventional minesweeping and detonation	14

Table 2. Lubricant Type and Schedule for Wetted Mine Countermeasures Equipment

Component	Applicable Ship Classes	Lubricant Mil Standard	Lubrication Schedule
Cutters	MCM 1 Class	MIL-L-9000	After each use
Snatch blocks		MIL-L-3150	Prior to and after each use
Swivels		MIL-G-23549	Quarterly, and prior to and after each use
Shackles		MIL-G-23549	Quarterly, and prior to and after each use
Towed acoustic device (diaphragm)		DOD-G-24508	Quarterly, after each streaming, or as a result of a sound measuring test
Multi-purpose crane lift wire for handling the SLQ-48 MNV	MHC 51 Class	MIL-G-18458B	Annually, or as required
SLQ-48 MNV arms	MHC 51 and MCM 1 Class	DOD-G-24508	Prior to each use

*G = grease, L = lubrication oil

Table 3a. Percentage of Constituents of Military Specification Oils and Greases

Component	MIL-G-18458B wire rope grease[a]	MIL-L-9000 engine oil	DOD-G-24508 ball and roller bearing grease[b]	DOD-G-24508 ball and roller bearing grease[c]	MIL-G-23549 general purpose grease	MIL-L-3150 general purpose lube oil
Base Constituents						
asphalt	25					
hydrocarbons						45-50
mineral oil (unspecified)				80	25	30-60
polyalphaolefins			70-80			
solvent refined, hydrotreated heavy paraffinic distillate		55-70				
solvent refined, hydrotreated residual oil		20-30			51	
Additives						
1-naphthaleneamine, n-phenyl				<2		
4-hydroxy-3, 5-di-tert-butylphenylpropionic acid thioclycolate					<1	
benzenepropanoic acid, 3,5-bis(1,1-dimethyl)-4-hydrooxyoctadecyl ester				<2		
calcium acetate			<5	<3		
calcium phenate		<15				
calcium sulfonate					4	
clay			5-10	<10		
Lithium Soaps	>54					
p,p-dioctyldiphenlamine				<2		
pentaerythritol				1		
polymers (unspecified)	<1					
sodium chromate, tetrahydrate			<1			
sodium nitrate			<2	1		
sodium phosphate, tribasic				<1		

Source: Ingredients/Identity Information section of lubricant-specific material safety data sheets from DoD Hazardous Materials Information System

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[a] Amendment 5 to MIL-G-18458B, March 26, 1996, prohibits heavy metals (including lead) and salts of heavy metals as constituents of MIL-G-18458B grease.

[b] As manufactured by Royal Lubricants Company Inc.

[c] As manufactured by Mobil Oil Company Inc.

Table 3b. Maximum Concentrations from SLQ-48 Arms

TOTAL RELEASE PER EXERCISE: 4 oz. GREASE RELEASED: DOD-G-24508 (100%) ESTIMATED TOTAL MAXIMUM CONCENTRATION: 7.3 µg/L			
Component	DOD-G-24508 ball and roller bearing grease[a]	DOD-G-24508 ball and roller bearing grease[b]	Maximum Concentration (µg/L)
Base Constituents			
mineral oil (unspecified)		80	5.8
polyalphaolefins	70-80		5.8
Additives			
1-naphthaleneamine, n-phenyl		<2	0.15
benzenepropanoic acid, 3,5-bis(1,1-dimethyl)-4-hydrooxyoctadecyl ester		<2	0.15
calcium acetate	<5	<3	0.37
clay	5-10	<10	0.73
p,p-dioctyldiphenlamine		<2	0.15
pentaerythritol		1	0.07
sodium chromate, tetrahydrate	<1		0.07
sodium nitrate	<2	1	0.15
sodium phosphate, tribasic		<1	0.07

Table 3c. Maximum Concentrations from O-Gear and Cutters

TOTAL RELEASE PER EXERCISE: 26 oz. GREASE RELEASED: MIL-G-23549 (53.8%); MIL-L-3150 (7.7%); MIL-L-9000 (30.8%) ESTIMATED TOTAL MAXIMUM CONCENTRATION: 2.97 µg/L				
Component	MIL-L-9000 engine oil	MIL-G-23549 general purpose grease	MIL-L-3150 general purpose lube oil	Maximum Concentration (µg/L)
Base Constituents				
hydrocarbons			45-50	0.11
mineral oil (unspecified)		25	30-60	0.14
solvent refined, hydrotreated heavy paraffinic distillate	55-70			0.64
solvent refined, hydrotreated residual oil	20-30	51		1.09
Additives				
4-hydroxy-3, 5-di-tert-butylphenylpropionic acid thioclycolate		<1		0.02
calcium phenate	<15			0.14
calcium sulfonate		4		0.06

[a] As manufactured by Royal Lubricants Company Inc.
[b] As manufactured by Mobil Oil Company Inc.

Table 3d. Maximum Concentrations from Acoustic and Magnetic Devices

TOTAL RELEASE PER EXERCISE: 6 oz. GREASE RELEASED: DOD-G-24508 (67%), MIL-G-23549 (33%) ESTIMATED TOTAL MAXIMUM CONCENTRATION: 0.688 µg/L				
Component	DOD-G-24508 ball and roller bearing grease[a]	DOD-G-24508 ball and roller bearing grease[b]	MIL-G-23549 general purpose grease	Maximum Concentration (µg/L)
Base Constituents				
mineral oil (unspecified)		80	25	0.425
Polyalphaolefins	70-80			0.369
solvent refined, hydrotreated residual oil			51	0.116
Additives				
1-naphthaleneamine, n-phenyl		<2		0.009
4-hydroxy-3, 5-di-tert-butylphenylpropionic acid thioclycolate			<1	0.002
benzenepropanoic acid, 3,5-bis(1,1-dimethyl)-4-hydrooxyoctadecyl ester		<2		0.009
calcium acetate	<5	<3		0.037
calcium sulfonate			4	0.009
clay	5-10	<10		0.092
p,p-dioctyldiphenlamine		<2		0.009
pentaerythritol		1		0.005
sodium chromate, tetrahydrate	<1			0.005
sodium nitrate	<2	1		0.014
sodium phosphate, tribasic		<1		0.005

[a] As manufactured by Royal Lubricants Company Inc.
[b] As manufactured by Mobil Oil Company Inc.

Table 4. Estimated Annual Lubricant Mass Loading

Source	Quantity per Exercise (oz)	Yearly Number of Exercises	Number of Vessels	Total Release (oz/yr)	Total Release (lbs/yr)
MHC 51 Class					
SLQ-48 MNV arms	4	240	9	8,640	540
SLQ-48 MNV Lift Cable	0.15	240	9	324	20
MCM 1 Class					
SLQ-48 MNV arms	4	12	14	672	42
O-gear, cutters	26	6	14	2,184	137
Acoustic and Magnetic	5	6	14	420	26
Total Mass Loading				12,240	765

Table 5. Water Quality Criteria and Discharge Standards

Source and Constituent	Environmental Concentration (μg/L)	Federal Discharge Standards (μg/L)	Most Stringent State Acute Water Quality Criteria[a] (μg/L)
SLQ-48 arms			
oil and grease	7.3[b]	Visible sheen* /15,000**	5,000 (FL)
SLQ-48 MNV Lift Cable			
oil and grease	30 ft^3 [c]	Visible sheen* /15,000**	5,000 (FL)
O-gear, cutters			
oil and grease	2.97	Visible sheen* /15,000**	5,000 (FL)
Acoustic and Magnetic			
oil and grease	0.688	Visible sheen* /15,000**	5,000 (FL)

Notes:
Refer to federal criteria promulgated by EPA in its National Toxics Rule, 40 CFR 131.36 (57 FR 60848; Dec. 22, 1992 and 60 FR 22230; May 4, 1995)

* Discharge of Oil. 40 CFR 110, defines a prohibited discharge of oil as any discharge sufficient to cause a sheen on receiving waters.
** International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). MARPOL 73/78 as implemented by the Act to Prevent Pollution from Ships (APPS).

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[a] FL = Florida
b Estimated
[c] Volume required to disperse to most stringent water quality standard

Table 6. Data Sources

	Data Source			
NOD report Section	**Reported**	**Sampling**	**Estimated**	**Equipment Expert**
2.1 Equipment Description and Operation				X
2.2 Releases to the Environment				X
2.3 Vessels Producing the Discharge	UNDS Database			X
3.1 Locality				X
3.2 Rate			X	
3.3 Constituents	PMS Cards			X
3.4 Concentrations	MSDS			
4.1 Mass Loadings			X	
4.2 Environmental Concentrations			X	
4.3 Potential for Introducing Non-Indigenous Species				X