OIL ABATEMENT PROGRAM

EVALUATION OF OIL REDUCTION ANTICIPATED FROM CONTROL OF MAJOR SOURCES

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Prepared for:

IMC Shipping Company
and
M/V *Selendang Ayu* Oil Spill Natural Resource Trustees

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ACRONYMS AND ABBREVIATIONS

ACZA............. ammoniacal copper zinc arsenate
ADEC .... Alaska Department of Environmental Conservation
AIS…………...Automatic Information Systems
AMEC............ AMEC Earth & Environmental, Inc
BaP .... benzo[a]pyrene
BBAC………...Buzzards Bay Action Committee
BMP………….Best Management Practices
BTU…………..British thermal unit
CCC………….California Coastal Commission
Chadux.......... Alaska Chadux Corporation
EPA............... U.S. Environmental Protection Agency
EPDM............ ethylene propylene diene monomer
ERMA............ Environmental Response Management Application
FORS………..Fast Oil Recovery Systems
Foundation .... BoatUS Foundation
HAZWOPER . Hazardous Waste Operations and Emergency Response
HDPE .... high-density polyethylene
IFO .... intermediate fuel oil
kg .... kilogram
LOP............... Letter of Permission
μg/cm²/day .... microgram per centimeter squared per day
MARCS………Marine Accident Risk Calculation System
MAREX………University of Georgia Marine Extension Service
MXAK………..Marine Exchange of Alaska
NAS............... National Academy of Sciences
NFWF………..National Fish and Wildlife Foundation
NOAA............ National Oceanic and Atmospheric Administration
OAP............... Oil Abatement Program
OASIS .... OASIS Environmental, Inc.
OSHA………..Occupational Safety & Health Administration
PAH............... Polycyclic aromatic hydrocarbon
Parties........... Responsible Party and Natural Resource Damage Trustees
Penco............ Pacific Environmental Corporation
Pinnacle .... Pinnacle Construction, Inc.
PST .... petrolatum saturated tape
PVC............... polyvinyl chloride
SOLAS .... International Maritime Organization Safety of Life and Sea
TEF .... Toxicity Equivalence Factors
Trustees .... Natural Resource Damage Trustees
UMC.............. Unalaska Marine Center

USACE.......... U.S. Army Corps of Engineers
USCG............ United States Coast Guard
VTS .... vessel traffic service
VTMS .... Vessel Traffic Management Systems
WDNR........... Washington Department of Natural Resources

EXECUTIVE SUMMARY

In December 2004, the M/V *Selendang Ayu* spilled bunker and marine diesel oil into the marine waters near Unalaska, Alaska. The Natural Resource Damage Trustees and the Responsible Party (Parties) determined that an Oil Abatement Program (OAP) in the Greater Unalaska Bay Area (Figure 1) might restore some of the resources damaged by the spill. The Parties contracted with OASIS Environmental, Inc. (OASIS) in May 2009 to study the feasibility of an OAP. OASIS produced an *OAP Feasibility Study Interim Report on Oil Inputs* (Interim Report) in March 2010.

Since the issuance of the Interim Report, the Parties have met almost monthly between May 2010 and January 2012 to direct OASIS research and to discuss the cost, logistics, and anticipated oil reduction from different projects that could be implemented to control major oil pollution sources. The Parties may pursue one project or a combination of projects.

This document builds upon the findings of the Interim Report and captures the research on specific projects that has been directed by the Parties and discussed in the OAP meetings. A spreadsheet that summarizes the major oil inputs in the Greater Unalaska Bay Area, oil removal estimates for different projects, and a comparison of project costs is included in Appendix G.

The more significant findings of this report are as follows:

- The sources that appear to be the most significant contributors to annual oil input in the Greater Unalaska Bay are creosote pilings, vessel bilge discharges, and vessel oil spills.
- Projects with greatest potential abatement impact to address these discharge sources include: wrapping or removing creosote treated pilings at the City of Unalaska Spit and Unalaska Marine Center Dock, distribution of bilge socks and sorbent pads, and increasing or upgrading the number Automatic Identification Systems (AIS) stations that provide vessel monitoring in the Aleutians.
- Wrapping or removing creosote treated wood pilings is the most expensive abatement project investigated.

As the Parties explore new abatement projects and/or further pursue and refine their interest in the projects discussed in this report, it will be important to discuss these projects with representatives of the City of Unalaska, including the new Port Director.

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1. INTRODUCTION

On December 8, 2004, the 738-foot freighter, M/V *Selendang Ayu,* ran aground and broke in two just off shore of Spray Cape, Unalaska Island, Alaska. In addition to its cargo of soy beans, the vessel spilled an estimated 354,218 gallons of oil (339,538 gallons of bunker oil and 14,680 gallons of marine diesel and miscellaneous oil). Approximately 70 miles of coastline were affected and natural resources were impacted.

PHOTO CREDIT: LAUREN ADAMS/UNALASKA COMMUNITY BROADCASTING

The Natural Resource Damage Trustees and the Responsible Party (Parties) determined that an Oil Abatement Program (OAP) in the Greater Unalaska Bay Area (Figure 1) might restore some of the resources damaged by the spill. The Parties contracted with OASIS Environmental, Inc. (OASIS) in May 2009 to study the feasibility of an OAP. OASIS produced an *OAP Feasibility Study Interim Report on Oil Inputs* (Interim Report) in March 2010.

Since the issuance of the Interim Report, the Parties have directed OASIS to:

1. Refine the oil input calculations found in the Interim Report.
2. Identify possible OAP projects that would reduce/abate the input of oil into the Greater Unalaska Bay or marine waters surrounding the Aleutian Islands.
3. Estimate the quantity and type of oil that these projects would abate.
4. Develop preliminary designs, logistics, and cost for projects, as well as gather information regarding the likely level of City of Unalaska support for the projects.

The Parties and OASIS met approximately monthly to discuss abatement projects from May 2010 through January 2012. At these meetings, the Parties directed OASIS to conduct research on particular projects, and OASIS has reported its findings to the group. This report summarizes the OAP research to-date.

2. MAJOR OIL INPUTS INTO UNALASKA BAY

The Interim Report (OASIS, 2010) detailed the numerous potential sources of oil pollution to the Greater Unalaska Bay Area. The calculations were based upon a review of pertinent literature, as well as on interviews with individuals who had local information about oil inputs that were conducted during a trip to Unalaska in October 2009. During the site visit, OASIS also gathered data on the potential oil inputs such as docks, boat activity, fuel transfers, and input controls.

The Interim Report (OASIS, 2010) used estimates of the polycyclic aromatic hydrocarbon (PAH) concentrations in the sediments in the Greater Unalaska Bay area to back-calculate the minimum amount of petroleum that would have to be released in order to achieve the level of PAHs found in the sediment. After evaluation of a number of potential oil sources, the Interim Report concluded that creosote pilings, spills, marine vessel motor operation, and vessel bilge disposal were the largest contributors of oil into Unalaska Bay.

2.1. Creosote Treated Pilings at Unalaska Public Harbors

Fluoranthene was found to be a predominant PAH compound in the sediment in the Greater Unalaska Bay area. The level of fluoranthene in sediments adjacent to shore structures was generally much higher than in sediments farther from shore. Fluoranthene is typically absent or found in very low concentrations in petroleum fuels used in Alaska. It is, however, often found in marine sediments near urbanized areas. The potential sources of fluoranthene include storm water runoff from roads with asphalt, road sealing materials, or creosote (a coal tar distillate) treated structures (OASIS, 2010). Creosote impregnated dock pilings are a common localized source of fluoranthene in sediments (Boehm, 2006; Bestari et al, 1998).

Creosote also has very high levels of the most harmful 16 priority PAHs categorized by the U.S. Environmental Protection Agency (EPA [EPRI, 1995]).

Table 1 in lists the number of creosote treated pilings at various docks in the Unalaska Area. The list estimates that private docks such as Delta Western and Alyeska Seafoods had the highest number of creosote treated pilings (approximately 500 each). It also estimated that public docks such as the Light Cargo dock (450 pilings), Alaska Ferry/UMC dock (150 pilings), and Robert Storrs International Small Boat Harbor (25) have creosote treated pilings. Based upon the levels of PAH found in local sediments, the interim report calculated that the annual rate of creosote loss from dock pilings in Unalaska could range from 125 to 1,135 gallons per year.

TABLE 1: CREOSOTE PILINGS AND INDICATORS OF CREOSOTE SOURCE OF SEDIMENT PAHS

Dock Area	Number of Creosote Pilings (Estimated)	Sediment PAH Indication of Creosote Source - Overall rank
Delta Western	500	1
Alyeska Seafoods	500	2
Light Cargo	450	3
Coastal Transportation	400	15
Resoff	250	17
APL	200	35
UniSea	150	4
North Pacific Fuel	150	24
Alaska Ferry	150	94
Harbor Crown Seafoods	30	12
Robert Storrs International Small Boat Harbor	25	106
Note: Current dock structures may not contain creosote but previously may have been constructed of creosote-treated materials		

The Parties directed OASIS to gather more specific information about the public docks. Based upon communications with Former Unalaska Port Director Alvin Osterback, the actual number and location of the creosote treated pilings differed from what was listed in the Interim Report. Mr. Osterback stated that the Spit Dock had 443 creosote treated pilings. (NOTE: This was erroneously referred to as the Light Cargo dock in the Interim Report.) Mr. Osterback estimated that the pilings were 35 feet in length and 12 inches in diameter. John Days, Unalaska Harbor Master, indicated that 25 feet of the 35 foot piling was submerged. Mr. Osterback indicated that the Unalaska Marine Center (UMC) Dock position 3, which is used by Alaska ferries, has 230 creosote treated pilings that were up to 50 feet in length and 12 to 14 inches in diameter. Mr. Days indicated that only 35 – 40 feet of the pilings were submerged (John Days, e-mail to Denise Koch, June 6, 2011). The as-built drawings would need to be reviewed in order to get more accurate data on the number of creosote treated pilings, their size, and their position in the dock structure. The Robert Storrs International Small Boat Harbor does not have any creosote treated pilings. (Alvin Osterback, e-mail to Denise Koch, November 15, 2010). The new Carl E. Moses Small Boat Harbor was constructed with all steel pilings. No creosote treated pilings have been replaced at the public harbors for at least the last seven years.

TABLE 2: NUMBER AND DIMENSIONS OF CREOSOTE PILINGS AT UNALASKA PUBLIC DOCKS

	Estimated # of Creosote Pilings in *Interim Report*	Refined # of Creosote Pilings	Dimension of Pilings	Length of Piling Submerged (ft.)
Spit Dock*	450	443	35 ft. (length) 12 in (diameter)	25
UMC Dock	150	230	50 ft. (length) 12 – 14 in (diameter)	35 to 40
Light Cargo Dock	450	0	NA	NA
Robert Storrs International Small Boat Harbor	25	0	NA	NA
Carl E. Moses Small Boat Harbor	NA	0	NA	NA

* This dock was erroneously referred to as the Light Cargo Dock in the Interim Report.

^ This dock was referred to as the Alaska Ferry dock in the Interim Report

2.2. Oil Discharge from Vessel Bilge

Oily bilge water is a mixture of water, lubricants, oil, and hydraulic fluid that accumulate in the lowest part of the vessel due to normal operation of the vessel. Sources that contribute hydrocarbon to bilge include engines, piping, and mechanical sources found throughout the vessel.

Christine Graves, Billing and Scheduling Clerk for the City of Unalaska, provided OASIS with the text records of the daily vessel checks of city-owned facilities for the period of June through August 2010. Based upon the vessel name, additional information such as vessel type and length could usually be found in the Alaska Commercial Fisheries Entry Commission permit holders' database.[1] OASIS compiled this information in order to gain an understanding of the distribution of ship traffic at the City docks and harbors and the type and size of the vessels. (NOTE: The Carl E. Moses Small Boat Harbor did not exist during this time period.)

[1] Alaska Commercial Fisheries Entry Commission permit holders' database: http://www.cfec.state.ak.us/plook/

TABLE 3. UNALASKA VESSEL TRAFFIC (JUNE 2010 – AUGUST 2010)

	Total	Robert Storrs International Small Boat Harbor	UMC Dock	Spit Dock	Light Cargo Dock
# of Ships	285	115	76	73	21

The Small Boat Harbor received the highest total number of ship visits during this time period. The boats tend to be fishing and recreational vessels. The vessels that visit the UMC Dock and Light Cargo Dock tended to be larger vessels (e.g. cargo ships, US Coast Guard vessels, Alaska Marine Highway Ferries, small cruise ships, etc.). Those larger vessels likely already have oily water separators. Many of the vessels that visited the Spit Dock appear to be large fishing vessels or processors.

OASIS assumed that the vessels that moor at the UMC Dock and Light Cargo Dock had oily water separators and that the vessels that typically dock at the Small Boat Harbor and Spit Dock do not have oily water separators and are more likely to have oily bilge water discharges. OASIS also made the conservative assumption that the annual number of vessels in the Small Boat Harbor and the Spit Dock is not much higher than the number present during the summer - 188 vessels during the summer months and 200 vessels annually. The National Research Council estimated that an average vessel under 100 gross tons generates 0.09 gallons of oil per day from the bilge (NRC, 2003). OASIS then assumed that, at the lower end, only 5% of the 200 vessels (10 vessels) would operate per day and. at the higher end, 30% of the vessels (60 vessels) would operate per day annually. Both the lower number of vessels and higher number of vessels were then assumed to discharge bilge versus holding it for disposal on shore. Based upon these assumptions, the calculated annual estimates of the discharge of oil from vessel bilge for the Greater Unalaska Bay area ranged from 329 gallons to 1,971 gallons.[2]

2.3. Oil Spills

2.3.1. Minor Oil Spills

During the 1995 to 2005 timeframe, there were 469,439 total gallons of hydrocarbons spilled in the Aleutian subarea. However, spills less than 99 gallons from all facilities contributed less than 1.7% of the total spilled volume - less than 7,980 gallons spilled during a ten year time period. The average volume of oil spilled by small spills was assumed to be 798 gallons spill per year (Alaska Department of Environmental Conservation [ADEC], 2007a).

[2] Lower estimate (10 vessels per day * 365 days * 0.09 gallons per vessel); Upper estimate (60 vessels per day * 365 days * 0.09 gallons per vessel)

2.3.2. Major Vessel Oil Spills

Between 1981 and 2004, there were a total of 26 major vessel oil spills in the Aleutians. When major vessel oil spills occurred, they had an average size of 111,479 gallons (minimum spill size of 1,176 gallons; median spill size of 12,012 gallons; maximum spill size of 2,041,662 gallons). Most spills were diesel (versus intermediate fuel oil [IFO] or bunker fuel). Major vessel oil spills are high impact events, but they do not occur every year (ADEC, 2007b). See Appendix A.

During the period from 1995 to 2005, spills from vessels were the most common sources of oil spills in the Aleutians. Vessels accounted for 47% of the total number of spills and were responsible for 88% of the total volume spilled. Vessels were the source for major spills (>1,000 gallons) 81% of the time (ADEC, 2007a).

The most recent annual summary of oil and hazardous substance spills in Alaska covers the period of July 1, 2010 through June 30, 2011. The summary indicates that vessels are in the top five types of facilities responsible for spills. During this period, vessels had 183 incidents that spilled a total of 15,235 gallons statewide (ADEC, 2012).

In addition to actual spill data gathered by the ADEC, there has been an effort to model and predict future oil spill risk in the Aleutian Islands. These islands support rich marine resources, including some of the nation's most productive commercial fisheries. The Aleutians also intersect the North Pacific Great Circle route, a major international shipping route between the West Coast of North America and Asia. The frequency of severe sea conditions increases the potential for accidents along this route. Although the majority of vessels that transit the North Pacific Great Circle route do not stop in the Aleutians, accidents involving these vessels have the potential to significantly and adversely affect the region. The recent *Aleutian Islands Risk Assessment Phase A* is a comprehensive risk assessment for the area that was funded by IMC Shipping Co. through a court settlement following the M/V *Selendang Ayu* oil spill. As part of this risk assessment, the Risk Analysis Team estimated the frequency of marine accidents and modeled spill scenarios for both the 2008/2009 baseline year as well as for future year 2034 using a Marine Accident Risk Calculation System (MARCS). The data input to the MARCS include vessel traffic, environment, and on-board and external operations. Largely due to an anticipated increase in trade and subsequent vessel traffic, the number of accidents is predicted to increase by 11% from the baseline year to 2034. There was a significant predicted shift in the type of ship most frequently responsible for the accidents from fishing vessels (72% of the accidents) in the base year to container ships (65% of the accidents) in the year 2034. Most accidents, and subsequent oil spills, were predicted to occur in Unimak Pass, Akutan Pass, and the approach to Dutch Harbor. The total average risk of bunker spills per year increases from 1,584 barrels (240 tons) to 2,904 barrels (440 tons). In addition, the spill scenarios that pose the highest risk of spills with the greatest possible consequences were also modeled. These sixteen high impact scenarios modeled spills that ranged from 3,050 barrels spilled from a container ship to 428,080 barrels from a crude oil tanker (Aleutian Islands Risk Assessment Management Team, 2011).

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3. PROMISING ABATEMENT PROJECTS

The Parties directed OASIS to research potential abatement projects. The projects described in this section were selected based upon the Parties discussions with stakeholders in Unalaska, the Parties internal meetings, and the projects' potential to reduce or prevent the sources of oil inputs into the Greater Unalaska Bay Area (OASIS, 2010),.

3.1. Creosote Treated Marine Pilings

Creosote is derived from tar that is produced from carbonization of bituminous coal. It is a complex mixture of aromatic compounds. PAHs constitute about 85% of the total mixture of creosote. Under most environmental conditions, the dominant aquatic transport process for these PAHs will be adsorption onto the suspended particulates (EPA, 2003a).

Creosote represents a significant potential for the release of hydrocarbons, particularly the more harmful PAHs, into the environment. The PAHs in creosote include 16 EPA priority pollutants (EPA, 2003b).

Creosote contains a much higher concentration of harmful PAHs than petroleum. Therefore, the replacement or wrapping of creosote treated marine pilings in Unalaska has the potential to abate damage caused by the release of a larger quantity of oil spilled from the M/V *Selendang Ayu.*

3.1.1. Creosote Piling Equivalency Calculations by NewFields Consulting

Gregory Douglas, Ph.D. is a forensic chemist with NewFields consulting. At the request of the Responsible Party, Dr. Douglas attempted to determine the number of creosote treated marine pilings that produced hydrocarbon toxicity equivalent to the toxicity caused by the oil spilled from the M/V *Selendang Ayu*.

Dr. Douglas first presented his findings to the Parties on January 25, 2011. Based upon questions from the Natural Resource Damage Trustees (Trustees), Dr. Douglas updated his spreadsheet to include information on creosote migration from pilings. He then presented the equivalency calculations to the Parties again on October 7, 2011. Dr. Douglas' "Selendang Oil to Piling Calculation" spreadsheet is included in Appendix B.

Dr. Douglas presented variations of the equivalency calculations, which are discussed in the next two sections. However, each method shared the following factors and assumptions.

The M/V *Selendang Ayu* spilled 354,218 gallons of oil. It was assumed that a minimal amount of oil was recovered, and the calculations are based upon a release of 350,000 gallons of oil.

There is a much higher concentration of PAHs contained in creosote versus the IFO that was spilled by the M/V *Selendang Ayu*. Although it is likely that the creosote on the treated pilings contains 80 – 85% PAHs, the calculations are based upon conservative assumption that the creosote only contains 20% PAHs.

Based upon forensic analysis, the oil spilled from the M/V *Selendang Ayu* was a mixture of 70% IFO bunkered in Singapore (Client ID = Maritec 110803 in Appendix B) and 30% IFO bunkered in Seattle (Client ID = SA Seattle IF 038 in Appendix B). The oil that is bunkered by ships is sampled as it is delivered. Analysis of the oil mixture spilled by the M/V *Selendang Ayu* indicated that it contained 2.3% total PAHs and 0.14% priority pollutant PAHs.

The dimensions of the pilings to be potentially wrapped or replaced in this calculation were based upon the Spit Dock, a municipal dock that contains creosote pilings. The pilings are 35 feet in length and 12 inches in diameter. The pilings were assumed to have had creosote applied at the lowest concentration (TT-C-645 Douglas Fir) based upon current industry specifications. The pilings at the Spit Dock were estimated by the former Unalaska Port Director to be approximately 30 years old (Alvin Osterback, e-mail to Denise Koch, May 15, 2010). Standard creosote application rates may have been higher at that time. Using an assumption that the pilings had creosote applied at the lowest concentration makes the equivalency calculation more conservative (i.e. more pilings would need to be removed).

Based upon this common foundation, the equivalency calculations then diverged, as discussed in the following sections.

3.1.1.1. Calculations Based Upon 16 Priority Pollutant PAHs

There are 16 PAHs that are considered priority pollutants by the EPA. Dr. Douglas calculated the concentration and mass of the 16 priority pollutant PAHs in the mixture of oil that was spilled. Then, he calculated the mass of the 16 priority pollutant PAHs that are contained in the creosote on a marine piling. The mass of the priority pollutant PAHs in the spilled oil was divided by the mass of the priority pollutant PAHs in the creosote of a marine piling. The mass of the 16 priority pollutant PAHs contained in the oil spilled by the M/V *Selendang Ayu* was equivalent to the mass of the 16 priority pollutant PAHs contained in 51.6 creosote treated pilings.

3.1.1.2. Equivalency Calculations based upon Benzo[a]pyrene Toxicity

In this approach, the toxicity of the carcinogenic PAHs, benzo(a)anthracene, benzo(b)flouranthene, benzo(k)flouranthene, chrysene, and indeno(1,2,3-cd)pyrene were normalized to benzo[a]pyrene (BaP) using toxicity equivalency factors (TEFs). The toxicity of benzo[a]pyrene is well established and the toxicity of other carcinogenic PAHs has been determined relative to BaP. BaP has been determined to be the more toxic of the other five PAHs. BaP is given the toxicity equivalent of 1, and the other five PAHs have toxicity equivalencies that are less than 1. The concentration of each of these PAHs is multiplied by its BaP toxicity equivalency.[3]

TABLE 4: TOXICITY EQUIVALENCY FACTORS FOR CARCINOGENIC POLYCYCLIC AROMATIC HYDROCARBONS

Table	TEF
Benzo(a)pyrene	1.0
Benz(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenzo(a,h)anthracene	1.0
Indeno(1,2,3-c,d)pyrene	0.1

A total BaP equivalency was then determined for both the Singapore and Seattle fuels. The mass of BaP equivalency can then be calculated for the mixture of spilled oil. The mass of BaP toxicity contained in the creosote on a marine piling is also calculated. The mass of the BaP toxicity equivalency in the spilled oil is then divided by the mass of the BaP toxicity equivalency in the creosote on a marine piling. This calculation determined that the mass of the BaP toxicity equivalency spill by the M/V *Selendang Ayu* was equivalent to the BaP toxicity equivalency contained in 20.5 pilings.

If the toxicity of these five carcinogenic PAHs is not normalized to the toxicity of BaP and the rest of the procedure is followed, the calculations indicate that 28.3 pilings should be wrapped or replaced.

3.1.2. Trustee Concerns with Creosote Piling Equivalency Calculations

The Trustees indicated a number of concerns about the equivalency calculation approach. The Parties discussed several of the concerns about the approach but did not reach consensus on the creosote piling to M/V *Selendang Ayu* spilled oil equivalency calculations.

3.1.2.1. Toxicity

The Trustees were concerned that the piling equivalency calculations focused solely on toxicity and did not adequately account for the damage to the marine environment caused by other effects of the spilled oil (e.g. the different effects to marine resources from coating by the pilings versus coating by the oil, different time periods over which

[3] Note that these toxicity equivalency factors for carcinogenic PAHs are most often used as part of human health risk assessments. EPA Mid-Atlantic Risk Assessment guidance states that these equivalency factors should not be used when calculating non-cancer risk. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm

exposure occurred, different rates of release into the environment, and different areas of habitat affected).

The Trustees also had separate discussions with Mark Carls, a toxicologist and environmental chemist from the National Oceanic and Atmospheric Administration (NOAA) Auke Bay Laboratory. Mr. Carls has conducted intensive field research to understand the residual distribution and lingering bioavailability of oil spilled by the M/V *Selendang Ayu*.

Mr. Carls indicated that the creosote pilings were probably less toxic than M/V *Selendang Ayu* oil because creosote has fewer alkylated homologs[4] per unit mass. Shifts in PAH composition indicate that the suite of PAHs dissolved in water becomes more toxic per unit mass as weathering progresses and the percentage of larger PAHs increases (Carls, 2009).

While acute effects leading to mortality are one component of toxicity, longer lasting non-narcotic toxicity mechanisms can still cause biological problems in animals exposed to lingering M/V *Selendang Ayu* oil. Numerous research papers have demonstrated that PAH toxicity increases with molecular size and alkyl substitution. There is significant toxicity in weathered oil derived from larger molecules. The persistence of weathered oil, as well as evidence of mortality, malformations, and genetic damage in herring and pink salmon exposed to weathered oil (as compared to less weathered oil), demonstrates that the toxicity is also persistent (Carls, 2009). Mr. Carls asserts that comparison of published oil toxicity and creosote toxicity results establishes the case that toxicity of spilled oil is greater than or equal to that of creosote.

Dr. Douglas' experience, however, is that coal tar, which is the basis of creosote, is much more toxic than fuel oil because it has a high concentration of EPA priority pollutant PAHs.

3.1.2.2. Leaching of Creosote from Pilings

The Trustees were also concerned that the creosote piling equivalency calculations were based upon 100% of the creosote that was originally applied to the pilings even though a) the pilings were approximately 30 years old and some amount of creosote had probably leached out of the pilings; and b) some portions of the piling are above the waterline or buried in the sediment and are not in contact the water column.

In response to the weathering concern, Dr. Douglas relied on a model developed by Dr. Kenneth Brooks of Aquatic Environmental Sciences (Brooks, 1997) that estimates the PAH migration rate (weathering) from a marine piling. The model is based upon a number of factors such as temperature, salinity, piling surface area, original creosote charge, time, and current flow. Using inputs typical for the waters of Unalaska - a

[4] Petroleum PAHs have abundant alkyl group substitution on their ring structure. Alkyl homologs of aromatic compounds predominate the unsubstituted parent aromatic structures in crude oils. Alkylated PAHs are more abundant, persist for a longer time, and are sometimes more toxic than the parent PAHs. Alkyl substitution usually decreases water solubility and increases the likelihood of bioaccumulation. Within an aromatic series, acute toxicity increases with increasing alkyl substitution on the aromatic nucleus (Irwin, 1997).

temperature of 10 degrees Celsius, 30 parts per thousand salinity, tidal current flow, and 33 kilograms (kg) of creosote initially applied - the model calculates that the mass loss of creosote from a marine piling in the first 10 years is 10%. After 20 years, 15% of mass is lost and then the loss rate is extremely low. After 80 years, the model estimates that only 16% of the PAH mass will be lost from creosote. There was also a study of marine pilings in Vancouver Harbor. After 40 years of service, the marine pilings retained 75% of their original creosote charge.

Based upon the model and the Vancouver study, Dr. Douglas believed that the weathering of the pilings in Unalaska probably decreased the mass of creosote by 15% – 25%. Dr. Douglas stated that use of the conservative estimate that creosote only contained 20% PAHs, instead of the more realistic 80% value, gave a safety factor of 4x. This safety factor would adequately cover for the other variables, such as weathering.

3.1.3. Types and Effectiveness of Different Wrap Materials

3.1.3.1. Concerns about Wrapping Marine Pilings

Much of the West Coast data on the different types of marine piling wrap and the effectiveness of those wrap materials is from California.[5]

The California Coastal Commission (CCC) has several permits that include discussion about environmentally preferred piling materials. A 2003 CCC permit concluded that wrapping creosote pilings in a watertight plastic sleeve was not an effective way to minimize impacts to marine resources.

> “In the past, the Commission has required that creosote treated pilings be wrapped in a watertight plastic sleeve to minimize impacts to marine resources. However, questions are raised with respect to the effectiveness of this requirement. In most cases, the plastic wrap has been applied prior to piling installation and entails nailing the plastic to the wood and capping the piling for a water resistant seal. In theory this protective measure seems to make sense; however, a recent site visit to the Port indicates that the requirement of plastic wrapping has achieved limited benefits.
>
> The plastic wrap appears to be well worn from abrasion with vessels, torn in places, lacking the intended watertight seal, and in some instances has fallen off completely into the water. In fact, it appears that the plastic wrap may eventually become floatable plastic marine debris.” (CCC, 2003)

This information indicates that piling wraps will not be effective on pilings that are likely to receive vessel contact. In addition, a wrapped piling may allow creosote to accumulate under the covering and move into the aquatic environment in a significant pulse if it is breached (Goyette, 1999).

[5] Monika Shoemaker is the Washington State Department of Natural Resources Aquatic Restoration manager. Ms. Shoemaker was unaware of any projects where someone had conducted a neutral study of how well piling coverings/wrappings work; her program had not.

3.1.3.2. Effectiveness of Piling Wrap Materials at Preventing Leaching

There are several different manufacturers and models of wraps for marine pilings (see Appendix C). These wrap systems were primarily designed to protect against marine borer destruction and deterioration. The systems encapsulate the pilings. They prevent oxygen from reaching the piling and suffocate the boring organisms. Some product manufacturers claim that the systems also prevent the leaching of creosote and ammoniacal copper zinc arsenate (ACZA) into the marine environment.

OASIS could not find a study that reported the effectiveness of various piling wrap materials on reducing the leaching rate of creosote from marine pilings. A study on the effectiveness of wrapping marine pilings treated with another kind of wood preservative, ACZA, was found.

In 2006, the Port of Los Angeles commissioned a study to determine the effectiveness of four different piling wrapping materials at reducing or sequestering the observed metal leaching from ACZA-treated Douglas fir marine pilings.

The following post installation[6] piling wraps were tested:

> PVC/Polyethylene - 30 millimeter outer wrap of polyvinyl chloride (PVC) and a 6 mil inner wrap of polyethylene. This is currently the standard post driving, diver-installed wrap used by the Port of Los Angeles.
>
> EPDM – 60 millimeter outer wrap of ethylene propylene diene monomer (EPDM) and an inner wrap of petrolatum saturated tape (PST). (Vendor: Denso, North America).
>
> PVC/ PST – 30 millimeter outer wrap of PVC and inner wrap of PST. (Vendor: Denso, North America).

The PVC, EPDM, and PST wraps are typically applied to the pilings after installation (post driving), sealed with a double overlapping closure, and affixed with stainless steel nails along the seam. The ends of the wraps were sealed via stainless steel 0.75 inch banding.

The piling wrapping was completed on October 16, 2006 at the Port's Construction and Maintenance facility. The PVC outer wraps were installed by the Construction and Maintenance Division's piling wrap installation subcontractor, American Marine Corporation. The EPDM and PVC/PST wraps were installed by the Denso vendor representative. After applying and cinching the outer wrap, the top and bottom of each wrapped piling was secured with a stainless steel band, and the seams were secured using stainless steel nails.

Metal losses for the wrapped pilings were measured in the laboratory on days 0, 1, 3, 7, 14, and 30 after immersion in seawater. ACZA treated, but unwrapped pilings were used as a control. Both study and control pilings were tested in triplicate.

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[6] The study also evaluated the effectiveness of shrink wrapping ACZA treated marine pilings with high-density polyethylene (HDPE) *prior* to piling installation. Those results are not discussed here since they are not applicable to treating the existing pilings in Unalaska.

Metal loss rates were highest after 24 to 48 hours of immersion, and declined over the one month test period. However, the study concluded that small amounts of copper and zinc would continue to migrate from ACZA-treated wood for an extended period of time – likely for the life of the pilings.

TABLE 5: AVERAGE 1-MONTH LEACHING RATES FOR WRAPPED AND UNWRAPPED ACZA TREATED PILINGS

ACZA-treated Pilings	Arsenic Loss Rate ($\mu g/cm^2/day$)	Copper Loss Rate ($\mu g/cm^2/day$)	Zinc Loss Rate ($\mu g/cm^2/day$)
Unwrapped Pilings[1]			
Static[2]	0.3	61.1	1
Dynamic[3]	0.12	21	1.1
Wrapped Pilings (static only)			
T-PVC[4]	0.013	0.008	0.015
T-EPDM[4]	0.102	0.001	0.081
T-PST[4]	0.021	0.024	0.098

$\mu g/cm^2/day$ = microgram per centimeter squared per day

1 Average loss rate of six measurements (days 0.5, 1, 3, 7, 14, 28) for three pilings

2 Static (fixed volume) testing

3 Dynamic (flow-through) testing

4 Average loss rate of five measurements (days 1, 3, 7, 14, 30) for three pilings

The measured mean metal losses from all of the wrapped pilings were very low (generally < 0.1 $\mu g/cm^2/day$). These results indicate that all of the wraps were effective in minimizing the short term (<1 month) metal losses from ACZA-pressure-treated pilings compared to the unwrapped treated pilings (AMEC Earth & Environmental, Inc. [AMEC], 2007).

Although all of the wraps were determined to be effective at reducing leaching, the Port of Los Angeles has continued using PVC/Polyethylene combination to wrap their pilings. The Port uses this combination due to familiarity; it is the wrap system that they have been using for years (Katherine Prickett, e-mail to Denise Koch, October 4, 2010). The duration of a wrap is between 5 to 10 years, depending upon the density of vessel traffic in the area. In ideal conditions, the wrap should last 10 years (Katherine Prickett, e-mail to Denise Koch, September 27, 2010).

3.1.4. Comparison of Replacement versus Wrapping Creosote Treated Marine Pilings

Piling removal projects require permitting by the U.S. Army Corps of Engineers (USACE). The USACE requires anything from a Letter of Permission (LOP) for minor projects to an individual permit for larger, more complex projects. State permits may also be required (e.g. Department of Transportation, Department of Fish and Game, Department of Natural Resources, Department of Environmental Conservation).

Piling removal techniques typically include vertical pulling, vibratory extraction, horizontal snapping and breaking techniques, cutting, hydraulic jetting, and combinations of these methods. The Washington Department of Natural Resources (WDNR) Puget Sound Initiative developed Best Management Practices (BMPs) for Derelict Creosote Piling Removal. The goal of the BMPs is to control turbidity and sediments from re-entering the water column during piling removal, and to prescribe debris capture and the disposal of removed pilings and debris. Their preferred method of piling removal is vibratory extraction (WDNR, undated).

Barges with cable cranes or hydraulic excavators are typically used to remove pilings by pulling the piling vertically out of the sediment. This equipment may also be used with a vibratory hammer that aids in removing the piling. A tug, a flat deck barge to hold the removed pilings and debris, and one or more smaller craft to move workers, supplies, anchors, and other equipment would also likely be needed. Large marine equipment typically needs at least 6 feet of water, and smaller marine equipment typically needs at least 3 feet of water to operate effectively.

The Port of San Francisco applied for federal stimulus funds in 2009 to help fund a large pier and dock removal program (Werme, 2009). This project included removal of approximately 473,000 square feet of piers and wharves, many in degraded condition that were constructed with creosote treated timbers and supported by 7,390 creosote pilings. The estimated total cost for demolition and disposal on this project was $8.1 million. This cost was for removal 2 feet below the mud line, not for complete piling extraction, and did not include the planning, engineering, design, or permitting costs (Polson, 2009). Projects in Alaska would likely be more expensive due to the cost of moving marine equipment to a remote site as well as the transportation of the pulled pilings to appropriate disposal facilities.

3.1.5. Cost Estimates for Wrapping Creosote Treated Pilings at the Spit and Unalaska Marine Center Docks

Ballard Diving & Salvage, Inc. is a privately held company that specializes in environmental diving and deep water construction. It is based in Seattle with offices in several other locations, including Anchorage. Ballard Diving & Salvage has extensive experience wrapping in-place timber pilings in Washington and Oregon. The company has not wrapped pilings in Alaska. However, they have completed other types of projects in Kodiak, Dutch Harbor, Juneau, and Sitka and are familiar with Alaska working conditions. Although there are several other companies who wrap pilings in California and the Pacific Northwest, Ballard Diving & Salvage, Inc. was the only company that could provide an Alaska specific quote (see Appendix D).

Ballard Diving & Salvage estimated that mobilization and de-mobilization of equipment and supplies from Seattle, Washington to Dutch Harbor, Alaska would cost $75,000. The mobilization/demobilization costs also include longshoreman loading and unloading and diver travel costs. In addition to these costs, the Spit Dock pilings (35 feet long, 12 inch diameter) would cost $5,300 per piling to wrap. The larger pilings at the Unalaska Marine

Center (50 feet long, 12 – 14 inch diameter) would cost $8,700 per piling. The increased decompression time associated with deeper dives means the pilings will require more dive time to wrap. The pilings would be wrapped with a Tapecoat Enviroshield T Module.[7] Tapecoat has been used to wrap pilings in the Pacific Northwest. The wrap system consists of a PST inner layer protected by an outer jacket and sealed with stainless steel bands, top and bottom, and vertically with a moldable sealant. Any application of covers in Alaska would need to cover above the highest tide.

The estimate was based upon the following assumptions: 1) at least 50 pilings would be wrapped; 2) there was a three man diving crew; 3) Alaska Department of Fish & Game allows marine growth on the pilings to be power washed off and will not require it to be contained, decanted, and disposed; and 4) work takes place in the summer. The labor costs were calculated based upon private rates; public works rates are more expensive.[8]

In order for Ballard Diving & Salvage to provide a more accurate estimate, the Parties or their contractor would need to work with the City of Unalaska to provide bidders with the precise number, location, and dimensions of the pilings to be wrapped and information on the associated dock structures.

3.1.6. Cost Estimates for Removing and Replacing Creosote Treated Pilings at the Spit and Unalaska Marine Center Docks

The cost of removing and replacing creosote treated pilings at docks is high, especially if structural work is required. Please note that the following cost estimates do not include any permit-related work or treatment or removal of existing PAH-contaminated sediments.

Pacific Pile and Post, LP helped to construct the new Carl E. Moses Small Boat Harbor in Unalaska. A company representative stated that the creosote coated pilings at the UMC Dock are below an asphalt deck. In order to remove and replace those pilings, you would basically have to rebuild a good dock. Those pilings are better candidates for wrapping. Many of the creosote coated pilings at the Spit Dock are fender pilings, which are not good candidates for wraps. It would be better to remove and replace those pilings.

The mobilization and demobilization cost associated with removal and replacement of pilings would be very large ranging from $300,000 - $460,000. (The costs would be lower if the project could be coordinated with any other dock projects in the area.) The mobilization cost is in addition to the cost for replacement of individual pilings.

Steel pilings are best suited to Alaska. Steel pilings are lighter and are less likely to suffer damage due to freeze/thaw than concrete. Pacific Pile and Post, LP estimated that removal of pilings at the Spit Dock would cost approximately $10,000. The removal and

[7] Representatives of several marine construction and diving companies and the wrap vendors themselves agreed that the mobilization and demobilization of equipment to the site and the diver labor to install the wraps would constitute over 90% of the project cost. Therefore, the type of piling wrap selected is not a point of emphasis in the cost estimate.
[8] OASIS is unclear if wrapping pilings at a public dock would legally be considered a public works project if it were funded by a private entity as part of a settlement agreement.

replacement costs at the UMC dock would cost approximately $15,000 per piling (Jason Davis, telephone conversation with Denise Koch, August 25, 2012).

Ballard Diving & Salvage, Inc. provided similar estimates for the removal and replacement of creosote treated pilings at the two Unalaska docks. The company estimated that the mobilization and demobilization of a crane barge to Dutch Harbor would cost approximately $460,000. The removal and replacement of pilings was estimated at $17,250 per piling (Michael Eakin, Chief Estimator, e-mail to Denise Koch, September 2, 2011)

3.1.7. Abatement Potential and Cost

According to Dr. Douglas' calculations, the removal or wrapping of 21 to 52 creosote treated wood pilings would mitigate the impact of 350,000 gallons of oil spilled from the M/V *Selendang Ayu.* The Trustees were concerned that these estimates were too low. The Parties did not reach agreement on the number of pilings that would need to be wrapped or replaced. To present the data in a format comparable with other projects, the cost per gallon of oil abated is based upon the assumption that the projects would mitigate 350,000 gallons of oil. It is not intended to imply agreement among the Parties on the project's remediation value.

Based upon feedback from marine contractors familiar with Unalaska, the creosote treated pilings at the UMC Dock are better candidates for wrapping versus replacement. Assuming that 50 pilings were wrapped, the project would cost approximately $510,000[9]. The cost per gallon of oil removed is $1.46 ($510,000/350,000).

The replacement of creosote treated pilings is much more expensive than wrapping. According to Pacific Pile and Post, the creosote treated pilings at the Spit Dock are likely better candidates for replacement versus wrapping. If 50 pilings were replaced, it would likely cost between $960,000 and $1,322,500.[10] The cost per gallon of oil removed is $3.78 ($1,322,500/ 350,000 gallons).

3.2. Bilge Oil Pollution Prevention

3.2.1. Distribution of Free Bilge Socks and Sorbent Pads

Oil discharge from vessel bilge was identified as a major annual oil input for the Unalaska region (OASIS, 2010). The bilge compartment on most boats captures a variety of liquids including rain, sea water, fuel, and engine oil. Maintenance of inboard engines can also result in spills into the bilge. Almost all boats have pumps that evacuate the bilge compartment to prevent the boat from swamping. The pumping of bilge water laden with fuel and oil is an important source of oil to the marine environment and is often the cause of oily sheen seen near harbors (Costa, 2000).

9 [($8,000 per piling * 50 pilings) + ($75,000 mobilization/demobilization)].
10 [($10,000 per piling * 50 pilings) + ($460,000 mobilization/demobilization)] to [($17,250 per piling * 50 pilings) + ($460,000 mobilization/demobilization)]

The distribution of free bilge socks and sorbent pads would decrease the volume of oil that enters the marine environment.

3.2.1.1. Physical Properties of Oil Only Sorbent Pads

Sorbent pads can be used inside the vessel around leaky equipment or outdoors to soak up hydrocarbons. Sorbent pads come in different sizes and absorbencies. They are typically constructed of highly-absorbent fine fibers that trap oil but repel water. Fully saturated pads float on water and can be used to clean spills on vessels or in harbors. The saturated pads have a high British thermal unit (BTU) value and incinerate well.

3.2.1.2. Physical Properties of Bilge Socks

A bilge sock looks like a long fabric tube, filled with absorbent material. They can be made of polypropylene, cellulose, plasticizing polymer, or a plasticizing polymer/ cellulose blend. Some bilge socks of polyethylene or other materials are designed to be wrung out and reused. However, the pilot bilge sock distribution projects researched used single use bilge socks so that there would be no dripping of oil from the bilge sock to boats or harbors. Plasticizing polymers seem to work best for encapsulation and single use disposal.

Polymers in bilge socks form permanent bonds with hydrocarbons, but do not absorb water. For most vessels, one or two bilge socks should last an entire season. Salinity does not affect bilge sock performance. Temperature will not affect the absorbency of the bilge sock as long as the oil is still in liquid form.

Manufacturers of bilge socks include Lakefront Enterprises, Inc. (Enviro-Bond), Trace Marine, and AbTech. The size of the bilge socks range from 9 inches to 36 inches long with diameters from 2 to 3 inches. Dependent upon the size of sock selected, the manufacturers claim that the socks can absorb 1.5 to 4 quarts of oil.

In 2001, Boat US Foundation (Foundation) did a comparative study on many of the bilge socks that were on the market. They grouped the bilge socks into three categories: 1) encapsulators (single use disposal socks); 2) collectors (reusable socks); and 3) bio bugs (socks that allegedly digest the oil). The test consisted of plastic trays intended to replicate a boat's bilge. Each plastic tray contained two gallons of freshwater and one bilge sock. Each bilge sock was subject to a 10-minute test to determine how quickly the bilge sock absorbed 0.5 quart of oil, a 2-hour test to determine if the bilge sock absorbed the 0.5 quart of oil, and a 10-day test to measure if the bilge sock absorbed a capacity of oil equal to the manufacturer's claim.

The Foundation advised against the use of collectors due to the mess associated with leakage. Given the time period of testing, the Foundation could not determine if bio-remediating (bio bugs) bilge socks worked.

The Foundation preferred the use of encapsulating single use bilge socks. The encapsulating bilge sock that received the highest ratings (captain's choice, item #403) was manufactured by Lakefront Enterprises, Inc. (BoatUS Foundation, 2001). A table comparing the performance of all the different bilge socks tested by the Foundation is contained in Appendix E.

PHOTO CREDIT: LAKEFRONT ENTERPRISES, INC.

The Enviro-Bond bilge socks that are manufactured by Enviro-Bond have been used in several free bilge sock distribution projects on the East Coast. The encapsulation and solidification potential of the Enviro-Bond captain's choice bilge sock (item number 403) polymer bilge sock is provided in the Table 6. Although this information is based upon experience in much warmer water, it does indicate the effectiveness of the bilge socks at absorbing different fuel sources (Bob Bergquist, President Lakefront Enterprises, e-mail communication with Denise Koch, September 13, 2011).

TABLE 6: ENCAPSULATION AND SOLIDIFICATION POTENTIAL OF ENVIRO-BOND BILGE SOCKS IN WARM WATER

	Time	Temp	Rating	Ratio by Weight Polymer to Hydrocarbon
Crude Oil	5 min.	70° F	Excellent	1 to 1
Diesel Fuel	5 min.	70° F	Excellent	1 to 6
Gasoline	5 min.	70° F	Excellent	1 to 15

3.2.1.3. Precedent for Bilge Sock Distribution Programs

East Coast states such as Massachusetts, Georgia, and Florida have piloted free bilge sock distribution programs. OASIS did not find examples of such programs on the West Coast. The pilot projects all used encapsulating bilge socks so the bilge socks would not drip on boats and their operators and could be disposed of as municipal trash.

Administrators of the programs indicated that cooperation from Harbor Masters and local marine suppliers was crucial to educating boat operators on the utility of bilge socks as well as for distributing them. The major goal of all the pilot projects was to educate the public on the importance of the issue of bilge oil pollution prevention and to encourage boat operators to purchase and use bilge socks after the pilot projects ended. Examples of some of the public education documents as well as letters documenting that bilge socks were allowed to be disposed of in the municipal trash are contained in Appendix E.

3.2.1.3.1. Massachusetts

In 1999, the Buzzards Bay Action Committee (BBAC) received a grant from the Massachusetts Coastal Zone Management office to provide free bilge oil socks to recreational boat operators in Buzzards Bay. The grant also provided funds for towns to pay for the collection and disposal of the used bilge socks.

As part of the pilot project, the BBAC evaluated twenty (20) different bilge socks against the five criteria. The bilge sock must:

1) Be able to pass through a 3.5 inch diameter hole, meant to simulate small bilge compartments on some boats;
2) Have a rope with a loop to enable its attachment and removal from bilges;
3) Absorb at least 1.5 quarts of hydrocarbons;
4) Not drip or release oil under moderate pressure;
5) Be accepted at conventional waste disposal incineration facilities in Massachusetts.

Three bilge socks met all five criteria: bilge sock G from Dawg, Inc.; bilge sock h from Dawg, Inc.; and Enviro-Bond bilge sock from Lakefront Enterprises. Based upon price, the Enviro-Bond sock was selected to be distributed (Costa, 2000).

Joseph Costa, Executive Director of the BBAC, stated that 8,000 bilge socks were distributed free of charge to boat operators as part of this project. The project was well received by Harbor Masters and boat operators. Harbor Masters distributed bilge socks to the public during their normal course of business. Since Harbor Masters distributed the items, their buy-in was critical (Joe Costa, telephone conversation with Denise Koch, July 13, 2011).

The bilge socks were easy to use and each bilge sock had a tag with instructions. The pilot was so successful that Harbor Masters and the public contacted BBAC for the next several years to request the free bilge socks. One of the goals of the project was to educate the public about the ability of the low cost bilge socks to prevent oil from entering the marine environment. The BBAC hoped that the public would purchase bilge socks after the free distribution program ended. Local marinas started carrying bilge socks after the free distribution program ended. However, there was no data on current bilge sock usage (Joe Costa, telephone conversation with Denise Koch, July 13, 2011).

The Buzzards Bay program was so successful that Massachusetts Office of Coastal Zone Management sponsored the purchase of an additional 10,000 Enviro-Bond bilge socks that were distributed statewide to operators free of charge in 2002. The bilge socks were also distributed through Harbor Masters. Massachusetts determined that since this brand of bilge sock encapsulated the oil and fuel, it could be disposed of with household trash. Therefore, the Office of Coastal Zone Management did not sponsor the collection or disposal of the bilge socks (Robin Lacey, Clean Marina Specialist with the Massachusetts Office of Coastal Zone Management, e-mail communication with Denise Koch, July 18, 2011). The Office of Coastal Zone Management estimated that the total 18,000 bilge socks that had been distributed in the Buzzards Bay and statewide program absorbed 2.5 quarts of oil per sock, keeping as much as 11,000 gallons of petroleum out of the waterways.

3.2.1.3.2. Florida

Volusia County, Florida sponsored the distribution of free bilge socks in 2001. The majority of the funding came from a grant from the Florida Natural Resources Damage Restoration Grant Program, which is funded from fines levied on companies with petroleum spill violations, and Volusia County.

In 2001, Volusia County officials purchased one bilge sock for each wet slip in each marina in the county. A total of 4,400 bilge socks were purchased at $5.52 each, for a total of $24,288. The bilge socks were not packaged or tagged; county staff had to spend a significant amount of time to bag and tag each bilge sock. In addition, the County purchased waterproof tags, information cards, counter displays, and metal signs for bait and tackle stores. The total cost for the bilge socks, labor to bag and tag the socks, and the educational material was $52,650. All bilge socks were distributed during 2001.

The Volusia County Environmental Management program set requirements similar to Massachusetts' for their bilge socks, and they also selected the Enviro-Bond bilge socks manufactured by Lakefront Enterprises (Georgia Zern, Estuarine Restoration Program Manager, Volusia County Environmental Management, e-mail with Denise Koch, July 20, 2011). In addition, the Enviro-Bond bilge sock was certified by a Florida State Laboratory as meeting the requirements for safe disposal in municipal trash.

In 2004, the Florida Department of Environmental Protection incorporated the bilge sock distribution into their on-going Clean Marinas Program. An individual can receive a free bilge sock in exchange for signing a clean boater pledge card.[11] The clean boater pledge references the Clean Boater program, which advises among several practices that boat operators use absorbent materials in their bilge. Approximately 10,000 bilge socks were

[11] The clean boater pledge requires that an individual: 1) Keep Florida's waterways free of trash and recycle. 2) Practice proper fueling techniques. 3) Use pump out facilities. 4) Support Florida Clean Marinas, Clean Boatyards and Clean Marine Retailers whenever possible. 4) Promote clean boating habits and the Clean Boater program to fellow boaters.5) Remember that a clean environment ALWAYS starts with ME. (http://www.dep.state.fl.us/cleanmarina/boater/)

distributed in the last year (Brenda Leonard, Florida Department of Environmental Protection, Clean Marina Program Manager, e-mail to Denise Koch, April 5, 2012).

3.2.1.3.3. Georgia

In 2007, the University Of Georgia Marine Extension Service (MAREX) developed a bilge sock distribution program for commercial and recreational boat operators. MAREX developed bilge sock training and educational materials, including Power Point presentations, brochures, and instructional materials for the bilge sock kits. Marine specialists conducted 45 coastal bilge sock training and use workshops. More than 4,000 bilge socks were distributed to owners and operators of shrimp boats, pilot boats, research vessels, and recreational vessels.

MAREX also conducted surveys when the bilge socks were distributed as well as after the bilge sock recipients had used the bilge socks. Prior to being given the bilge socks as part of the voluntary program, less than 20% of the respondents had used bilge socks. Over 90% of the respondents who stated that they did not use bilge socks indicated that convenient dockside disposal receptacles would encourage the individuals to use a bilge sock on a regular basis. In a follow-up survey, 100% of the respondents said that they now used bilge socks (University of Georgia, 2007). However, the survey information was not detailed enough to distinguish whether the respondents were simply using the free bilge socks that they had received or if they had integrated the use of bilge socks into their operations and purchased them on their own.

The staff member who started and administered the MAREX bilge sock program retired. The replacement staff member did not know the total number of bilge socks that were purchased or the cost of the program. The active outreach for the bilge sock program has ceased but MAREX continues to distribute the remainder of their bilge sock supply. Commercial fishermen (mostly shrimpers with 50 to 80 foot trawlers) are the boaters who most frequently request the bilge socks from MAREX. They have indicated that the bilge socks are easy to use and are easily disposable. MAREX will not re-order bilge socks once they exhaust their supply. The goal is that operators will continue to use the bilge socks by purchasing the item themselves (Lisa Gentit, MAREX, e-mail communication with Denise Koch, July 21, 2011).

3.2.1.4. Logistical Considerations for Bilge Sock and Sorbent Pad Distribution Program in Unalaska

Based upon a snapshot of the vessel traffic at the City of Unalaska Harbors (Table 3), the ships that dock at the Small Boat Harbor and the Spit Dock are likely the best candidates for a free bilge sock and sorbent pad distribution program. The Carl E. Moses Small Boat Harbor, which began operating in December 2011, would also be a good location to distribute bilge socks. Bilge sock distribution programs on the East Coast have typically been multi-year programs that distribute thousands of bilge socks.

Based upon information from East Coast bilge sock distribution programs, buy-in from Port and Harbor staff is critical to the program success. A former Unalaska Port Director thought that a program to distribute bilge socks and sorbent material to boat operators free of charge would be a good idea and a first line of defense against bilge oil entering the marine environment (Alvin Osterback, e-mail communication to Denise Koch, July 11, 2011). In January 2012, OASIS was informed that Alvin Osterback had left his position. The Port Director position is still vacant. The details of any proposed sorbent material distribution project will need to be vetted with Mr. Osterback's successor.

In addition, the Alaska Chadux Corporation (Chadux) is very interested in assisting a sorbent distribution program in Unalaska. Chadux is a not-for-profit oil spill response organization. It is based in Anchorage, Alaska but has emergency equipment, limited storage space, and one staff member in Unalaska in order to service its local members. Chadux believes there would be a high demand for the sorbent material. Chadux may be able to rent storage space for the sorbent pads at approximately $1.20 per square foot. They estimated that two inventory events would be required per year at $120 per inventory event ($240 total). The Chadux staff could transport sorbent materials on their truck to different harbors using fish totes. The place, time, and date that the sorbent material would be distributed could be advertised for free on the local Reader Board hosted by Unalaska Community Broadcasting. Chadux estimated that they would charge $100 per day to distribute sorbent materials to the harbors (John LeClair, Chadux Operations Manager, teleconference with Denise Koch, October 25, 2011). However, the Trustees have indicated that they would prefer for the materials to be distributed using post and attach boxes so that individuals may access the materials any time that they needed them anonymously. Chadux would not be able to assist with the construction of any post and attach boxes to distribute sorbent materials. They were concerned that the approval process with the City would be onerous, and construction and maintenance of post and attach boxes is beyond the scope of their services. However, Chadux could use their local staff member to periodically stock post and attach boxes.

OASIS contacted marine suppliers in Unalaska (Pacific Hardware, LFS Marine Supply, Sea Technology, and Lunde North); none of these local businesses sold bilge socks. Therefore, OASIS contacted manufacturers to discuss bilge sock pricing. Bilge socks retail for about $20. Trace Marine indicated that for bulk orders the cost would be closer to $10 per sock but would be dependent upon the total number of bilge socks ordered (Richard Brister, Trace Marine, telephone call with Denise Koch, July 12, 2011). Lakefront Enterprises quoted a unit price of $7.56 per sock based upon the purchase of 1,000 socks ($7,560 total) and a unit price of $6.96 for 10,000 socks ($69,600 total). Neither Trace Marine nor Lakefront Enterprises sell sorbent pads.

Both DAWG, Inc. and Spill Control, Inc. sell both bilge socks and sorbent pads. The items quoted in the following paragraphs are for oil-only sorbents (versus the more expensive universal sorbents which absorb oil, solvents, and acids/bases). The amount of sorbent material that can fit on a conex varies dependent upon the ratio of pads to bilge socks and whether the items will be packaged on pallets or not. Both companies can scale the sorbent order up or down. DAWG, Inc. erroneously thought that only 40 foot conex boxes could be shipped to Unalaska and provided pricing for that amount of material. They indicated they could scale down an order to fit a 20 foot conex at a similar per unit price. Chadux thought that a 20 foot conex filled with sorbents would be a better fit for the potential need and provided pricing for that amount of material.

DAWG, Inc. provided a quote of $30,300 for 500 bales (200 pads per bale) of 15 inch by 18 inch sorbent pads plus 200 cases (30 bilge socks per case) of 3 inch diameter by 48 inch long bilge socks. This amount of sorbent material would be expected to fill a 40 foot conex shipping container and has the capacity to absorb 21,400 gallons of hydrocarbons.[12] That equals a cost of $1.42 per gallon of oil absorbed ($30,300/21,400 gallons) (Scott Bakewell, V.P. Sales, DAWG, Inc., e-mail to Denise Koch, December 14, 2011).

DAWG, Inc. also sells a Salty Dawg Premium Kit that contains oil absorbent pads, bilge socks, pillows, wipers, disposal bags, and a pair of gloves.[13] These kits cost approximately $29 and absorb 7.5 gallons of oil for a cost of $3.87 per gallon of oil absorbed.

Spill Control, Inc. supplies sorbent materials for Chadux. They estimated that it would cost $12,200 to fill a 20 foot conex with 250 bales (200 pads per bale) of 15 inch by 18 inch sorbent pads plus 100 cases (30 bilge socks per case) of 3 inch diameter by 48 inch long bilge socks. This quantity of sorbent material would be able to absorb 10,500 gallons of hydrocarbons. That equals a cost of $1.16 per gallon of oil absorbed ($12,200/10,500 gallons) (Colin Daugherty, Chadux Response Supervisor, e-mail to Denise Koch, December 29, 2011).

The cost of sorbent per unit of gallon absorbed is much lower for a bulk order than for a pre-packaged kit. The distributors would likely provide a couple of cases of waste bags (400 bags total) free of charge with bulk orders.[14] Disposable gloves could be purchased and distributed with the sorbent material (Scott Bakewell, e-mail to Denise Koch, July 10, 2012).[15] Chadux indicated that their Unalaska staff member could bundle packages of sorbent pads, bilge socks, waste bags, and gloves to determine whether boat operators are more likely to take loose items or to prefer a package.

The cost estimates for the sorbent material provided in the preceding paragraphs do not include shipping charges to Unalaska. There are several options for transporting and storing large quantities of sorbent materials. Sampson Tug and Barge, Coastal Transportation, Northland Services, and Horizon Lines all ship materials from Washington State to Unalaska. It costs approximately $900 to ship 350 palletized Salty Dawg kits from Washington to Unalaska. Shipping a 20-foot conex costs approximately $5,500, whereas shipping a 40-foot conex costs approximately $8,200. There may also be longshoremen or harbor labor costs incurred with shipping a conex. Chadux conservatively estimated these costs at $800 for a 20-foot conex.

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[12] (38 gallons oil/case of pads * 500 cases) + (12 gallons of oil/case of socks * 200 cases)
[13] See http://www.dawginc.com/dawgr-salty-dawg-economy-marine-oil-only-spill-kit.html
[14] The liners are 200/case, usually $1.50 each, $300.00 per case.
[15] A case of size large disposable nitrile gloves contains 1,000 gloves and costs approximately $180 per case. http://www.dawginc.com/disposable-gloves.html

Storage space in Unalaska is limited. One option would be to use the shipping container as storage. Chadux indicated that a 20-foot conex offers the advantage of being more easily stacked than a 40-foot conex. If the conex is to be used for storage, it must be purchased. A 20-foot conex may cost as much as $4,000 in Seattle with a 40-foot conex being approximately $8,000. The conex would need to be disposed of after use. Chadux indicated that good conex boxes are rare in Unalaska and there would likely be individuals or organizations that would want the box. If the conex box is not to be used as storage, the materials may be stored with Chadux ($1.20 per square foot), or the new Port Director could be queried about available City storage space.

If a sorbent material distribution program were instituted, the used sorbents must be disposed of properly. Although encapsulating bilge socks do not leak and state agencies in Massachusetts, Georgia, and Florida have allowed used bilge socks to be disposed of as municipal trash, ADEC would require bilge socks to be disposed of with oily rags, not as regular solid waste. This was due, in part, to concerns that the bilge socks could leak and cause problems at the local landfill (Doug Huntman, DEC Rural Landfill Specialist, telephone conversation with Denise Koch, August 2011). Delta Western estimated a cost of $200 to dispose of a 55-gallon drum of oil soaked sorbents. Magone Marine operates on a time and materials basis ($80/hour) to pick up the oil soaked sorbents, process, and dispose of the materials (Ken Willis, Delta Western, telephone conversation with Denise Koch, January 2012). Chadux has a smart ash burner in Unalaska that could potentially be used to dispose of the used sorbent pads and bilge socks. However, they did not provide an estimate for the cost of disposal (John LeClair, meeting with Denise Koch, December 29, 2011).

The new City of Unalaska Port Director will need to be consulted to determine if: 1) the City is still interested in having a sorbent material distribution program at City harbors; 2) whether the City has the staff to distribute materials themselves or whether the City would welcome distribution assistance from Chadux; 3) whether the City has storage space for the sorbent materials; and 4) the preferred collection mechanism for used sorbents.

3.2.1.5. Abatement Potential and Cost

A smaller scale sorbent distribution program that distributed 350 Salty Dawg Premium Kits could absorb 2,625 gallons (7.5 gallons per kit x 350 kits). The kits would cost $10,150 ($29 per kit x 350 kits). The sorbents would cost $3.87 per gallon of oil absorbed ($10,150 / 2,625 gallons).

If a sorbent distribution program in Unalaska were patterned on East Coast programs, the program would distribute thousands of sorbent materials and could last several years. If enough sorbent pads and bilge socks to fill a 20-foot conex were purchased, approximately 10,500 gallons of oil could be absorbed for a sorbent cost of $12,200 (quote from Spill Control, Inc.). Bulk orders of sorbents, versus the purchase of kits, is much more economical, and the cost of the sorbents would be $1.16 per gallons of oil absorbed ($12,200/10,500 gallons). Waste disposal bags and disposable gloves would cost extra.

If enough sorbent pads and bilge socks to fill a 40-foot conex were purchased, approximately 21,400 gallons of oil could be absorbed for a sorbent cost of $30,300 (quote from DAWG, Inc.). The cost of the sorbents would be $1.42 per gallons of oil absorbed ($30,300/21,400 gallons). Waste oil bags would be included free of charge. Disposable gloves would be an additional cost.

In addition to the cost for the sorbent material, there would be significant shipping charges. Dependent upon the City's ability to contribute labor and space, there may also be charges for a third party to build post and attach boxes, material storage, and the labor necessary to inventory and distribute the sorbent materials. The used sorbents would need to be disposed of at an estimated cost of $200 per 55-gallon drum.

3.2.2. Fast Oil Recovery Systems

A Fast Oil Recovery System (FORS) is a piece of equipment that is installed on a new or existing ship to remove bilge oil. One such system, the FORS Bilge Oil Collector, is a relatively recent system, distributed within the last three to four years. The manufacturer claims that it can remove 99.9% of the oil in a vessel's bilge.

There are two models of bilge oil collectors. The T55 Tube Drive can collect up to 5 gallons of oil per 24 hours. The B77 Belt Drive can collect up to 15 gallons of bilge oil every 24 hours. The bilge oil is collected on a tube, oil scrubbers clean the oil from the tube, and the resulting oil can be collected into any receptacle and properly disposed of in an appropriate harbor collection area (http://www.fastoilrecovery.com/). See Appendix F for a diagram for the FORS T55 Tube Drive Bilge Oil Collector.

A marine supply store in Homer, AK, Desperate Marine, sells the FORS T55 Tube Drive Bilge Oil Collector system for approximately $900 per ship. The systems can be shipped in the mail or barged to locations throughout Alaska. FORS is easy to install by bolting to a bulkhead or mount. They can be installed on ships up to 100 feet long. The systems remove diesel and hydraulic oil from the bilge "amazingly well" but will not remove emulsified oil. When Desperate Marine began selling the systems, they offered a money back guarantee to their customers. Earlier versions of the systems had some design flaws and required periodic repair. However, the design flaws have been corrected in the latest version of the design. No customer has ever returned the system; even the earlier models (Steve from Desperate Marine in Homer, AK, telephone conversation with Denise Koch, November 2011).

Erven Bong & Associates LLC is an insurance broker for commercial fishing boats in Washington, Oregon, California, and Alaska, including Dutch Harbor. Since April 2010, the company has offered a credit up to $800 over four years to clients who install the FORS Bilge Oil Collectors. However, no vessel owner has applied for the rebate (Eric Erven, telephone conversation with Denise Koch, November 2011).

3.2.2.1. Abatement Potential and Cost

A FORS costs $900 and can be installed by the ship operator. If there were a FORS on 25 vessels that are home-ported in Unalaska, and assuming that each vessel operates at least 50 days per year for 3 years and leaks 0.09 gallons of bilge oil to the environment per day (NRC, 2003), 338 gallons[16] of bilge oil could be prevented from entering the marine environment. At a cost of $22,500 ($900 * 25), this project would cost $67 per gallon of oil removed.

Alternatively, the Parties could only partially sponsor the purchase of a FORS or work with Erven Bong & Associates, LLC to educate their Dutch Harbor customers about the credit for installation of a FORS.

3.3. Used Oil Disposal Buildings

A used oil disposal building was constructed in 2011 as part of the new Carl E. Moses Small Boat Harbor on Amaknak Island in the City of Unalaska. The Carl E. Moses Small Boat Harbor used oil building is located next to the harbor office and has sufficient oil storage to meet the needs of the new harbor (Figure 2). The general public will be allowed to dispose of used oil (e.g. synthetic oil, engine oil, transmission fluid, refrigeration oil, etc.) and oily rags in the building. The used oil will be collected by North Pacific Fuel. Oily rags may be turned over to Magone Marine. There are no plans to accept anti-freeze but anti-freeze is accepted by Petro Star (Alvin Osterback, telephone conversation with Denise Koch, July 13, 2011).

The Carl E. Moses Small Boat Harbor used oil building is 34 feet by 20 feet and cost approximately $413,000 to construct ($38,000 for planning and design; $375,000 to construct) (Kate Mickelson, PND Engineers, telephone conversation with Denise Koch, January 23, 2012). This used oil building cost approximately $600 per square foot to construct.

The City of Unalaska Former Port Director indicated to one of the Trustees that the Small Boat Harbor and C Float by Unisea would benefit from used oil disposal buildings. There are currently two portable tanks on a trailer at the Robert Storrs International Small Boat Harbor that hold approximately 200 gallons of oil. North Pacific Fuel uses a vacuum truck to pick up the waste oil approximately every three to four months when the tanks are full. It costs approximately $65 per drum to dispose of 100% used oil. Because the drop-off isn't monitored, it is not unusual that drums contain other contaminants (e.g. gasoline, solvents, salt water, anti-freeze). These contaminants can increase the cost of the disposal to up to $600 per drum (Norm, Manager at North Pacific Fuel, telephone conversation with Denise Koch, November 2012).

The Parties indicated that they were interested in a more basic used oil building than one recently constructed at the Carl E. Moses Small Boat Harbor. A more basic building could consist of a shack with a concrete pad and a trench around the base with catchment. (See photo included below.)

[16] 25 vessels * 50 days per year/vessel * 3 years * 0.1 gallons removed from bilge/day = 375 gallons

PHOTO PROVIDED BY TRUSTEE, ERIKA AMMANN

Robert Lund, P.E., an engineering technician for the City of Unalaska, suggested that a new used oil building at the Robert Storrs International Small Boat Harbor be composed of a modular steel or fiberglass structure. Per international fire code, it will need to contain a UL 142 listed double wall tank. In order for a new building to be more protective than the existing outdoor tanks, the building should have secondary containment on a non-slip floor. In accordance with the fire code, the tank must be vented to the outside of the building and bollards may potentially need to be installed around the building dependent upon the size of the oil tank. The building must be braced for 130 mile per hour winds and have site-specific seismic loading per the 2006 international building code. Mr. Lund estimated it would cost $10,000 for the design, $40,000 for the seaworthy modular, $10,000 for shipping, $40,000 for construction, and a $25,000 contingency for a total used oil building cost of $125,000. This cost assumes city-owned land is available and that the building can be placed on a gravel pad (Robert Lund, e-mail to Denise Koch, November 30, 2011).

Lakeview General constructed the Carl E. Moses Small Boat Harbor waste oil building (Kate Mickelson from PND Engineers, e-mail to Denise Koch, November 29, 2011). However, Lakeview General is no longer in business in Unalaska. West Construction has left Unalaska and Ehlehardt Construction is no longer in business. OASIS was unable to find a local contractor to discuss a cost estimate for the more basic waste oil structure.

Pinnacle Construction, Inc. (Pinnacle) in Anchorage does construction throughout rural Alaska. Pinnacle estimated that it would cost $115,000 to build an 8-foot by 10-foot shed, framed with 2x6 lumber, on a 10-foot by 10-foot by 6 -inch concrete slab on grade on a gravel pad. The waste oil shed would be sided with T1-11 plywood siding, have a metal roof, and include a 200 to 300 gallon waste oil tank with containment.

Pinnacle also offered an alternative option. They felt that they could modify a conex to serve as a waste oil collection building. It would cost an estimated $80,000 to purchase a conex and anchor it to a 10-foot by 10-foot by 6-inch concrete slab built on a gravel pad. The conex would have a garage type door in the side for access to the tank. The cost would include a 200 to 300 gallon waste oil tank with containment (Matt Hartman, Pinnacle Construction, Inc., e-mail to Denise Koch, January 24, 2012).

3.3.1. Abatement Potential and Cost

A new used oil building with secondary containment at the Robert Storrs International Small Boat Harbor would reduce the likelihood that oil that spills caused by boat operators, as they dispose of used oil or any leaks in the used oil tank, would contaminate the surrounding soil and potentially enter the harbor. Estimates for a used oil building range from $80,000 to $115,000.

Since the City already has a contract with North Pacific Fuel to dispose of the waste oil from the Robert Storrs International Small Boat Harbor, the Parties would not likely pay for the oil disposal costs, unless the presence of a waste oil building increased the volume of oil that was collected and consequently needed to be disposed.

3.4. Spill Prevention and Response

3.4.1. Enhanced Vessel Monitoring Program

3.4.1.1. Automatic Identification Systems (AIS)

The International Maritime Organization Safety of Life and Sea (SOLAS) Convention requires that Automatic Identification Systems (AIS) are fitted aboard international voyaging ships with gross tonnage of 300 or more tons, and on all passenger ships regardless of size. The U.S. Coast Guard (USCG) has required additional vessels to be equipped with AIS when operating in U.S. waters, including: self-propelled vessels 65 feet or more in length in commercial service (excluding passenger and fishing vessels), towing vessels more than 26 feet in length, and passenger vessels certified to carry more than 150 passengers (33 CFR 164.46).

Most commercial vessels (e.g. tankers, cargo ships, ferries, cruise ships, etc.) sailing in the vicinity of the Aleutian Islands are equipped with AIS. However, in order for the AIS system to be useful, there must be AIS receivers on land to receive and process the information.

In other parts of the country, vessel traffic service (VTS) technology is used by port or USCG authorities in a manner similar to that of air traffic control. The VTS technology typically uses radar to track vessel movement in a limited geographical area. The only VTS station in Alaska is in Valdez and monitors the tanker lanes in Prince William Sound. Even if there were more VTS stations in Alaska, AIS is newer technology that offers distinct advantages. The AIS system sends a signal every 3 - 6 seconds with far more data than radar provides, has a greater range, and provides a more complete and accurate picture of vessel movement than VTS technology. An AIS signal contains information on the vessel ID, name, location, speed, heading, destination, and type of cargo aboard. The AIS system receiving stations are unmanned and are thus far less expensive to operate than the traditional manned radar stations, which feed raw data to the VTS. AIS is also used to implement Vessel Traffic Management Systems (VTMS), which are often used to enhance maritime safety in large areas.

AIS technology has only been around for about seven years. The Marine Exchange of Alaska (MXAK) has built a system of over 85 AIS receiving stations in Alaska. These stations provide information on vessels sailing in over 200,000 square miles of Alaska waters and cover vessels arriving and departing at more than 40 Alaskan ports. The MXAK 24-Hour Operations Center monitors vessels' movements, reports detected casualties, and aids in locating vessels that can render assistance to vessels in distress. The MXAK is supported in part by federal, state, marine industry, and non-governmental organization funding (Presentation by Capt. Ed Page to OAP on January 24, 2012).

The USCG has awarded the MXAK with a Meritorious Public Service Commendation for the AIS system. Using the system built and maintained by the MXAK, the USCG is able to directly access the AIS data. In addition, the AIS system has automatic alarms that notify the MXAK of erratic vessel tracks that may indicate that the vessel is in distress (e.g. slow speed that may indicate that the vessel is drifting). The MXAK then notifies the USCG, sometimes prior to the vessel notifying the USCG. A vessel that voluntarily responds and succeeds in removing another vessel from maritime peril can expect payment. Depending upon the risk involved, the successful volunteer may receive an award equal to a significant percentage of the value of the rescued vessel, its bunker, and cargo. This is one reason why vessels may delay requesting rescue operations (Aleutian Islands Risk Management Team, 2011).

Mr. Paul Webb, a retired USCG Chief Petty Officer, who now works for the USCG District Office in Juneau as a civilian, is a Search and Rescue specialist. According to Mr. Webb, AIS is used every day by the USCG and is monitored by the agency's Watch Standers. Mr. Webb was unable to produce statistics on the number of times that AIS provided critical information in a search and rescue operation because AIS is so fully integrated into the USCG process. He estimated that the Juneau District Office responds to about 650 vessel emergencies per year. Their first step in initiating a response is to look at the AIS system. He stated that when a vessel is in distress, it helps to have minute by minute information. The reliable AIS system is used to accurately locate USCG vessels, tugs, and Good Samaritan vessels that can aid vessels in distress. For example, AIS was used to provide information to the USCG and emergency response vessels during the December 2010 cargo vessel, Golden Seas, maritime incident where the vessel was disabled and drifting toward Atka Island. Prior to use of the AIS system, the USCG sent out a request for assistance via radio communications and waited for responses to determine what vessels were in the region to provide assistance. The USCG can also locate a vessel that calls the USCG to notify that they are in distress, but it is unable to provide its latitude and longitude (i.e. if the ship loses power) using AIS. AIS can also be used to assist oil spill clean-up operations. Response vessels can be outfitted with AIS and the Incident Command Post can monitor the location of clean-up vessels to ensure that they are optimally positioned to recover spilled oil. The USCG is not planning on building any AIS receiver sites in Alaska and instead relies on the MXAK to provide an AIS system for Alaska (Paul Webb, telephone call with Denise Koch, January 26, 2012).

3.4.1.2. Relevance

The *Aleutian Islands Risk Assessment: Phase A Summary Report* (Aleutian Islands Risk Management Team, 2011), which was funded as part of the *Selendang Ayu* oil spill settlement, and the National Academy of Sciences (NAS) *Risk of Vessel Accidents and Spills in the Aleutian Islands* (NAS, 2008) recommend expansion of AIS in the Aleutians.

The Advisory Panel and Management Team who completed the *Aleutians Islands Risk Assessment: Phase A Summary Report* anticipated that an enhanced vessel monitoring program would directly reduce the risk of drift groundings by increasing situational awareness for vessel operators and the appropriate agents and agencies. This program would also indirectly reduce the risks of collisions and powered grounding by gathering data on vessel movements that can be analyzed in future risk assessments.

The Advisory Panel determined that this risk reduction option is practical, technologically feasible, and readily available, and should be implemented without further delay. Implementation options included the addition of AIS receivers at key locations to expand total coverage of the region.

There are nine AIS stations in the Aleutians region. Despite these nine AIS sites, there are more uncovered than there are covered AIS maritime areas in the Aleutians.

These gaps in vessel tracking coverage include the area where the M/V *Selendang Ayu* oil spill occurred. If there had been expanded AIS coverage in that area, MXAK may have been able to notify the USCG about the vessel distress prior to the USCG notification by the vessel, or it may have helped identify tug locations and reduced emergency response time. The M/V *Selendang Ayu* carried 410,000 gallons of fuel.

However, vessels that travel through the Aleutians can carry up to more than 20 times that amount of fuel (e.g. Tanker *Chembulk Savannah* carries 8,500,000 gallons of fuel), making even larger spills possible.

During the week of January 9, 2012, the Aleutian Island Risk Assessment Management Team recommended the National Fish and Wildlife Foundation (NFWF) allocate funds to the MXAK to expand AIS capabilities in the Aleutians by allocating funding for AIS projects on Adak and Nikolski. MXAK has already installed a new AIS site on Adak with these NFWF funds, which has increased vessel tracking coverage in the area by over 10,000 square miles.

The MXAK is still seeking funding for the following projects:

- Akutan: Harden system and upgrade AIS equipment to increase vessel tracking coverage of Unimak Pass region by approximately 7,500 square miles ($80,000).
- St. George Island: Upgrade AIS site to increase vessel tracking coverage in Bering Sea by approximately 6,000 square miles, closing the gap in coverage offshore of the Aleutian chain and providing early notice of disabled vessels ($75,000).
- Atka: Install a new site at an elevation to extend the range of vessel tracking and provide approximately 15,000 additional square miles of coverage ($85,000).

If all three projects were funded, the vessel tracking coverage would increase by more than 28,000 square miles. The green circles on Figure 3 show the areas that would have increased coverage if the AIS projects listed above were funded. The uncolored areas indicate areas without coverage. The different colors in the “star bursts” represent the coverage from existing AIS stations in the area. Some stations have an overlap in coverage area.

AIS coverage can:

- Validate that vessels are taking lower risk routes that provide greater margin of safety (e.g. safe distance from shore), which allows for more time to respond to casualties and prevent loss of vessel and oil spill.
- Aid in the earlier detection of disabled vessels, leading to a more timely dispatch of assist vessels or other actions that can help prevent a casualty, which in turn can lead to an oil spill.
- Aid in the optimal positioning of oil spill recovery vessels in the event of an oil discharge (e.g. support of NOAA’s newly developed Environmental Response Management Application [ERMA])

MXAK is only seeking capital funds to install or upgrade these AIS sites. MXAK has sufficient funds to operate the AIS sites.

3.4.1.3. Abatement Potential and Cost

Funding the capital costs for new or upgraded AIS sites in the Aleutians would decrease the gaps in AIS coverage. There is a high likelihood that an expanded AIS coverage area could help prevent emergencies or could enable more timely emergency response to a maritime event that could result in a vessel oil spill. The prevention value of AIS might be infrequent, but it would be of high impact.

OASIS researched whether there was a quantitative framework to evaluate the preventative value of AIS. The International Maritime Organization has developed an International Safety Management Code. The recording and analysis of maritime incidents is an integral part of the strategy for improving vessel safety. There are several theories on incident reporting. They include: 1) the iceberg model, where for every accident there are many more near misses; 2) the domino theory, where accidents are caused by a chain of events; and 3) the model where serious and less serious casualties have the same underlying causes. However, there are no exact scientifically proven ratios on the relationship between the number of maritime near-misses and an accident. A European study of the use of incident reporting in the maritime industry cautioned that "quantitative studies based on comparison of these relationships should be avoided" (Vepsalainen, 2010).

Although the precise value of AIS in preventing oils spills could not be calculated, oil spill statistics for the Aleutians provide some indication of what is to be gained from preventing oil spills. Vessels are the largest source of major oil spills (>1,000) in the Aleutians (ADEC, 2007a).

If a new or upgraded AIS site (~$85,000) helped to prevent an accident or helped to more effectively respond to an incident to prevent an average size oil spill (111,479 gallons) in a 23 year period, it would cost $0.76 per gallon of oil spill prevented.

3.4.2. Spill Kits

From 1995 through 2005, there were 145 reported spills at harbors and ports statewide. These spills resulted in a total of 3,223 gallons (ADEC, 2007b).

The new Carl E. Moses Small Boat Harbor has funding for two container vans with oil spill response equipment. The former Port Director indicated that the oil spill response equipment at this harbor in concert with the City's contract with oil spill response contractor, Chadux, would enable the City of Unalaska to respond to large oil spills in city harbors.

The former Port Director did, however, think that it would be helpful to pilot the effectiveness of having spill response sorbent material at the Robert Storrs International Small Boat Harbor to handle oil spills of less than 100 gallons. He indicated that two spill carts with 99-gallon absorbency and two spill kits with 50-gallon absorbency would be useful. Depending upon the usefulness of these kits, the City of Unalaska might like to have spill kits at their other harbors as well (Alvin Osterback, telephone conversation with Denise Koch, August 23, 2011).

Small spill kits are sold by many different manufacturers and are designed with different absorbencies.[17] These carts are contained in weather-resistant containers and are often

[17] Companies that provide spill kits include Supply Line Direct (http://www.supplylinedirect.com/item/spillresponse/spillkitscontrol/kits/oil-onlyspillkitsonwheels/) and DAWG Inc. (http://www.dawginc.com/dawgr-spill-response-cart-oil-only-spill-kit.html)

on wheels with castors. A 99-gallon absorbency spill carts range in price from $850 to $1,350, excluding shipping. A 50- to 65- gallon absorbency spill kit cost from $300 to $400, excluding shipping.

3.4.2.1. Abatement Potential and Cost

Two 99-gallon spill carts and two 65-gallon spill kits would cost approximately $3,500.[18] Shipping would be extra. If all materials in the carts and kits were used, it would absorb 328 gallons of oil for a cost of $10.67 of sorbent per gallon of oil absorbed.

3.4.3. Oil Spill Response and HAZWOPER Training

According to the former Port Director, the City's oil spill response contractor, Chadux, would respond to major oil spills. However, basic oil spill response or hazard awareness training would be useful for City Dock staff that are responsible for effectively cleaning up small oil spills or handling spill response for larger spills until Chadux arrived on scene. A flexible and cost effective video or computer based training program would be most useful for this staff (Alvin Osterback, telephone conversation with Denise Koch, August 23, 2011). A five-part basic "Oil Spill Clean Up Response" on-line training is offered by a company called Mastery.[19] (Similar courses may be offered by other firms.) Each course is only 35 minutes and costs $20 per session with on-line access for 60 days. It would cost $100 per staff member to complete the five part series.

Chadux regional responders are already sufficiently trained in oil spill response and hazardous waste operations and emergency response (HAZWOPER) (John LeClair, Chadux, telephone conversation with Denise Koch, October 24, 2011).

Jamie Sunderland, Director of Public Safety, thought that a HAZWOPER course could be useful for the professional firefighting staff or volunteers (Jamie Sunderland, e-mail to Denise Koch, December 14, 2011). Mr. Sunderland directed OASIS to discuss the matter with Jon Droska, Senior Fire Captain at Unalaska Fire Rescue.

Mr. Droska stated that professional firefighters, who may also respond to an oil spill, already have HAZWOPER training. However, it might be beneficial to provide HAZWOPER training to about 14 volunteer fire fighters, most of whom are City employees (Jon Droska, telephone conversation with Denise Koch, December 20, 2011). Volunteer fire fighters might also be called to assist with hazardous material or oil spills. Mr. Droska wanted to ensure that any HAZWOPER course taken by the volunteer fire fighting staff was geared toward emergency response.[20] He also wanted to determine whether a 24-hour versus 40-hour HAZWOPER training course would be best suited to the group. OASIS provided Mr. Droska with the United States Department of Labor Occupational Safety & Health Administration (OSHA) training decision flow charts to assist him with his determination (OSHA, 2001). The OSHA guidance varies based upon the workers will be acting in an emergency response capacity or be responsible for

[18] [99 gallon carts ($1,350 * 2) + 65 gallon spill kits ($400 * 2)] = $3,500
[19] http://www.mastery.com/courses.php
[20] Mr. Droska was very concerned that HAZWOPER courses were geared toward personnel who work in hazardous materials facilities versus incident response.

post-emergency clean-up. An active emergency responder would need 24-hour HAZWOPER training. A post-emergency spill site worker would need 40-hour HAZWOPER training.

Chadux will hold a 24-hour HAZWOPER training course in Unalaska on April 23 – 25, 2012. A hands-on oil spill response drill will be conducted on April 26, 2012. Participants in the course may participate in the drill at no extra cost. The cost to attend the course is approximately $300 per student; prices vary based upon the number of attendees (Chris Burns, telephone call to Denise Koch, April 2, 2012). If fourteen volunteer fire fighters were to attend it cost a total of $4,200. Chadux has not yet scheduled the next 24-hour HAZWOPER course in Unalaska, but the costs would be similar.

If the City were to request that Chadux schedule a 24-hour HAZWOPER course in Unalaska at a custom date just for the volunteer firefighters, Chadux estimated that it would cost:

Travel and accommodations	$2,200
Instructor	$3,000
+ Classroom rental	$ 300
Total	$5,500

The quote includes the cost for two instructors and all printed material (e.g. HAZWOPER manual, Spill Tactics for Alaskan Responders manual, and ERG guide). If fourteen volunteer firefighters attended, the per student cost would be about $400. The last day of the 24-hour HAZWOPER course covers the material necessary for the annual 8-hour HAZWOPER refresher. City professional firefighters could join the course on the last day to satisfy their HAZWOPER refresher requirement (Chris Burns, Chadux Preparedness Supervisor, e-mail communication with Denise Koch, December 2, 2011).

Penco (Pacific Environmental Corporation) and the Alaska Abatement Corporation no longer offer HAZWOPER training in Dutch Harbor.

There are several companies[21] that offer 24-hour HAZWOPER on-line training for a per student cost that ranges between $200 and $250.

3.4.3.1. Abatement Potential and Cost

The benefit of this project is to increase the number of available responders for an oil or hazardous waste incident in the local Unalaska area. Chadux is the only company that offers HAZWOPER training in Unalaska. If fourteen local volunteer fire fighters attended a scheduled HAZWOPER course ($300 per person) offered by Chadux, the training would cost $4,200.

[21] http://www.oshacampus.com/ ; http://www.safetyunlimited.com/ ; http://www.24hourhazwopertrainingcourse.com/

4. PROJECT NOT LIKELY TO BE USEFUL

4.1. Additional Hazardous Waste Collection Event

During a trip taken by the Parties to Unalaska, it was suggested that the Parties sponsor an additional municipal hazardous waste collection event per year.

The City of Unalaska sponsors one, two-day hazardous waste collection event per year. The waste is collected at the Solid Waste Baler facility. Only residential hazardous waste is collected at this event. Each resident may dispose of up to 220 pounds of waste free of charge. Businesses and agencies pay the City's hazardous waste contractor for disposal based upon the type and amount of waste. The collected items are loaded onto a 20-foot or 40-foot container and are barged to Seattle for disposal in Washington. The cost for collecting, processing, transporting, and disposing of the hazardous waste for the annual event costs is about $30,000.

Bob Miner, Unalaska landfill supervisor, indicated that the City could have used an additional hazardous waste cleanup day a few years ago. However, the municipal hazardous waste collection is currently adequate for the level of resident production (Bob Miner, e-mail to Denise Koch, July 27, 2011).

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5. DISCUSSION AND NEXT STEPS

The purpose of this document is to summarize the major oil inputs into the Greater Unalaska Bay area as well as the logistics, costs, and abatement value of different projects that have interested the Parties. OASIS has presented most of the information contained in this report to the Parties in teleconferences that occurred between May 2010 and January 2012. The research to date has been summarized here so that the Parties may more effectively compare and contrast the projects and pursue the projects of most interest to them. The Trustees and Responsible Party may have preferences for different projects.

A spreadsheet the summarizes the major oil inputs into the Greater Unalaska Bay area, oil removal estimates for different projects, and a comparison of project costs is found in Appendix G. A total cost for each type of project is presented. When feasible, the cost per gallon of oil pollution prevented or removed is also calculated for a project (e.g. creosote treated wood piling wrapping or replacement, sorbent distribution, FORS, AIS, and spill kits). However, some projects such as HAZWOPER or oil spill response training and a used oil building at the Robert Storrs International Small Boat Harbor do not lend themselves to this cost per gallon calculation.

The costs contained in this report are preliminary. They are based upon communications with contractors and vendors and subsequent general quotations. Assumptions such as the number of creosote treated pilings to be wrapped or the volume of sorbent material to be distributed were made in order to generate initial costs. Specific details and parameters would need to be provided to contractors and vendors in order for them to provide more specific cost quotes. This is particularly important for construction related projects such as wrapping or replacing creosote treated pilings and the construction of used oil buildings.

OASIS received limited input on abatement projects from representatives of the City of Unalaska. Most of the abatement projects would require the involvement or approval of the City of Unalaska Port Department. Although former Port Director, Mr. Alvin Osterback, provided valuable input about the potential projects, the Port Director position is currently vacant. It will be critical to solicit input on many of the projects with the new Port Director.

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FIGURES

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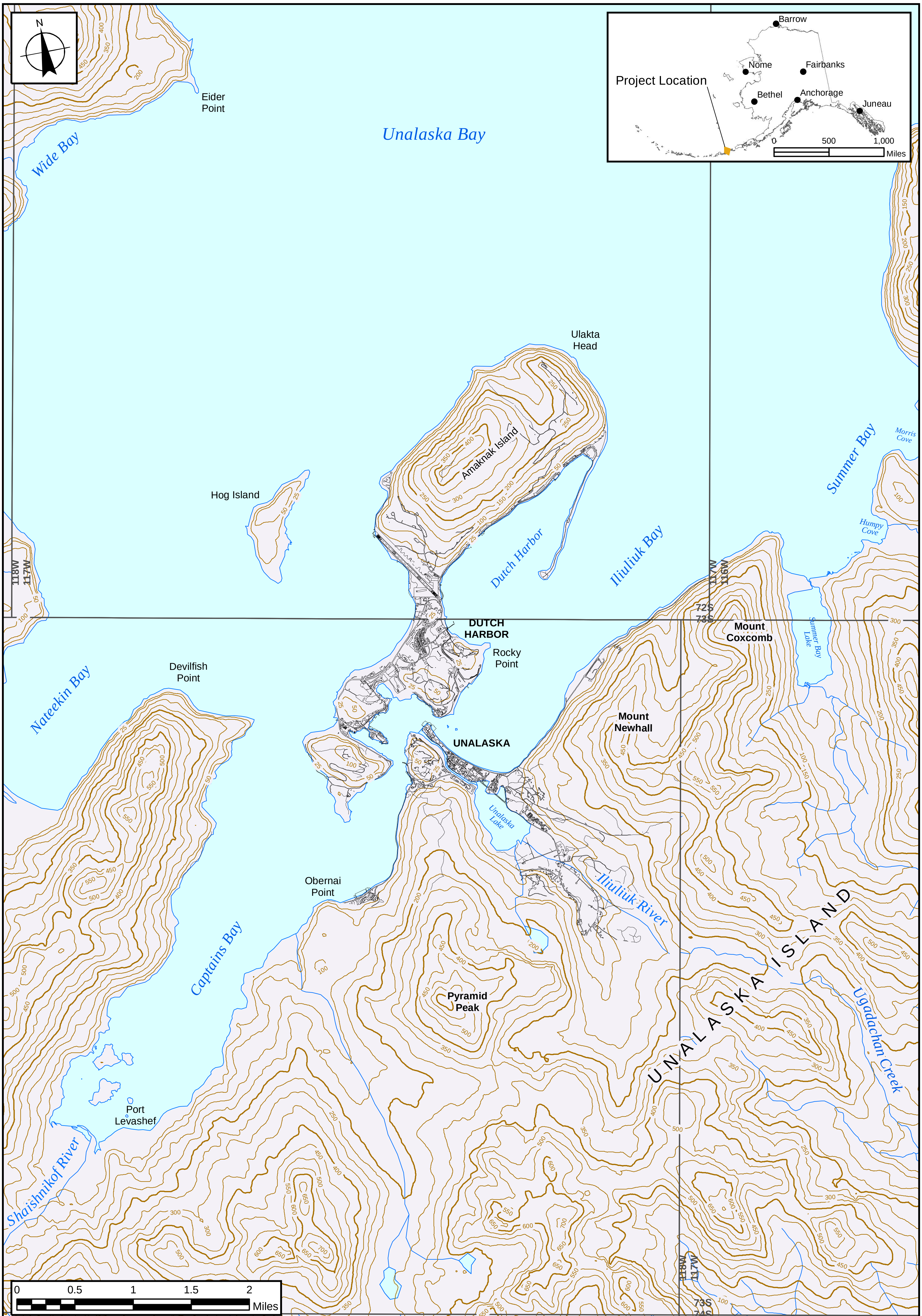
Figure 1: Greater Unalaska Bay Project Focus Map



GREATER UNALASKA BAY OIL ABATEMENT PROJECT
PROJECT FOCUS MAP

EVALUATION OF OIL REDUCTION PROJECTS
NATURAL RESOURCE DAMAGE ASSESSMENT AND RESTORATION
Unalaska, Alaska

DATE: MAR. 2012
CHKD: D.K.
DRWN: A.V.K.
PROJ. No.: 0147086

oasis ENVIRONMENTAL
825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880

FIGURE 1

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oasis ENVIRONMENTAL

DATE: MAR 2012
CHKD: D.K.
DRWN: A.V.K.
PROJ. No.: 0147086

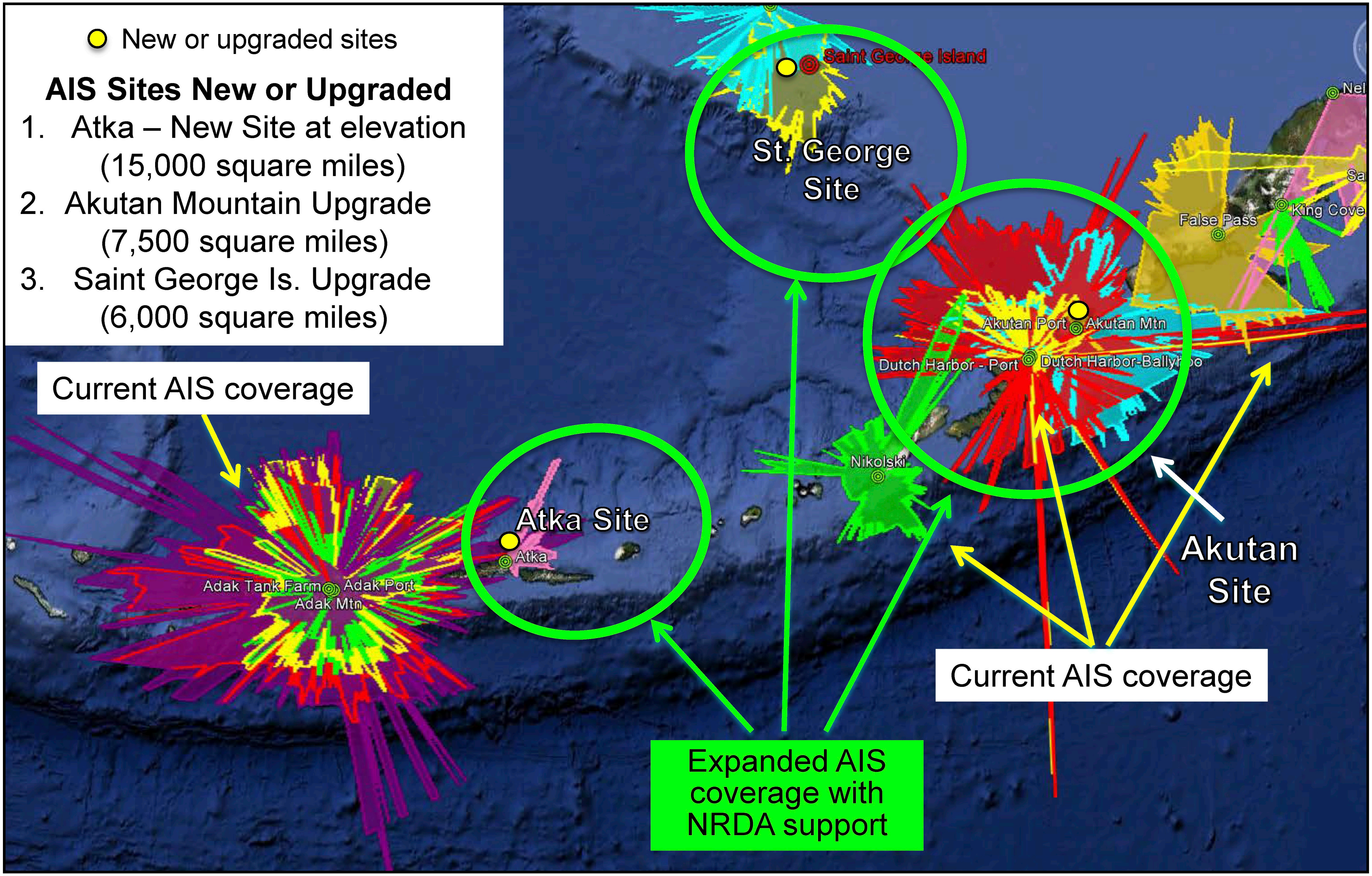
825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880

CARL E. MOSES BOAT HARBOR
WASTE OIL BUILDING

FEASIBILITY STUDY
NATURAL RESOURCE DAMAGE ASSESSMENT AND RESTORATION
Unalaska, Alaska

FIGURE **2**

SOURCE: P|N|D Engineers, Inc.



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oasis ENVIRONMENTAL

DATE: MAR. 2012
CHKD: D.K.
DRWN: A.V.K.
PROJ. No.: 0147086
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PROPSED AIS EXPANDED COVERAGE IN THE ALEUTIANS

FEASIBILITY STUDY
NATURAL RESOURCE DAMAGE ASSESSMENT AND RESTORATION
Unalaska, Alaska

FIGURE 3

SOURCE: Marine Exchange of Alaska - AIS Expansion in the Aleutians - NDRA Funds-Mar 2012.ppt, Slide 5

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APPENDIX A

Major Vessel Oil Spills in the Aleutians from 1981 to 2004

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Major Vessel Oil Spills in the Aleutians from 1981 to 2004

Spill Date	Location	Spill Name	Facility Type	Product	Gallons
12/26/1988	East of Shumagin Islands	Tank Barge 283	Vessel	Diesel	2,041,662
12/8/2004	Unalaska Island, Skan Bay	M/V Selendang Ayu	Vessel	IFO 380, Diesel	335,732
3/5/1981	Attu Island	M/V Dae Rim	Vessel	Diesel	109,998
1/17/1989	Amchitka Island	T/B Foss 256	Vessel	Diesel	83,958
1/11/1989	Unalaska Island	M/V Chil Bo San	Vessel	Diesel	60,984
11/26/1997	Unalaska, Summer Bay	M/V Kuroshima	Vessel	Bunker	38,976
2/1/1988	Nikolski	F/V Alaska Star	Vessel	Diesel	35,952
12/10/1988	Akun Island	M/V Aoyagi Maru	Vessel	Diesel	31,962
2/27/1989	Dutch Harbor	M/V Swallow	Vessel	Diesel	29,988
2/17/1988	Yunalaska Island	F/V Captain Billy	Vessel	Diesel	16,002
12/3/1988	Shemya Island	F/V Opty	Vessel	Diesel	16,002
7/22/1995	Seguam Island	F/V Northern Wind	Vessel	Diesel	14,994
3/8/1987	Uluak Island	F/V Birgit	Vessel	Diesel	12,012
11/3/1988	Atka Island	F/V City of Seattle	Vessel	Diesel	12,012
5/6/1987	Uliaga Island	F/V Tae Woong	Vessel	Diesel	10,500
2/8/1991	Unalaska, Reese Bay	F/V Skagit Eagle	Vessel	Diesel	9,954
5/8/1999	Unamak Island	F/V Controller Bay	Vessel	Diesel	7,980
4/12/1993	Umnak Island	F/V Phoenix	Vessel	Diesel	6,972
10/15/1989	Chuginadak Island	F/V Polar Command	Vessel	Diesel	4,998
2/20/1989	St. Paul Island	M/V Yard Arm Knot	Vessel	Diesel	3,500
12/8/1986	St. Paul Island	F/V Jamie Lynn	Vessel	Diesel	3,000
8/13/1991	Atka Island	F/V Greenhope	Vessel	Diesel	2,982
5/11/2001	Cold Bay	F/V Kristen	Vessel	Diesel	2,982
5/11/1987	North of Unimak Pass	Tank Vessel	Vessel	Diesel	2,674
10/24/1996	Tanaga Island	F/V Rebecca B	Vessel	Diesel	1,512
2/19/1997	Akun Island	F/V Lisa Jo	Vessel	Diesel	1,176

12,012	Median Spill Size
111,479	Average Spill Size
2,898,464	Total volume of marine spills
2,041,662	Max spill size
1,176	Min spill size

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APPENDIX B

NewFields M/V *Selendang Ayu* Oil to Piling Calculation Spreadsheets

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M/V *Selendang Ayu* Oil to Piling Calculations
PAH and BaP Equivalents in *Selendang Ayu* Oil

Client ID	SA Seattle - RMG 35	SA Seattle - IF 038	Maritec 110803	4 Port IFO Tank	PST-5A/B	PST8-F
Lab ID	0412115-05	0412115-06	0707139-01	0412137-01	0501019-01	0501023-03
Matrix	Oil	Oil	Oil	Oil	Oil	Oil
Reference Method	Modified 8270C	Modified 8270C	Modified 8270C	Modified 8270C	Modified 8270C	Modified 8270C
Batch ID	SO122004B23	SO122004B23	SO073107B04	SO122904B18	SO011105B08	SO011105B07
Date Collected	11/22/2004	11/23/2004	9/20/2004	12/19/2004	1/2/2005	1/5/2005
Date Received	12/20/2004	12/20/2004	7/24/2007	12/28/2004	1/7/2005	1/10/2005
Date Prepped	12/20/2004	12/20/2004	7/31/2007	12/29/2004	1/12/2005	1/12/2005
Date Analyzed	12/21/2004	12/21/2004	8/16/2007	12/30/2004	1/19/2005	1/17/2005
Sample Size (wet)	0.10	0.11	0.109	0.113	0.1055	0.1071
% Solid	100	100	100	100	100	100
File ID	P21108.D	P21110.D	A24872.D	P21311.D	P11182.D	P11150.D
Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg

Analytes	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL
cis/trans-Decalin	63	2	61	2	21	1.8	57	1.8	37	1.9	360	1.9
C1-Decalins	160	2	150	2	44	1.8	140	1.8	87	1.9	590	1.9
C2-Decalins	230	2	220	2	71	1.8	210	1.8	110	1.9	610	1.9
C3-Decalins	170	2	160	2	59	1.8	150	1.8	84	1.9	360	1.9
C4-Decalins	250	2	260	2	93	1.8	250	1.8	130	1.9	570	1.9
Benzothiophene	230	2	220	2	17	1.8	210	1.8	120	1.9	75	1.9
C1-Benzo(b)thiophenes	540	2	520	2	130	1.8	510	1.8	300	1.9	190	1.9
C2-Benzo(b)thiophenes	690	2	660	2	430	1.8	680	1.8	370	1.9	230	1.9
C3-Benzo(b)thiophenes	560	2	540	2	690	1.8	580	1.8	290	1.9	320	1.9
C4-Benzo(b)thiophenes	350	2	340	2	750	1.8	390	1.8	160	1.9	260	1.9
Naphthalene	1800	2	1700	2	58	1.8	1700	1.8	1000	1.9	920	1.9
C1-Naphthalenes	4500 D	10	4500 D	9	200	1.8	4900 D	8.8	2400 D	9.5	2800 D	9.3
C2-Naphthalenes	5700	2	6000 D	9	480	1.8	6600 D	8.8	3000	1.9	3700	1.9
C3-Naphthalenes	4400	2	4400	2	770	1.8	4600	1.8	2200	1.9	2900	1.9
C4-Naphthalenes	2200	2	2200	2	680	1.8	2400	1.8	980	1.9	1500	1.9
Biphenyl	120	2	120	2	29	1.8	120	1.8	69	1.9	230	1.9
Dibenzofuran	100	2	98	2	11	1.8	99	1.8	52	1.9	62	1.9
Acenaphthylene	8.8	2	9.2	2	1.7 J	1.8	7.3	1.8	3.0	1.9	13	1.9
Acenaphthene	160	2	160	2	22	1.8	170	1.8	89	1.9	58	1.9
Fluorene	230	2	230	2	53	1.8	230	1.8	160	1.9	190	1.9
C1-Fluorenes	580	2	610	2	190	1.8	630	1.8	360	1.9	430	1.9
C2-Fluorenes	960	2	990	2	390	1.8	1000	1.8	540	1.9	680	1.9
C3-Fluorenes	1100	2	1100	2	480	1.8	1100	1.8	560	1.9	580	1.9
Anthracene	93	2	92	2	32	1.8	97	1.8	62	1.9	27	1.9
Phenanthrene	770	2	780	2	180	1.8	830	1.8	540	1.9	440	1.9
C1-Phenanthrenes/Anthracenes	2500	2	2500	2	600	1.8	2700	1.8	1800	1.9	1100	1.9
C2-Phenanthrenes/Anthracenes	3400	2	3300	2	890	1.8	3500	1.8	2100	1.9	1100	1.9
C3-Phenanthrenes/Anthracenes	2300	2	2200	2	670	1.8	2200	1.8	1200	1.9	660	1.9
C4-Phenanthrenes/Anthracenes	830	2	790	2	440	1.8	740	1.8	460	1.9	290	1.9
Retene	U	2	U	2	U	1.8	U	1.8	U	1.9	U	1.9
Dibenzothiophene	360	2	340	2	100	1.8	350	1.8	210	1.9	230	1.9
C1-Dibenzothiophenes	1000	2	1000	2	590	1.8	1000	1.8	620	1.9	750	1.9
C2-Dibenzothiophenes	1800	2	1700	2	1300	1.8	1800	1.8	1000	1.9	1100	1.9
C3-Dibenzothiophenes	1500	2	1400	2	1600	1.8	1500	1.8	820	1.9	860	1.9
C4-Dibenzothiophenes	640	2	610	2	1200	1.8	660	1.8	340	1.9	410	1.9
Benzo(b)fluorene	33	2	31	2	13	1.8	30	1.8	19	1.9	7.9	1.9
Fluoranthene	48	2	47	2	9	1.8	48	1.8	27	1.9	14	1.9
Pyrene	290	2	280	2	90	1.8	290	1.8	190	1.9	70	1.9
C1-Fluoranthenes/Pyrenes	740	2	700	2	280	1.8	690	1.8	420	1.9	210	1.9

M/V *Selendang Ayu* Oil to Piling Calculations
PAH and BaP Equivalents in *Selendang Ayu* Oil

Client ID	SA Seattle - RMG 35		SA Seattle - IF 038		Maritec 110803		4 Port IFO Tank		PST-5A/B		PST8-F	
Lab ID	0412115-05		0412115-06		0707139-01		0412137-01		0501019-01		0501023-03	
Matrix	Oil		Oil		Oil		Oil		Oil		Oil	
Reference Method	Modified 8270C		Modified 8270C		Modified 8270C		Modified 8270C		Modified 8270C		Modified 8270C	
Batch ID	SO122004B23		SO122004B23		SO073107B04		SO122904B18		SO011105B08		SO011105B07	
Date Collected	11/22/2004		11/23/2004		9/20/2004		12/19/2004		1/2/2005		1/5/2005	
Date Received	12/20/2004		12/20/2004		7/24/2007		12/28/2004		1/7/2005		1/10/2005	
Date Prepped	12/20/2004		12/20/2004		7/31/2007		12/29/2004		1/12/2005		1/12/2005	
Date Analyzed	12/21/2004		12/21/2004		8/16/2007		12/30/2004		1/19/2005		1/17/2005	
Sample Size (wet)	0.10		0.11		0.109		0.113		0.1055		0.1071	
% Solid	100		100		100		100		100		100	
File ID	P21108.D		P21110.D		A24872.D		P21311.D		P11182.D		P11150.D	
Units	mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
Analytes	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL
C2-Fluoranthenes/Pyrenes	730	2	700	2	360	1.8	700	1.8	400	1.9	230	1.9
C3-Fluoranthenes/Pyrenes	440	2	420	2	380	1.8	410	1.8	260	1.9	140	1.9
C4-Fluoranthenes/Pyrenes	160	2	150	2	330	1.8	160	1.8	87	1.9	42	1.9
Naphthobenzothiophenes	90	2	86	2	120	1.8	86	1.8	54	1.9	29	1.9
C1-Naphthobenzothiophenes	190	2	180	2	540	1.8	210	1.8	120	1.9	57	1.9
C2-Naphthobenzothiophenes	200	2	190	2	870	1.8	200	1.8	120	1.9	48	1.9
C3-Naphthobenzothiophenes	130	2	120	2	800	1.8	130	1.8	80	1.9	25	1.9
C4-Naphthobenzothiophenes	63	2	59	2	640	1.8	65	1.8	51	1.9	15	1.9
Benz[a]anthracene	48	2	47	2	14	1.8	46	1.8	26	1.9	9.2	1.9
Chrysene/Triphenylene	96	2	97	2	44	1.8	94	1.8	52	1.9	32	1.9
C1-Chrysenes	240	2	240	2	140	1.8	220	1.8	130	1.9	44	1.9
C2-Chrysenes	230	2	240	2	210	1.8	220	1.8	140	1.9	32	1.9
C3-Chrysenes	180	2	180	2	260	1.8	180	1.8	110	1.9	20	1.9
C4-Chrysenes	74	2	70	2	190	1.8	71	1.8	42	1.9	9.6	1.9
Benzo[b]fluoranthene	8.1	2	8.8	2	5.2	1.8	7.9	1.8	4.4	1.9	0.85 J	1.9
Benzo[k]fluoranthene	2 J	2	2.6	2	1.6 J	1.8	1.7 J	1.8	1.1 J	1.9	0.16 J	1.9
Benzo[a]fluoranthene	0.89 J	2	0.96 J	2	U	1.8	0.81 J	1.8	0.70 J	1.9	U	1.9
Benzo[e]pyrene	16	2	16	2	22	1.8	16	1.8	9.1	1.9	1.7 J	1.9
Benzo[a]pyrene	14	2	13	2	15	1.8	13	1.8	7.8	1.9	0.80 J	1.9
Perylene	6.4	2	6.1	2	5.1	1.8	5.6	1.8	3.1	1.9	0.55 J	1.9
Indeno[1,2,3-cd]pyrene	2.6	2	2	2	2.3	1.8	1.9	1.8	1.3 J	1.9	0.40 J	1.9
Dibenz[a,h]anthracene	2.3	2	2.3	2	2.8	1.8	2.2	1.8	1.7 J	1.9	0.60 J	1.9
Benzo[g,h,i]perylene	15	2	15	2	12	1.8	15	1.8	8.6	1.9	0.59 J	1.9
C23 Tricyclic Terpane (T4)	48	2.0	47	1.8	29	1.8	48	1.8	26	1.9	26	1.9
C24 Tricyclic Terpane (T5)	17	2.0	16	1.8	6.2	1.8	16	1.8	8.6	1.9	10	1.9
C25 Tricyclic Terpane (T6)	13	2.0	13	1.8	9.0	1.8	14	1.8	7.9	1.9	11	1.9
C24 Tetracyclic Terpane (T6a)	4.2	2.0	4.2	1.8	16	1.8	5.1	1.8	3.4	1.9	8.1	1.9
C26 Tricyclic Terpane-22S (T6b)	4.2	2.0	4.6	1.8	U	1.8	4.1	1.8	2.2	1.9	2.8	1.9
C26 Tricyclic Terpane-22R (T6c)	4.6	2.0	4.6	1.8	2.9	1.8	4.5	1.8	2.2	1.9	2.8	1.9
C28 Tricyclic Terpane-22S (T7)	2.6	2.0	2.9	1.8	U	1.8	2.7	1.8	1.2 J	1.9	U	1.9
C28 Tricyclic Terpane-22R (T8)	2.7	2.0	3.2	1.8	U	1.8	3.1	1.8	1.6 J	1.9	U	1.9
C29 Tricyclic Terpane-22S (T9)	2.8	2.0	2.5	1.8	U	1.8	2.9	1.8	2.0	1.9	U	1.9
C29 Tricyclic Terpane-22R (T10)	2.0	2.0	2.5	1.8	U	1.8	2.4	1.8	1.8 J	1.9	U	1.9
18a-22,29,30-Trisnorneohopane-TS (T11)	4.5	2.0	5.6	1.8	29	1.8	7.0	1.8	3.6	1.9	6.1	1.9
17a(H)-22,29,30-Trisnorhopane-TM (T12)	5.3	2.0	5.9	1.8	55	1.8	8.7	1.8	4.3	1.9	4.5	1.9
17a/b,21b/a 28,30-Bisnorhopane (T14a)	2.1	2.0	2.6	1.8	U	1.8	1.8	1.8	U	1.9	U	1.9
17a(H),21b(H)-25-Norhopane (T14b)	4.2	2.0	4.0	1.8	U	1.8	2.6	1.8	U	1.9	U	1.9
30-Norhopane (T15)	18	2.0	18	1.8	150	1.8	25	1.8	13	1.9	12	1.9

M/V *Selendang Ayu* Oil to Piling Calculations
PAH and BaP Equivalents in *Selendang Ayu* Oil

Client ID	SA Seattle - RMG 35		SA Seattle - IF 038		Maritec 110803		4 Port IFO Tank		PST-5A/B		PST8-F	
Lab ID	0412115-05		0412115-06		0707139-01		0412137-01		0501019-01		0501023-03	
Matrix	Oil		Oil		Oil		Oil		Oil		Oil	
Reference Method	Modified 8270C		Modified 8270C		Modified 8270C		Modified 8270C		Modified 8270C		Modified 8270C	
Batch ID	SO122004B23		SO122004B23		SO073107B04		SO122904B18		SO011105B08		SO011105B07	
Date Collected	11/22/2004		11/23/2004		9/20/2004		12/19/2004		1/2/2005		1/5/2005	
Date Received	12/20/2004		12/20/2004		7/24/2007		12/28/2004		1/7/2005		1/10/2005	
Date Prepped	12/20/2004		12/20/2004		7/31/2007		12/29/2004		1/12/2005		1/12/2005	
Date Analyzed	12/21/2004		12/21/2004		8/16/2007		12/30/2004		1/19/2005		1/17/2005	
Sample Size (wet)	0.10		0.11		0.109		0.113		0.1055		0.1071	
% Solid	100		100		100		100		100		100	
File ID	P21108.D		P21110.D		A24872.D		P21311.D		P11182.D		P11150.D	
Units	mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
Analytes	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL
18a(H)-30-Norneohopane-C29Ts (T16)	5.2	2.0	5.2	1.8	26	1.8	6.3	1.8	3.1	1.9	2.5	1.9
17a(H)-Diahopane (X)	1.8 J	2.0	2.3	1.8	U	1.8	1.4 J	1.8	U	1.9	U	1.9
30-Normoretane (T17)	3.0	2.0	2.2	1.8	17	1.8	1.8	1.8	U	1.9	U	1.9
18a(H)&18b(H)-Oleananes (T18)	U	2.0	U	1.8	U	1.8	U	1.8	U	1.9	3.2	1.9
Hopane (T19)	32	2.0	29	1.8	150	1.8	36	1.8	18	1.9	10	1.9
Moretane (T20)	2.0	2.0	2.0	1.8	14	1.8	2.6	1.8	U	1.9	U	1.9
30-Homohopane-22S (T21)	15	2.0	15	1.8	78	1.8	16	1.8	10	1.9	4.3	1.9
30-Homohopane-22R (T22)	10	2.0	9.5	1.8	60	1.8	14	1.8	7.7	1.9	2.9	1.9
30,31-Bishomohopane-22S (T26)	11	2.0	10	1.8	48	1.8	12	1.8	8.5	1.9	U	1.9
30,31-Bishomohopane-22R (T27)	7.6	2.0	7.7	1.8	38	1.8	9.4	1.8	5.2	1.9	U	1.9
30,31-Trishomohopane-22S (T30)	8.5	2.0	7.8	1.8	44	1.8	9.0	1.8	8.0	1.9	U	1.9
30,31-Trishomohopane-22R (T31)	6.0	2.0	5.1	1.8	26	1.8	5.5	1.8	3.6	1.9	U	1.9
Tetrakishomohopane-22S (T32)	5.8	2.0	7.2	1.8	32	1.8	6.4	1.8	5.3	1.9	U	1.9
Tetrakishomohopane-22R (T33)	4.8	2.0	4.5	1.8	22	1.8	4.8	1.8	U	1.9	U	1.9
Pentakishomohopane-22S (T34)	5.7	2.0	6.8	1.8	31	1.8	6.5	1.8	5.9	1.9	U	1.9
Pentakishomohopane-22R (T35)	3.2	2.0	3.7	1.8	24	1.8	3.6	1.8	U	1.9	U	1.9
13b(H),17a(H)-20S-Diacholestane (S4)	8.2	2.0	8.5	1.8	20	1.8	7.5	1.8	5.5	1.9	8.3	1.9
13b(H),17a(H)-20R-Diacholestane (S5)	4.4	2.0	5.7	1.8	U	1.8	5.3	1.8	4.0	1.9	4.2	1.9
13b,17a-20S-Methyldiacholestane (S8)	2.4	2.0	3.4	1.8	U	1.8	3.4	1.8	1.9	1.9	2.2	1.9
14a(H),17a(H)-20S-Cholestane (S12)	3.2	2.0	4.8	1.8	4.9	1.8	4.0	1.8	2.3	1.9	2.2	1.9
14a(H),17a(H)-20R-Cholestane (S17)	9.2	2.0	9.8	1.8	27	1.8	13	1.8	7.6	1.9	5.9	1.9
13b,17a-20R-Ethyldiacholestane (S18)	2.6	2.0	1.9	1.8	U	1.8	2.6	1.8	1.6 J	1.9	U	1.9
13a,17b-20S-Ethyldiacholestane (S19)	0.55 J	2.0	1.0 J	1.8	U	1.8	U	1.8	U	1.9	U	1.9
14a,17a-20S-Methylcholestane (S20)	1.6 J	2.0	2.0	1.8	6	1.8	3.3	1.8	U	1.9	U	1.9
14a,17a-20R-Methylcholestane (S24)	4.8	2.0	5.5	1.8	U	1.8	4.8	1.8	2.6	1.9	1.4 J	1.9
14a(H),17a(H)-20S-Ethylcholestane (S25)	7.0	2.0	7.9	1.8	34	1.8	8.1	1.8	5.3	1.9	2.9	1.9
14a(H),17a(H)-20R-Ethylcholestane (S28)	6.5	2.0	5.4	1.8	24	1.8	6.4	1.8	5.5	1.9	2.2	1.9
14b(H),17b(H)-20R-Cholestane (S14)	5.9	2.0	5.7	1.8	20	1.8	5.4	1.8	3.6	1.9	5.2	1.9
14b(H),17b(H)-20S-Cholestane (S15)	5.1	2.0	5.4	1.8	16	1.8	5.7	1.8	3.5	1.9	4.8	1.9
14b,17b-20R-Methylcholestane (S22)	4.3	2.0	5.2	1.8	16	1.8	6.2	1.8	3.8	1.9	3.6	1.9
14b,17b-20S-Methylcholestane (S23)	5.0	2.0	5.3	1.8	18	1.8	5.4	1.8	2.8	1.9	2.2	1.9
14b(H),17b(H)-20R-Ethylcholestane (S26)	10	2.0	10	1.8	33	1.8	10	1.8	6.7	1.9	4.8	1.9
14b(H),17b(H)-20S-Ethylcholestane (S27)	6.7	2.0	6.2	1.8	23	1.8	8.1	1.8	4.4	1.9	3.4	1.9
Client ID	SA Seattle - RMG 35		SA Seattle - IF 038		Maritec 110803		4 Port IFO Tank		PST-5A/B		PST8-F	
Lab ID	0412115-05		0412115-06		0707139-01		0412137-01		0501019-01		0501023-03	
D2/P2	0.529		0.515		1.461		0.514		0.476		1.000	
D3/P3	0.652		0.636		2.388		0.682		0.683		1.303	
TM/TS	1.18		1.05		1.90		1.24		1.19		0.74	
TPAH	41101		40733		16323		42847		22931		22070	

M/V *Selendang Ayu* Oil to Piling Calculations
PAH and BaP Equivalents in *Selendang Ayu* Oil

Client ID	SA Seattle - RMG 35		SA Seattle - IF 038		Maritec 110803		4 Port IFO Tank		PST-5A/B		PST8-F	
Lab ID	0412115-05		0412115-06		0707139-01		0412137-01		0501019-01		0501023-03	
Matrix	Oil		Oil		Oil		Oil		Oil		Oil	
Reference Method	Modified 8270C		Modified 8270C		Modified 8270C		Modified 8270C		Modified 8270C		Modified 8270C	
Batch ID	SO122004B23		SO122004B23		SO073107B04		SO122904B18		SO011105B08		SO011105B07	
Date Collected	11/22/2004		11/23/2004		9/20/2004		12/19/2004		1/2/2005		1/5/2005	
Date Received	12/20/2004		12/20/2004		7/24/2007		12/28/2004		1/7/2005		1/10/2005	
Date Prepped	12/20/2004		12/20/2004		7/31/2007		12/29/2004		1/12/2005		1/12/2005	
Date Analyzed	12/21/2004		12/21/2004		8/16/2007		12/30/2004		1/19/2005		1/17/2005	
Sample Size (wet)	0.10		0.11		0.109		0.113		0.1055		0.1071	
% Solid	100		100		100		100		100		100	
File ID	P21108.D		P21110.D		A24872.D		P21311.D		P11182.D		P11150.D	
Units	mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
Analytes	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL	Result	SSRL
TPAH No S Compounds	35095		35017		8550		36816		19497		18538	
EPAPAH 16	3588		3486		542		3554		2174		1777	
BAP Equivalents	19.986		**18.903**		17.21		18.691		11.033		1.8786	
Total BAP EQ Conc	**171**		**170**		**82**		165		93		43	

BaP equivalents = (0.1) benzo(a)anthracene + (1.0)BaP + (0.1)benzo(b)flouranthene + (0.01) benzo(k)flouranthene + (0.001)chrysene + (0.1) ideno(1,2,3cd)pyrene.

M/V Selendang Ayu Oil to Piling Calculations
PAH and BaP Equivalents in Creosote Treated Piling

Abbrev	Analytes	Coal Tar Oil Chem Service Measured Concentration mg/kg	Coal Tar Oil Chem Service Units Conversion mg/lb	Marine Piling Southern Pine CS250-62 @ 25 lbs/ft^3 mg/ft^3	Marine Piling Douglas Fir CS249-62 @ 20 lbs/ft^3 mg/ft^3	Moderate Hazard Marine Piling Douglas Fir TT-C-645 @ 17 lbs/ft^3 mg/ft^3	Moderate Hazard Marine Piling Southern Pine TT-C-650 @ 20 lbs/ft^3 mg/ft^3	Limnoria Hazard Marine Piling Douglas Fir TT-C-645 @ 20 lbs/ft^3 mg/ft^3	Limnoria Hazard Marine Piling Southern Pine TT-C-650 @ 25 lbs/ft^3 mg/ft^3	Minimum Marine Piling PAH Inventory mg/ft^3	Maximum Marine Piling PAH Inventory mg/ft^3	Average Marine Piling PAH Inventory mg/ft^3
N0	Naphthalene *	59,000	26,762	669,049	535,239	454,953	535,239	535,239	669,049	454,953	669,049	566,461
N1	C1-Naphthalenes	9,400	4,264	106,594	85,275	72,484	85,275	85,275	106,594	72,484	106,594	90,250
N2	C2-Naphthalenes	3,700	1,678	41,957	33,566	28,531	33,566	33,566	41,957	28,531	41,957	35,524
N3	C3-Naphthalenes	1,200	544	13,608	10,886	9,253	10,886	10,886	13,608	9,253	13,608	11,521
N4	C4-Naphthalenes	330	150	3,742	2,994	2,545	2,994	2,994	3,742	2,545	3,742	3,168
B	Biphenyl	1,700	771	19,278	15,422	13,109	15,422	15,422	19,278	13,109	19,278	16,322
DF	Dibenzofuran	6,200	2,812	70,307	56,245	47,809	56,245	56,245	70,307	47,809	70,307	59,526
AY	Acenaphthylene *	6,400	2,903	72,575	58,060	49,351	58,060	58,060	72,575	49,351	72,575	61,447
AE	Acenaphthene *	1,200	544	13,608	10,886	9,253	10,886	10,886	13,608	9,253	13,608	11,521
F0	Fluorene *	8,400	3,810	95,254	76,204	64,773	76,204	76,204	95,254	64,773	95,254	80,649
F1	C1-Fluorenes	1,200	544	13,608	10,886	9,253	10,886	10,886	13,608	9,253	13,608	11,521
F2	C2-Fluorenes	500	227	5,670	4,536	3,856	4,536	4,536	5,670	3,856	5,670	4,801
F3	C3-Fluorenes	280	127	3,175	2,540	2,159	2,540	2,540	3,175	2,159	3,175	2,688
A0	Anthracene *	8,600	3,901	97,522	78,018	66,315	78,018	78,018	97,522	66,315	97,522	82,569
P0	Phenanthrene *	24,000	10,886	272,155	217,724	185,066	217,724	217,724	272,155	185,066	272,155	230,425
PA1	C1-Phenanthrenes/Anthracenes	5,800	2,631	65,771	52,617	44,724	52,617	52,617	65,771	44,724	65,771	55,686
PA2	C2-Phenanthrenes/Anthracenes	1,900	862	21,546	17,237	14,651	17,237	17,237	21,546	14,651	21,546	18,242
PA3	C3-Phenanthrenes/Anthracenes	580	263	6,577	5,262	4,472	5,262	5,262	6,577	4,472	6,577	5,569
PA4	C4-Phenanthrenes/Anthracenes	140	64	1,588	1,270	1,080	1,270	1,270	1,588	1,080	1,588	1,344
DBT0	Dibenzothiophene	1,300	590	14,742	11,793	10,024	11,793	11,793	14,742	10,024	14,742	12,481
DBT1	C1-Dibenzothiophenes	400	181	4,536	3,629	3,084	3,629	3,629	4,536	3,084	4,536	3,840
DBT2	C2-Dibenzothiophenes	260	118	2,948	2,359	2,005	2,359	2,359	2,948	2,005	2,948	2,496
DBT3	C3-Dibenzothiophenes	130	59	1,474	1,179	1,002	1,179	1,179	1,474	1,002	1,474	1,248
DBT4	C4-Dibenzothiophenes	46	21	522	417	355	417	417	522	355	522	442
FL0	Fluoranthene *	14,000	6,350	158,757	127,006	107,955	127,006	127,006	158,757	107,955	158,757	134,415
PY0	Pyrene *	10,000	4,536	113,398	90,718	77,111	90,718	90,718	113,398	77,111	113,398	96,010
FP1	C1-Fluoranthenes/Pyrenes	7,100	3,221	80,513	64,410	54,749	64,410	64,410	80,513	54,749	80,513	68,167
FP2	C2-Fluoranthenes/Pyrenes	1,800	816	20,412	16,329	13,880	16,329	16,329	20,412	13,880	20,412	17,282

M/V Selendang Ayu Oil to Piling Calculations
PAH and BaP Equivalents in Creosote Treated Piling

Abbrev	Analytes	Coal Tar Oil Chem Service Measured Concentration mg/kg	Coal Tar Oil Chem Service Units Conversion mg/lb	Marine Piling Southern Pine CS250-62 @ 25 lbs/ft^3 mg/ft^3	Marine Piling Douglas Fir CS249-62 @ 20 lbs/ft^3 mg/ft^3	Moderate Hazard Marine Piling Douglas Fir TT-C-645 @ 17 lbs/ft^3 mg/ft^3	Moderate Hazard Marine Piling Southern Pine TT-C-650 @ 20 lbs/ft^3 mg/ft^3	Limnoria Hazard Marine Piling Douglas Fir TT-C-645 @ 20 lbs/ft^3 mg/ft^3	Limnoria Hazard Marine Piling Southern Pine TT-C-650 @ 25 lbs/ft^3 mg/ft^3	Minimum Marine Piling PAH Inventory mg/ft^3	Maximum Marine Piling PAH Inventory mg/ft^3	Average Marine Piling PAH Inventory mg/ft^3	
FP3	C3-Fluoranthenes/Pyrenes	560	254	6,350	5,080	4,318	5,080	5,080	6,350	4,318	6,350	5,377	
FP4	C4-Fluoranthenes/Pyrenes	180	82	2,041	1,633	1,388	1,633	1,633	2,041	1,388	2,041	1,728	
NBT0	Naphthobenzothiophenes	860	390	9,752	7,802	6,632	7,802	7,802	9,752	6,632	9,752	8,257	
NBT1	C1-Naphthobenzothiophenes	420	191	4,763	3,810	3,239	3,810	3,810	4,763	3,239	4,763	4,032	
NBT2	C2-Naphthobenzothiophenes	160	73	1,814	1,451	1,234	1,451	1,451	1,814	1,234	1,814	1,536	
NBT3	C3-Naphthobenzothiophenes	85	39	964	771	655	771	771	964	655	964	816	
NBT4	C4-Naphthobenzothiophenes	22	10	249	200	170	200	200	249	170	249	211	
BA0	Benz[a]anthracene *	5,300	2,404	60,101	48,081	40,869	48,081	48,081	60,101	40,869	60,101	50,885	
C0	Chrysene/Triphenylene *	4,500	2,041	51,029	40,823	34,700	40,823	40,823	51,029	34,700	51,029	43,205	
BC1	C1-Chrysenes	1,800	816	20,412	16,329	13,880	16,329	16,329	20,412	13,880	20,412	17,282	
BC2	C2-Chrysenes	590	268	6,690	5,352	4,550	5,352	5,352	6,690	4,550	6,690	5,665	
BC3	C3-Chrysenes	430	195	4,876	3,901	3,316	3,901	3,901	4,876	3,316	4,876	4,128	
BC4	C4-Chrysenes	140	64	1,588	1,270	1,080	1,270	1,270	1,588	1,080	1,588	1,344	
BB	Benzo[b]fluoranthene *	2,900	1,315	32,885	26,308	22,362	26,308	26,308	32,885	22,362	32,885	27,843	
BJK	Benzo[k]fluoranthene *	3,100	1,406	35,153	28,123	23,904	28,123	28,123	35,153	23,904	35,153	29,763	
BAF	Benzo[a]fluoranthene	960	435	10,886	8,709	7,403	8,709	8,709	10,886	7,403	10,886	9,217	
BEP	Benzo[e]pyrene	2,100	953	23,814	19,051	16,193	19,051	19,051	23,814	16,193	23,814	20,162	
BAP	Benzo[a]pyrene *	3,800	1,724	43,091	34,473	29,302	34,473	34,473	43,091	29,302	43,091	36,484	
IND	Indeno[1,2,3-cd]pyrene *	2,000	907	22,680	18,144	15,422	18,144	18,144	22,680	15,422	22,680	19,202	
DA	Dibenz[a,h]anthracene *	530	240	6,010	4,808	4,087	4,808	4,808	6,010	4,087	6,010	5,089	
GHI	Benzo[g,h,i]perylene *	1,600	726	18,144	14,515	12,338	14,515	14,515	18,144	12,338	18,144	15,362	
PER	Perylene	910	413	10,319	8,255	7,017	8,255	8,255	10,319	7,017	10,319	8,737	
BF	Benzo(b)fluorene	1,600	726	18,144	14,515	12,338	14,515	14,515	18,144	12,338	18,144	15,362	
	EPAPAH16 (sum of * above)	155,330	70,456	1,761,412	1,409,130	1,197,760	1,409,130	1,409,130	1,761,412	1,197,760	1,761,412	1,491,329	EPA 16 PP PAH
	TPAH52	210,113	95,306	2,382,641	1,906,113	1,620,196	1,906,113	1,906,113	2,382,641	1,620,196	2,382,641	2,017,303	
	TPH	670,000	303,907	7,597,671	6,078,137	5,166,416	6,078,137	6,078,137	7,597,671	5,166,416	7,597,671	6,432,695	
	BAP Equivalents	4,856	2,202	55,060	44,048	37,441	44,048	44,048	55,060	37,441	55,060	46,618	BAP Equivalents
	BAP Equivalents Total (No Tx F	21,600	9,798	244,940	195,952	166,559	195,952	195,952	244,940	166,559	244,940	207,382	BAP Equivalents Total
T19	Hopane	1.4	1.4										
	TOC	NA	NA										
	c(loc)	4	4										
	Lab ID	0508103-13	0508103-13										
	Matrix	Product	Product										
	Date Collected	9/1/2005	9/1/2005										
	Date Received	9/1/2005	9/1/2005										

1 lb = 0.4536 kg

BaP equivalents = (0.1) benzo(a)anthracene + (1.0)BaP + (0.1)benzo(b)flouranthene + (0.01) benzo(k)flouranthene + (0.001)chrysene + (0.1) ideno(1,2,3cd)pyrene.

M/V *Selendang Ayu* Oil to Piling Calculations
Number of Pilings to Remove Based Upon Toxicity Equivalency of 16 Priority Pollutant PAHs

Assumptions			
Based on 16 Priority Pollutant PAH		**Fraction Seattle**	**Fraction Singapore**
30/70 Mixture of Seattle 038 and Maritec (Singapore Load)		**0.3**	**0.7**
Use specification with lowest coal tar content TT-C-645 Douglas Fir			
Based On Lowest Piling PAH Specification			
16 Priority Pollutant PAH Selandang Oil to Number of Pilings		**Results**	**Units**
Assumptions: 17 Lbs/ft^3			
Vol to Mass of Selendang Oil Lost		350,000	gallons
Vol Oil Liters (1 US gallon = 3.78541178 liters)		1,324,894	liters
Mass of Selendang Oil released (Oil Density = 0.9 kg/L oil)		1192405	kgs oil
Selandang Oils 16 PP PAH Concentration for Maritec IFO (mg/kg oil)		542	16 PP PAH mg/kg oil
Selandang Oils 16 PP PAH Concentration for Seattle IFO samples (mg/kg oil)		3486	16 PP PAH mg/kg oil
30% Seattle/70% Singapore Mean SA Oils 16 PP PAH Concentration (mg/kg oil)		1425.5	16 PP PAH mg/kg oil
Total Mass of SA 16 PP PAH Released Kg		**1700**	kg/Spill
Total Mass 16 PP PAH Per Piling (kg/ft^3)		1.198	kg/ft^3
Total piling volume (35Ft X 1 foot diameter) = (ft^3)		27.48	ft^3 /Piling
Total Mass 16 PP Per Piling (kg/piling)		32.91	kg/Piling
Number of Pilings To Be Removed Based on 16 PP PAH		**51.6**	No. of Piling to Remove

M/V *Selendang Ayu* Oil to Piling Calculations

Number of Pilings to Remove Based Upon Concentration of BaP Equivalents Without Toxicity Factors

Assumptions			
Based on concentration of BaP equivalent compounds with no toxicity factors		**Fraction of Seattle**	**Fraction of Singapore**
30/70 Mixture of Seattle 038 and Maritec (Singapore Load)		**0.3**	**0.7**
Use specification with lowest coal tar content TT-C-645 Douglas Fir (Conservative)			
BaP EQ T PAH Selandang Oil to Number of Pilings		**Results**	**Units**
Vol to Mass of Selendang Oil Lost		350,000	gallons
Vol Oil Liters (1 US gallon = 3.78541178 liters)		1,324,894	liters
Mass of Selendang Oil released (Oil Density = 0.9 kg/L oil)		1192405	kgs oil
Selandang Oils BaP EQ T PAH Concentration for Maritec IFO (mg/kg oil)		82	BAP EQ T PAH mg/kg oil
Selandang Oils BaP EQ T PAH Concentration for Seattle IFO samples (mg/kg oil)		170	BAP EQ T PAH mg/kg oil
Mean SA Oils BaP EQ T PAH Concentration (mg/kg oil)		108.6	BAP EQ T PAH mg/kg oil
Total Mass of SA BaP EQ T PAH Released Kg		**129**	kg/Spill
Total Mass BaP EQ T Per Piling (kg/ft^3)		0.167	kg/ft^3
Total piling volume (35Ft X 1 foot diameter) = (ft^3)		27.48	ft^3 /Piling
Total Mass BaP EQ T Per Piling (kg/piling)		4.58	kg/Piling
Number of Pilings To Be Removed Based on BAP EQ T		**28.3**	No. of Piling to Remove
Straight BaP Equivalents Piling Equivalents Calculation - No Toxicity Factors			
BaP EQ T = benzo(a)anthracene + BaP + benzo(b)flouranthene +			
benzo(k)flouranthene + chrysene + ideno(1,2,3cd)pyrene.			

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M/V *Selendang Ayu* Oil to Piling Calculations

Number of Pilings to Remove Based Upon Concentration of BaP Equivalents With Toxicity Factors

Assumptions			
Based on 16 Priority Pollutant PAH		**Fraction of Seattle**	**Fraction of Singapore**
30/70 Mixture of Seattle 038 and Maritec (Singapore Load)		**0.3**	**0.7**
Use specification with lowest coal tar content TT-C-645 Douglas Fir			
BAP Equivalents Selandang Oil to Number of Pilings. (Mean CT BAP Equivalents)		**Results**	**Units**
Vol to Mass of Selendang Oil Lost		350,000	gallons
Vol Oil Liters (1 US gallon = 3.78541178 liters)		1,324,894	liters
Mass of Selendang Oil released (Oil Density = 0.9 kg/L oil)		1192405	kgs oil
Selandang Oils BAP Eq. Concentration for Maritec IFO (mg/kg oil)		17.21	BAP Eq. mg/kg oil
Selandang Oils BAP Eq. Concentration for Seattle IFO samples (mg/kg oil)		18.9	BAP Eq. mg/kg oil
30% Seattle/ 70% Singapore Mean SA Oils BAP Equivalent Concentration (mg/kg oil)		17.7	BAP Eq. mg/kg oil
Total Mass of SA BAP Equivalents Released Kg		**21**	kg/Spill
Total Mass BAP EQ Per Piling (kg/ft^3)		0.037	kg/ft^3
Total piling volume (35Ft X 1 foot diameter) = (ft^3)		27.48	ft^3 /Piling
Total Mass BAP EQ Per Piling (kg/piling)		1.03	kg/Piling
Number of Pilings To Be Removed		**20.5**	No. of Piling to Remove
BAP Equivalents Piling Equivalents Calculation			
BaP equivalents = (0.1) benzo(a)anthracene + (1.0)BaP + (0.1)benzo(b)flouranthene +			
(0.01) benzo(k)flouranthene + (0.001)chrysene + (0.1) ideno(1,2,3cd)pyrene.			

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M/V *Selendang Ayu* Oil to Piling Calculations
PAH Migration Calculations

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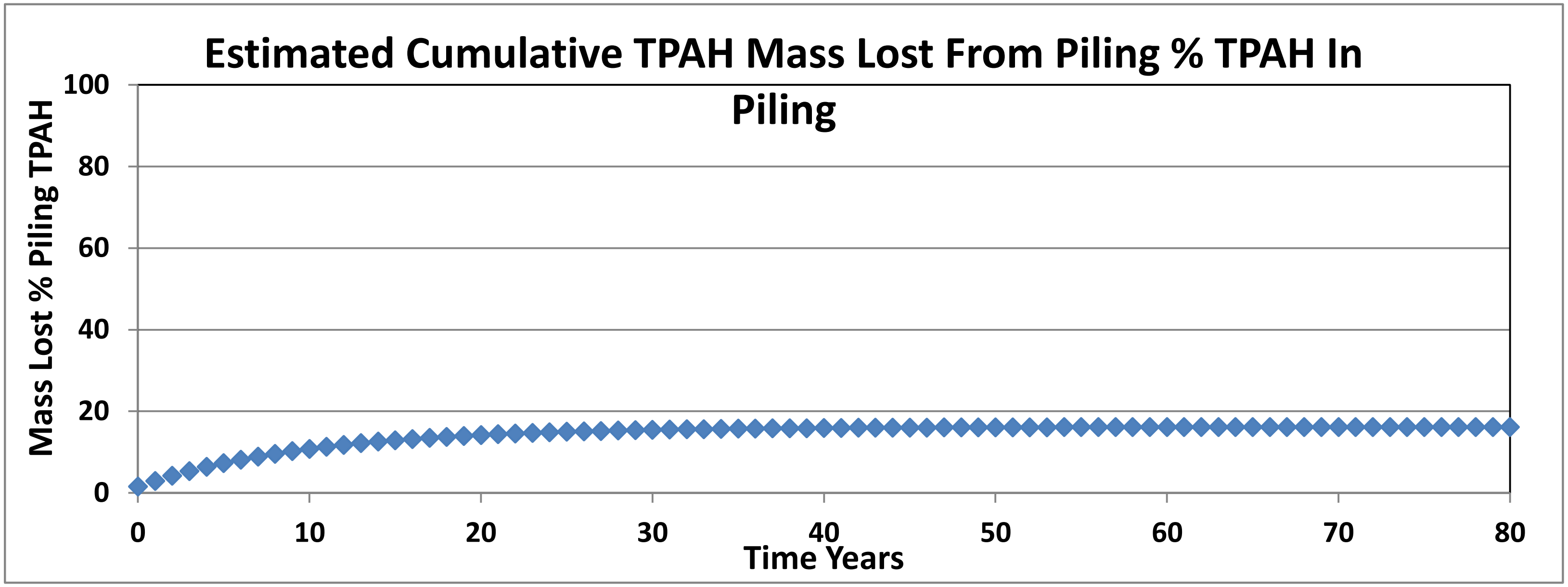
PAH Piling Migration Model			
Ingram et al., 1982			
Brooks 1997			
	Result	**Units**	
PAH Migration = µg cm^{-2} day^{-1}	14.03	µg cm-2 day-1	
Temp =	10	°C	
Salinity	30	PPT	
Actual retention T=0	20	Lbs/Ft^3	
Piling Length 35 ft (1050 cm)	1050	CM	
Piling Diameter 1 ft (30 cm))	30	CM	
Percent Buried In Sediment	1		
Surface Area = 2*3.14*r*h	98910	CM2	
Piling Total TPAH Mass kg	32.91	kg	
Total TPAH Mass Lost 80 Years	16	%	

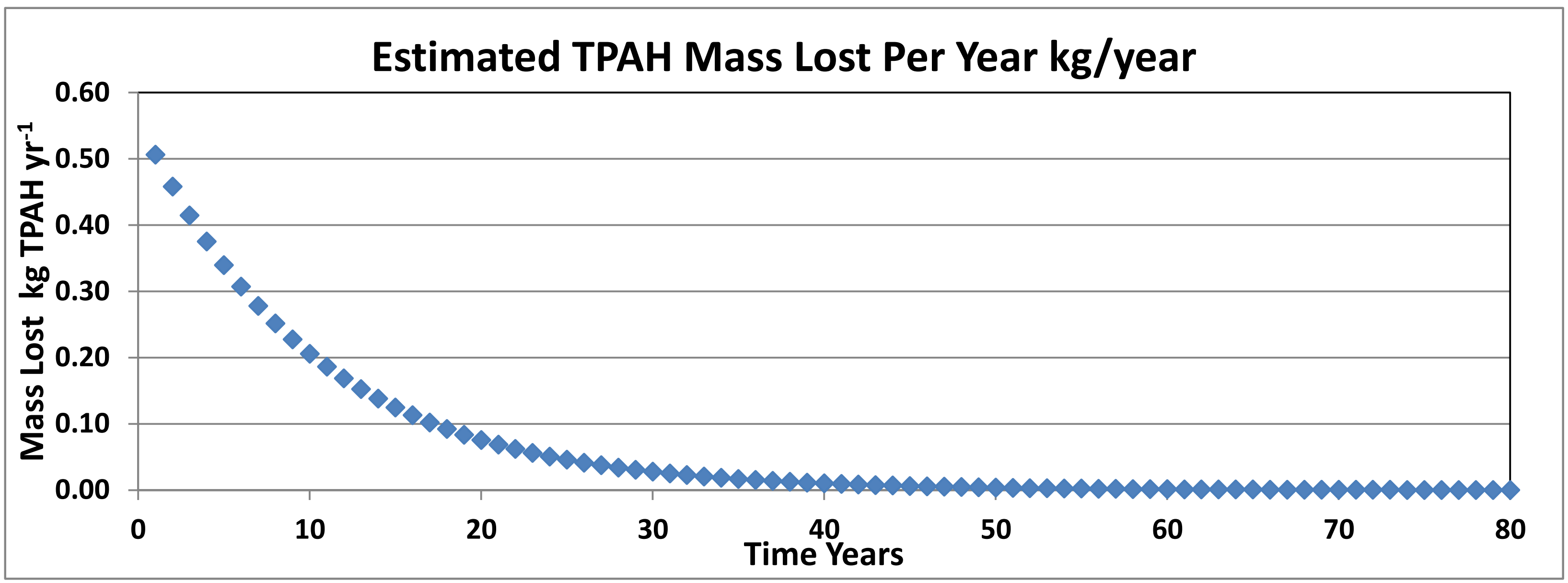
	Time Yr	M_T	Mass Lost kg TPAH/day	Mass Lost kg TPAH/year	Mass Lost Cumulative kg TPAH/year	Mass Lost Cumulative % Total Piling TPAH
Migration (T) µg cm-2 day-1	0	14.028	0.00139	0.51	0.51	1.54
	1	12.69	0.00126	0.46	0.96	2.93
	2	11.49	0.00114	0.41	1.38	4.19
	3	10.39	0.00103	0.38	1.75	5.33
	4	9.40	0.00093	0.34	2.09	6.36
	5	8.51	0.00084	0.31	2.40	7.30
	6	7.70	0.00076	0.28	2.68	8.14
	7	6.97	0.00069	0.25	2.93	8.90
	8	6.30	0.00062	0.23	3.16	9.60
	9	5.70	0.00056	0.21	3.36	10.22
	10	5.16	0.00051	0.19	3.55	10.79
	11	4.67	0.00046	0.17	3.72	11.30
	12	4.23	0.00042	0.15	3.87	11.76
	13	3.82	0.00038	0.14	4.01	12.18
	14	3.46	0.00034	0.12	4.13	12.56
	15	3.13	0.00031	0.11	4.25	12.91
	16	2.83	0.00028	0.10	4.35	13.22
	17	2.56	0.00025	0.09	4.44	13.50
	18	2.32	0.00023	0.08	4.53	13.75
	19	2.10	0.00021	0.08	4.60	13.98

20	1.90	0.00019	0.07	4.67	14.19
21	1.72	0.00017	0.06	4.73	14.38
22	1.55	0.00015	0.06	4.79	14.55
23	1.41	0.00014	0.05	4.84	14.70
24	1.27	0.00013	0.05	4.89	14.84
25	1.15	0.00011	0.04	4.93	14.97
26	1.04	0.00010	0.04	4.96	15.08
27	0.94	0.00009	0.03	5.00	15.19
28	0.85	0.00008	0.03	5.03	15.28
29	0.77	0.00008	0.03	5.06	15.37
30	0.70	0.00007	0.03	5.08	15.44
31	0.63	0.00006	0.02	5.10	15.51
32	0.57	0.00006	0.02	5.13	15.57
33	0.52	0.00005	0.02	5.14	15.63
34	0.47	0.00005	0.02	5.16	15.68
35	0.42	0.00004	0.02	5.18	15.73
36	0.38	0.00004	0.01	5.19	15.77
37	0.35	0.00003	0.01	5.20	15.81
38	0.31	0.00003	0.01	5.21	15.84
39	0.28	0.00003	0.01	5.22	15.87
40	0.26	0.00003	0.01	5.23	15.90
41	0.23	0.00002	0.01	5.24	15.93
42	0.21	0.00002	0.01	5.25	15.95
43	0.19	0.00002	0.01	5.26	15.97
44	0.17	0.00002	0.01	5.26	15.99
45	0.16	0.00002	0.01	5.27	16.01
46	0.14	0.00001	0.01	5.27	16.02
47	0.13	0.00001	0.00	5.28	16.04
48	0.12	0.00001	0.00	5.28	16.05
49	0.10	0.00001	0.00	5.29	16.06
50	0.09	0.00001	0.00	5.29	16.07
51	0.09	0.00001	0.00	5.29	16.08
52	0.08	0.00001	0.00	5.30	16.09
53	0.07	0.00001	0.00	5.30	16.10
54	0.06	0.00001	0.00	5.30	16.10
55	0.06	0.00001	0.00	5.30	16.11
56	0.05	0.00001	0.00	5.30	16.12
57	0.05	0.00000	0.00	5.31	16.12
58	0.04	0.00000	0.00	5.31	16.13
59	0.04	0.00000	0.00	5.31	16.13

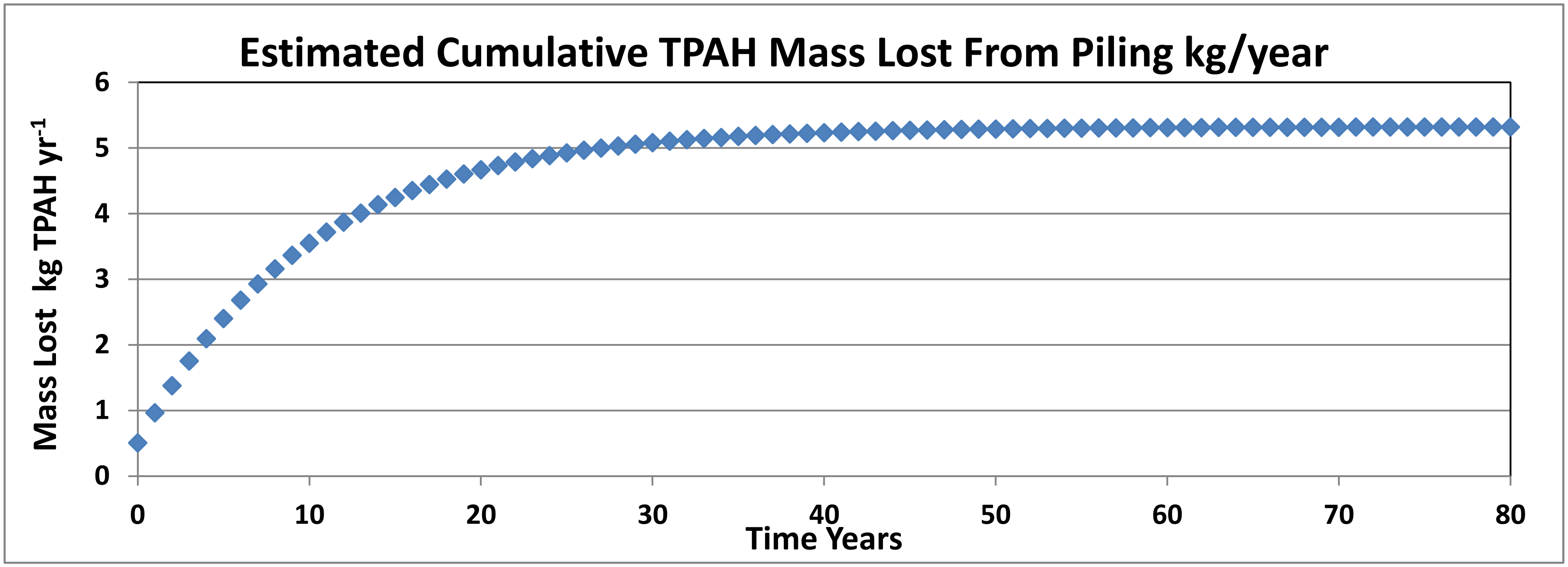
	60	0.03	0.00000	0.00	5.31	16.13
	61	0.03	0.00000	0.00	5.31	16.14
	62	0.03	0.00000	0.00	5.31	16.14
	63	0.03	0.00000	0.00	5.31	16.14
	64	0.02	0.00000	0.00	5.31	16.15
	65	0.02	0.00000	0.00	5.31	16.15
	66	0.02	0.00000	0.00	5.32	16.15
	67	0.02	0.00000	0.00	5.32	16.15
	68	0.02	0.00000	0.00	5.32	16.15
	69	0.01	0.00000	0.00	5.32	16.16
	70	0.01	0.00000	0.00	5.32	16.16
	71	0.01	0.00000	0.00	5.32	16.16
	72	0.01	0.00000	0.00	5.32	16.16
	73	0.01	0.00000	0.00	5.32	16.16
	74	0.01	0.00000	0.00	5.32	16.16
	75	0.01	0.00000	0.00	5.32	16.16
	76	0.01	0.00000	0.00	5.32	16.16
	77	0.01	0.00000	0.00	5.32	16.16
	78	0.01	0.00000	0.00	5.32	16.16
	79	0.01	0.00000	0.00	5.32	16.17
	80	0.00	0.00000	0.00	5.32	16.17
Total TPAH Mass Loss From Piling kg			**0.01458**	**5.32**	**Total kg Lost**	
Total TPAH In Piling kg			**32.91**	**32.91**	**kg/Piling**	
Pecrent Mass Lost Due To Migration			**0.04**	**16.17**	**% Mass Lost**	

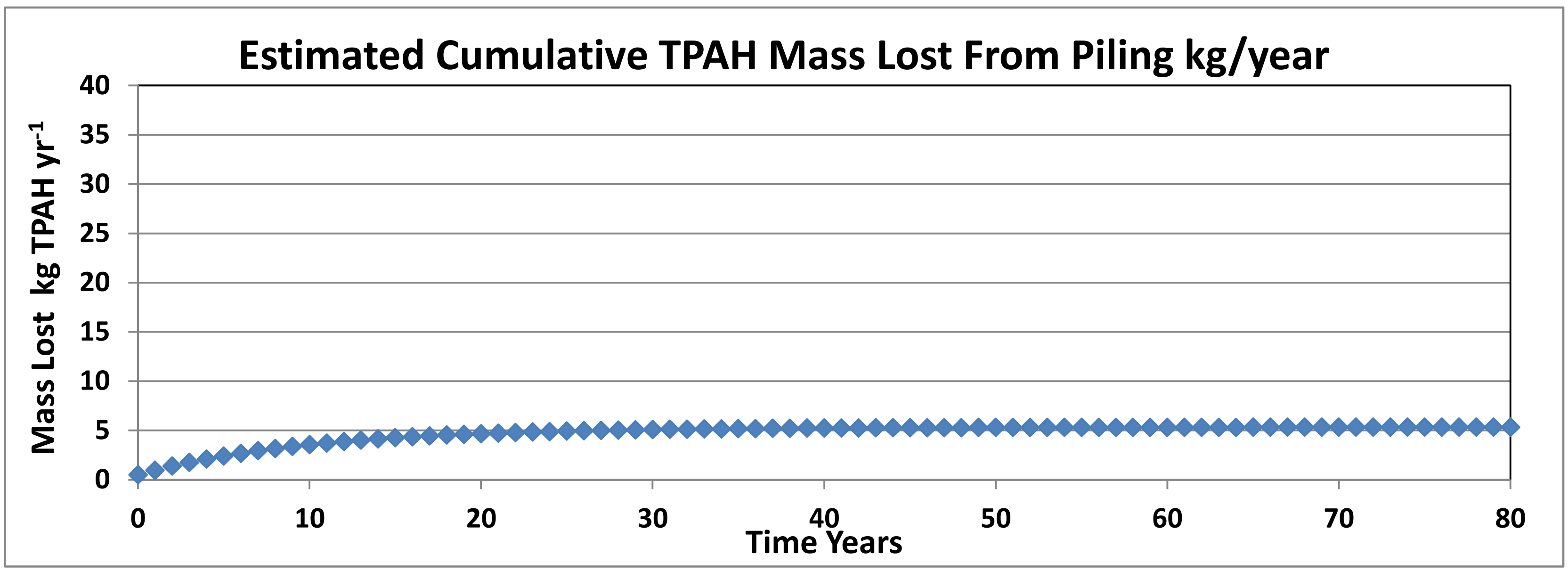
M/V *Selendang Ayu* Oil to Piling Calculations
PAH Migration Calculations

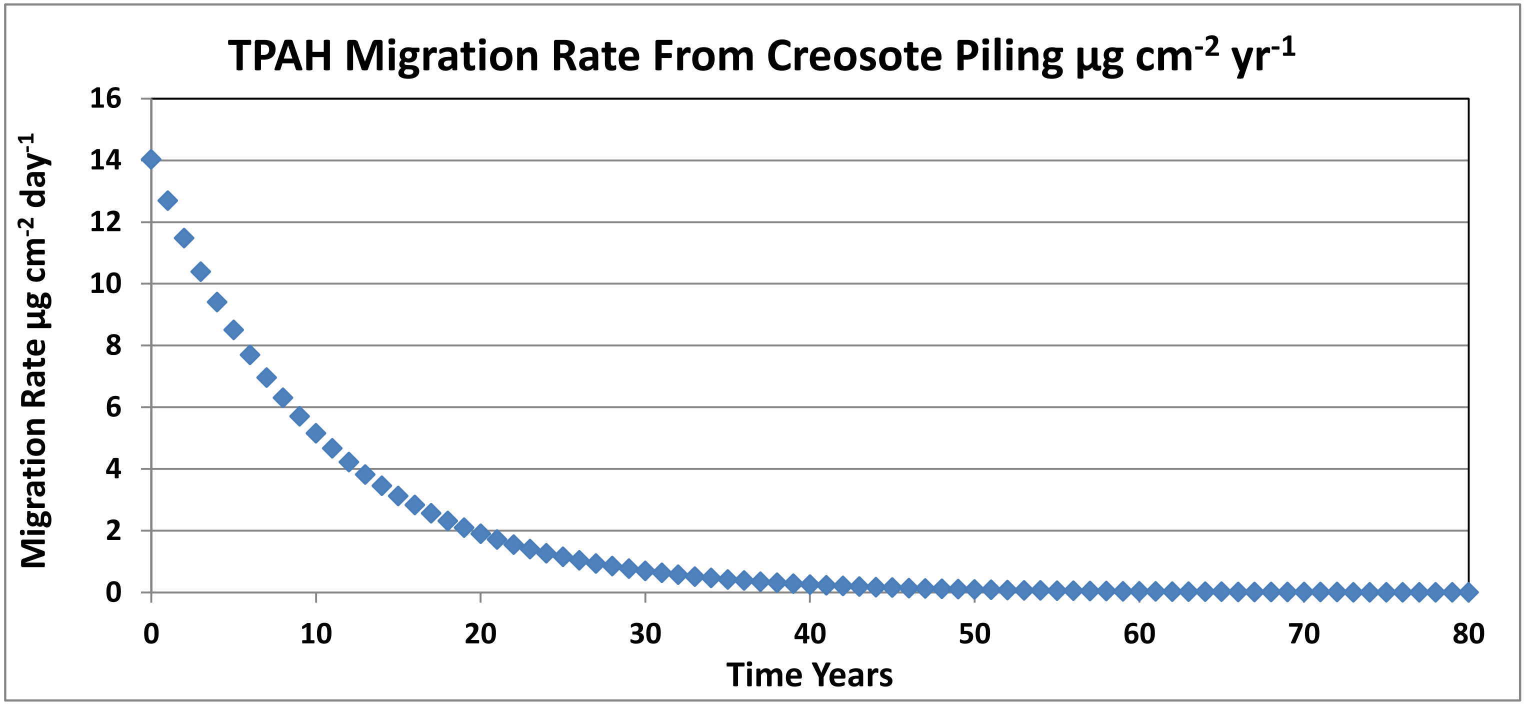




M/V *Selendang Ayu* Oil to Piling Calculations
PAH Migration Calculations






TPAH Migration Rate From Creosote Piling µg cm-2 yr-1
Migration Rate µg cm-2 day-1
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
Time Years

M/V *Selendang Ayu* Oil to Piling Calculations
Percent of PAHs by Weight in *Selendang Ayu* Oil vs. Creosote

Two Different IFO's Were Released During Spill			
Client ID	**SA Seattle - IF 038**	**Maritec 110803**	
Lab ID	0412115-06	0707139-01	
Matrix	Oil	Oil	
File ID	P21110.D	A24872.D	
Units	mg/Kg	mg/Kg	
% of Spill	30%	70%	
TPAH mg/kg	40733	16323	
30%SA/70% Maritec Composite PAH	23400	**=2.3 % SA OIl**	
TPAH 16 USEPA PP* mg/kg	3486	527	
30%SA/70% Maritec Composite PP PAH	**1426**	**=0.14% SA OIl**	
Analytes	Result	Result	
Naphthalene*	1700	58	N0
C1-Naphthalenes	4500	200	N1
C2-Naphthalenes	6000	480	N2
C3-Naphthalenes	4400	770	N3
C4-Naphthalenes	2200	680	N4
Biphenyl	120	29	B
Dibenzofuran	98	11	DF
Acenaphthylene*	9.2	1.7	AY
Acenaphthene*	160	22	AE
Fluorene*	230	53	F0
C1-Fluorenes	610	190	F1
C2-Fluorenes	990	390	F2
C3-Fluorenes	1100	480	F3
Anthracene*	92	32	A0
Phenanthrene*	780	180	P0
C1-Phenanthrenes/Anthracenes	2500	600	PA1
C2-Phenanthrenes/Anthracenes	3300	890	PA2
C3-Phenanthrenes/Anthracenes	2200	670	PA3
C4-Phenanthrenes/Anthracenes	790	440	PA4
Retene			
Dibenzothiophene	340	100	DBT0
C1-Dibenzothiophenes	1000	590	DBT1
C2-Dibenzothiophenes	1700	1300	DBT2
C3-Dibenzothiophenes	1400	1600	DBT3
C4-Dibenzothiophenes	610	1200	DBT4

Naphthaler	59,000
C1-Naphth	9,400
C2-Naphth	3,700
C3-Naphth	1,200
C4-Naphth	330
Biphenyl	1,700
Dibenzofur	6,200
Acenaphth	6,400
Acenaphth	1,200
Fluorene *	8,400
C1-Fluorer	1,200
C2-Fluorer	500
C3-Fluorer	280
Anthracene	8,600
Phenanthre	24,000
C1-Phenar	5,800
C2-Phenar	1,900
C3-Phenar	580
C4-Phenar	140

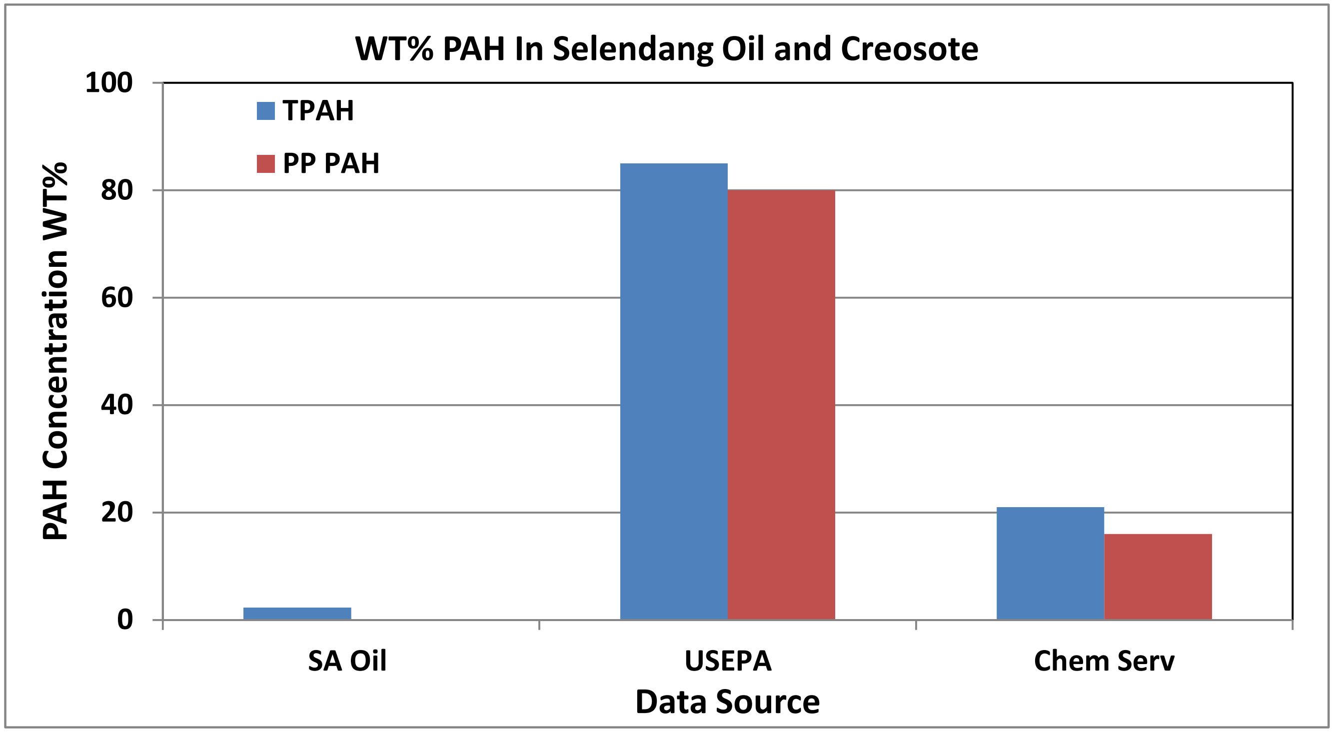
Dibenzothi	1,300
C1-Dibenz	400
C2-Dibenz	260
C3-Dibenz	130
C4-Dibenz	46

M/V *Selendang Ayu* Oil to Piling Calculations
Percent of PAHs by Weight in *Selendang Ayu* Oil vs. Creosote

Benzo(b)fluorene	31	13	FL0	Fluoranthe	14,000
Fluoranthene*	47	9	PY0	Pyrene *	10,000
Pyrene*	280	90	FP1	C1-Fluoran	7,100
C1-Fluoranthenes/Pyrenes	700	280	FP2	C2-Fluoran	1,800
C2-Fluoranthenes/Pyrenes	700	360	FP3	C3-Fluoran	560
C3-Fluoranthenes/Pyrenes	420	380	FP4	C4-Fluoran	180
C4-Fluoranthenes/Pyrenes	150	330	NBT0	Naphthobe	860
Naphthobenzothiophenes	86	120	NBT1	C1-Naphth	420
C1-Naphthobenzothiophenes	180	540	NBT2	C2-Naphth	160
C2-Naphthobenzothiophenes	190	870	NBT3	C3-Naphth	85
C3-Naphthobenzothiophenes	120	800	NBT4	C4-Naphth	22
C4-Naphthobenzothiophenes	59	640	BA0	Benz[a]ant	5,300
Benz[a]anthracene*	47	14	C0	Chrysene/T	4,500
Chrysene/Triphenylene*	97	44	BC1	C1-Chryse	1,800
C1-Chrysenes	240	140	BC2	C2-Chryse	590
C2-Chrysenes	240	210	BC3	C3-Chryse	430
C3-Chrysenes	180	260	BC4	C4-Chryse	140
C4-Chrysenes	70	190	BB	Benzo[b]flu	2,900
Benzo[b]fluoranthene*	8.8	5.2	BJK	Benzo[k]flu	3,100
Benzo[k]fluoranthene*	2.6	1.6	BAF	Benzo[a]flu	960
Benzo[a]fluoranthene	0.96		BEP	Benzo[e]py	2,100
Benzo[e]pyrene	16	22	BAP	Benzo[a]py	3,800
Benzo[a]pyrene*	13	15	IND	Indeno[1,2	2,000
Perylene	6.1	5.1	DA	Dibenz[a,h	530
Indeno[1,2,3-cd]pyrene*	2	2.3	GHI	Benzo[g,h,	1,600
Dibenz[a,h]anthracene*	2.3	2.8	PER	Perylene	910
Benzo[g,h,i]perylene*	15	12	BF	Benzo(b)flu	1,600

M/V *Selendang Ayu* Oil to Piling Calculations
Percent of PAHs by Weight in *Selendang Ayu* Oil vs. Creosote

	SA Oil	USEPA	Chem Serv
TPAH	2.3	85	21
PP PAH	0.14	80	16



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APPENDIX C

Manufacturers and Distributors of Marine Piling Wraps

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Manufacturers and Distributors of Marine Pile Wraps

Company Name	Address	Telephone	Website	E-mail	Comments
Denso North America	9747 Whithorn Drive Houston, TX 77095	(888) 821-2300	http://www.densona.com/Index.aspx	info@densona.com	Vendors of two wraps included in Port of LA ACZA leaching study
PVC Tech Corp.	1931 East Vista Bella Way Dominguez Hills, CA 90220	(310) 608-1115	http://www.pvctech.com	info@pvctech.com	Supplier of 30 mil PVC sheeting used to wrap piles in Port of LA.
Chase Corp.	295 University Avenue Westwood, MA 02090	(781) 332-0700	http://www.chasecorp.com/tapecoat	info@chasecorp.com	Tapecoat Enviroshield Series T Module included in Ballard Salvage & Diving Estimate. Used in Seattle Aquarium wrap project.
Maskell Pipe & Supply, Inc.	8604 Cottonwood Ave. Fontana, CA 92335	(909) 574-8662			Supplied high density polyethylene pile wrap for the Ventura Pier project completed by John S. Meek Company
Barrier Industrial Marine Products	1141 Sun Century Road Naples, FL 34110	(970) 731-8284	http://www.barrierimp.com/pdf/PVC-T.pdf		Distributor of Pile-Gard PVC-T, polyvinyl chloride sheet wrap
Formapile Industries, Inc.	2559 Fourth Street Fort Meyers, FL 33901	(239) 471-0428	http://www.formapile.com/Formapile-Industries/Piling-Restoration.aspx		Perma-pile is a high molecular density polyethylene wrap designed to protect against marine borers.

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APPENDIX D

Ballard Diving & Salvage Estimate for Unalaska Timber Piling Wrap

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Bid Due Date: ASAP
Project: Budgetary Estimate for Timber Pile Wrap Using Enviroshield Series T Module

Ballard Diving & Salvage
1-206-782-6750
www.ballarddiving.com



Project:
BUDGETARY ESTIMATE for the installation of Tapecoat TC Enviroshield Series T Module on 35 foot piles and 50 foot piles.

Work Scope:
Mobilize a three man OSHA approved surface supplied diving crew to clean an undetermined number of 35 foot and 50 foot timber piles and install a "wrap" to prevent the timber pile from leaching creosote into the marine environment.

Project Pricing:

Task	Description	Total
Mobe / Demobe	Mobe and Demobilization to and from Dutch Harbor, AK. From Seattle, WA.	$ 75,000.00
Diving Services – 35 Foot Pile	Diving services to clean and install one 35 foot Tapecoat T Module Timber Pile Wrap System – Each	$ 5,300.00
Diving Services – 50 Foot Pile	Diving services to clean and install one 50 foot Tapecoat T Module Timber Pile Wrap System – Each	$ 8,700.00

Exclusions/Notes:

- Environmental controls (booms, curtains, turbidity control, SPCC plans)
    - Marine growth to be pressured washed off and allowed to drop to the seafloor
- Permits
- Engineering and special inspections
- Crane and rigging services
- Warranty other than standard one year on labor
- Work to be done in summer months
- Subsistence for the weekend to be assessed at $ 450.00 per day.
- Pricing is based on non-prevailing wages, considered private bid.
- Water depth to be less than 50 fsw

Terms:

Pricing is good for 90 days. Rates are good Monday thru Friday between the hours of 0700 to 1900, NO weekends and or holidays.

Executive Summary

Ballard Diving and Salvage is a privately held company specializing in deep water construction, ROV inspection, heavy marine salvage and nuclear, hydroelectric, industrial and environmental diving. With our wide array of inland, coastal and offshore diving experience we can offer our customers innovative and cost effective solutions to their particular needs.

A proven track record of safe, efficient and innovative underwater services has made BDS an industry leader. Our attitude of success and pride has consistently delivered quality projects on time – or ahead of schedule. We're well known for our expertise in aggressively managing underwater construction projects with demanding schedules and complex components. Call or log on to our website for more information.

Ballard Diving & Salvage staffing for this project and organization contacts by list

Michael Eakin, Chief Estimator
(206) 782-6750 Office
(971) 563-9706 Cell

Our goal as a company is to provide unsurpassed customer service, employ the most qualified personnel and to operate efficiently and in a safe manner. When you contract BDS for your underwater project you can expect the project to be completed on time, successfully and accident free.

TERMS & CONDITIONS

Personnel Terms:

1. All diving services and related activities will be conducted in compliance with Federal (OSHA, USCG, USA Corps of Engineers), State (WISHA), and local requirements. In addition, BDS adheres to its own Safe Practices Standards as well as the Association of Diving Contractors (ADC) Consensus Standards for commercial diving. BDS is a member in good standing with the ADC.
2. Minimum call out time may be subject to contractual agreements; however, in lieu of no contract applicability, minimum call out time is 4 hours per person, except for projects over 50 miles from operations office location, which require 8-hour daily minimum.
3. Labor Rates are subject to the following:
   a) Weekdays: 0700 to 1500 hours charged at Straight Time (ST = Hourly Rate); 1500 to 1900 hours charged at Overtime (OT = 1 ½ times the Hourly Rate); 1900 to 0700 hours charged at Double Time (DT = 2 times the Hourly Rate). Changes to start times for Weekday ST, OT and DT may be requested by Client and may be approved by BDS on a case-by-case basis.
   b) Saturday: First 8 hours charged at Overtime (1 ½ times the Hourly Rate); hours over first 8 hours charged at Double Time (2 times the Hourly Rate).
   c) Sundays and Holidays: All time charged at Double Time (2 times the Hourly Rate).
   d) The following are included holidays: New Years Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Day after Thanksgiving and Christmas Day. Other holidays may apply when employing certain union personnel.
   e) The current Labor Rates are applied regardless of the number of hours worked for any Client on any particular day. Rates for hours subsequent to a break of less than 8 hours are calculated as continuous to hours prior to break.
4. All project specific personnel, including accounting, administrative, logistics and management, whether on site, at BDS offices, or at support locations, are chargeable per the above rates. All personnel are charged subject to the current rates schedule. Labor rates for remote sites and prevailing-wage projects may be subject to a premium or surcharge.
5. Time charges begin with equipment and personnel mobilization activities. Time charges terminate at the conclusion of the services, which includes transportation of equipment and personnel back to operations centers and any necessary demobilization activities. All houly rates will be charged from the location of personnel when dispatched, including but not limited to BDS operations locale, hotel or other jobsite as applicable. Personnel on standby for Customer will be charged accordingly which will be determined on a case by case basis. Onsite training or security processing required by the owner or prime contractor will be charged at the applicable rate.

6. Transportation and any incidental costs for all emergency (call- out) responses are charged at cost plus 15%. Mileage, Zone pay or Per Diem charges will be charged accordingly based upon the applicable contractual agreements in force at the time, or determined on a case by case basis. Typical per diem rates for lodging, based on double occupancy, are $75.00 to 100.00 per person per day. Rates for premium areas and remote sites will be determined on a case by case basis.

Equipment Terms:

1. All equipment sent to the project site by BDS shall be in a basic operating condition. Additional components required for extraordinary use or application for operation of the basic equipment will be charged as an extra to the client. Equipment prices do not include fuel, operator or mobilization unless otherwise stated. Fuel consumed in non-mileage related operation of equipment, including vehicle and non-vehicle equipment and vessels, will be charged at cost plus 15%.
2. Time charges are calculated portal to portal, beginning with equipment mobilization activities from the BDS operations center unless otherwise specified, including all time at the site. Time charges terminate at the conclusion of the operation, which includes transportation of equipment back to BDS operations center and completion of any necessary demobilization activities, including equipment cleaning, repair, replacement and/or delivery to BDS of restored equipment.
3. Day rates are based on 8 hours of operation. Equipment will be charged in half-day increments for additional hours over 8, up to a total of 3 days charge during a 24-hour period.
4. Minimum call out for hourly equipment is four hours per day for local projects and eight hours per day for projects over 50 miles from mobilization site. Minimum charge for daily rate equipment is daily charge per day. Customers will be charged for unused requested equipment until released and returned to service per Note 3.
5. Base mileage charges are $.50 per mile for cars, $.65 per mile for trucks/vans and $.85 per mile for commercial trucks. A fuel surcharge of an additional $0.15 will be added to the base mileage charges for every $0.50 increase above $3.50 per gallon of diesel in the local BDS operations area at the time of service.
6. Equipment not specified on the Price List will be charged at cost (including rental, insurance, freight, fuel, etc.) plus 15%.
7. In addition to payment of rental charges, Customer agrees to pay BDS, in accordance with rates contained in this Price List, for any cleaning or repairs necessary to return all equipment to the same condition as at the commencement of services (with the exception of normal wear and tear). Customer is also responsible for the payment of all transportation and disposal charges for any waste generated during cleaning. Only BDS or its subcontractors shall perform any cleaning and decontamination operations on all equipment owned, rented or subcontracted by BDS. If BDS determines that equipment cannot be returned to the condition it was in at the commencement of the services, Customer shall pay for all costs at cost plus 15%, including freight and other expenses incurred by BDS to replace this equipment.

Materials / Other Costs Terms:

1. All materials utilized will be charged at the current rate as listed on the current price list. All other materials, not listed on price list, will be charged at cost plus 15%.
2. Performance, Payment & Maintenance bonds required will be charged at cost plus 15%.
3. Special premiums for Insurance coverage in excess of $ 5MM and/or or for specialized activities considered outside the normal scope of operations for BDS will be charged at cost plus 15%.

Chase Specialty Coatings

SERIES T MODULE

TC ® Enviroshield ® Series

Proven Corrosion Protection for Pilings and Offshore Risers

Modular Marine Corrosion Protection System

TC ENVIROSHIELD

SERIES R Module
SERIES S Module
SERIES T Module
SERIES H Module
SERIES M Module

The TC Marine borers have plagued mariners for centuries. In recent years their infestation has accelerated with the reduction of pollution in our waterways and harbors. The TC Enviroshield T Series module is an easy answer to this costly problem. This modular protection system is a permanent solution that stops borer infestation by restricting the flow of oxygenated water to timber pilings and marine wood.

TC Enviroshield Series T modules are designed with an abrasion-resistant outer jacket that incorporates a moldable gasket material. This field-applied marine protection can be installed in and out of the water on a minimally-prepared wet or dry surface.

TC Enviroshield Series T modules are designed to protect round, irregular and tapered timber pilings.

- **Eliminates the flow of oxygenated water to pile surface**
- **Lowers the dissolved oxygen content of the water inside the pile wrap**
- **Tapecoat's unique Moldable Sealant provides vertical,top and bottom seal**
- **Flexible EPDM outer jacket is UV resistant, will not harden, become brittle or crack over time**

TAPECOAT Chase Specialty Coatings

The Tapecoat Company
P.O. Box 631 Evanston, IL 60204-0631 USA • 800.758.6041

TAPECOAT - TC Enviroshield Series 'T' Module
With TC Envirotape - Flexible Timber Pile Wrap System

PART I GENERAL

1.1 Description

A. Work Included

1. This section specifies requirements for wrapping timber piles with petrolatum based protection modules. All products used by the Contractor, as a part of the encapsulation system, shall be manufactured by a single manufacturer to ensure product compatibility. The manufacturer of the encapsulation system shall be a member of the Steel Structures Painting Council (SSPC) or the National Association of Corrosion Engineers (NACE).
2. The manufacturer shall be ISO 9001 registered.
3. The work specified in this section consists of surface preparation of the pile and encapsulation.

1.2 References

A. Federal Standards

B. American Society for Testing and Materials (ASTM) Publications

1.3 Quality Assurance

A. Sample Installation

If so directed by the Engineer, prior to commencing production installation, <u>each</u> team to be protecting piles shall clean and wrap 1 pile, which shall be inspected by the Engineer and his diver/inspector. Upon approval of the sample, production may commence and approved samples shall be used by the Engineer as standard for judging the work of this section.

B. Manufacturer's Representative

The Contractor shall arrange for a qualified technical representative of the manufacturer of the approved system to be present at the construction site to instruct and demonstrate the application procedures.

1.4 Delivery, Storage, and Protection

Deliver materials in original packages, containers, boxes or crates bearing the name of the manufacturer, brand, and model. Store all materials and equipment delivered to the construction site, so that weather conditions or other potential hazardous situations are properly taken into account. Exercise particular care to avoid damaging materials throughout all lifting or handling operations.

<u>PART 2 - PRODUCTS</u>

2.1 ACCEPTABLE SYSTEMS

TC Enviroshield Series 'T' with TC Envirotape inner wrap as manufactured by The Tapecoat Company, Evanston, Illinois (800-758-6041).

2.2 MATERIALS

The materials used consist of a petrolatum inner layer protected by an outer jacket and sealed with stainless steel bands, top and bottom, and vertically with a moldable sealant secured with large headed stainless nails. Materials shall conform to the following respective specifications:

A. Inner Petrolatum Material - TC Envirotape or equal:

Color -
Thickness - 60 mils
Bacteria resistance - Excellent
Low Temperature (ASTM D-1737) - Excellent
Operating Temperature - 200 degree F

B. Outer Jacket Material - TC Enviroshield Series T:

The flexible outer jacket shall be an EPDM coated polyester scrim with integral rip-stops. It shall be new, non-rigid, domestic, virgin material. Use of reprocessed material is prohibited. The sheet shall be uniform throughout, free from dirt, oil, and other foreign matter and free from cracks, creases, wrinkles, bubbles, pits, tears, holes and any defects that may affect its service. The plasticizer system shall be such as to insure stability and adequate resistance of the barrier to fungal and bacterial degradation. The use of water-soluble compounds in the ingredients is prohibited. A black pigment shall be dispersed to produce an even color, which is fade resistant in sunlight. The barrier shall be of a width ample to encircle each pile to maintain a continuous airtight fit at the final fastening. The system shall conform to the following mechanical and physical requirements:

Property	Requirements	Test Method
Material	Reinforced EPDM	
Thickness	40 Mils	ASTM D 751
Weight	. 28 lb/ft^2	
Specific Gravity	1.15 ± 0.05	ASTM D-279
Breaking strength	100 LBF/IN	ASTM D 751
Elongation at break	350%	ASTM D 751
Tongue tear strength	35 LBF	ASTM D 751
Brittleness point	-50° F	ASTM D 2137
Ozone resistance	NO CRACKS	ASTM D 1149
Water Absorption mass	2	ASTM D 471
Heat Aging 28 Day at 240° F:		
Breaking Strength	90 LBF	ASTM D 751
Elongation at Break	250%	ASTM D 412
Tongue Tear Strength	25 LBF	ASTM D 751
Linear Dimension Change	±1%	ASTM D 1204

C. Stainless Steel Banding and Clamps:

Type 316 Stainless Steel, 3/4” wide, 0.030” thick with fully rounded smooth edges.

D. Moldable Seals (gaskets):

The moldable seal material shall be a 100% solids formulation of thermoplastic elastomeric and synthetic resins. The seal material shall conform to the following requirements:

Property	Requirements
Thickness	60 Mils min.
Service Temperature Flexibility	-30 to 150° F
Flexibility	½" radius @ -20° F No cracking
Water Absorption	Less than 5%

E. Nails:

Ring shank Type 316 Stainless Steel, full diameter head, 2-1/2" long, 8 gauge (0.165" dia)

Part 3 – EXECUTION

3.1 INSTALLATION

A. Cleaning and Surface Preparation

The entire surface of each pile shall be thoroughly cleaned to remove all marine growth and foreign matter for the entire length that is to be covered by the barrier wrap. The cleaning does not require the removal of surface growths from cavities or other indentations that do not come in contact with the barrier. But does require removal of all surface projections such as nails, bolts, large splinters, fouling organisms, and other surface conditions that would either penetrate the wrap or cause undue deformation. Pile wrapping must be completed within 72 hours of the cleaning of the pile, unless a longer time period is permitted by the Engineer.

B. Location

Size of Barrier Wrap: Number of piles to be wrapped shall be as indicated on the Contract Drawings. Barrier wraps shall begin at minimum top elevation 2 feet above the highest high tide location and down to a point 24" below the final mud line elevation.

C. The flexible barrier wrap (module) shall be installed as follows

1. Beginning at the top of the pile, spirally wrap the pile with water displacing petrolatum tape (min of 6" wide). Starting with a double layer at the top and then with a minimum of a 1" overlap of each previous layer. Overlap the end of each roll of tape a minimum of 6" to start a new roll. Apply sufficient pressure to the tape to provide continuous contact to the pile surface, smooth the overlaps by hand pressing out folds and pockets. Continue down the pile until the complete pile has been wrapped.
2. Position the EPDM outer wrap along the top of the piling, align the leading edge vertically & fasten the leading edge down the pile every 24" by nailing. Begin nailing at the top and nail down the pile, pulling the module vertical tight during the nailing operation. Drive the nails flush with the EPDM material, making certain the nail heads do not drive through the material.
3. Wrap the module around the piling, pull the material tight, remove the release liner and secure by nailing through the vertical batten every 6" with 2 ½" long nails, as the release liner is removed.

4. Remove the release liner from the seal at each end of module. Band the module 2" from the top over the center of the seals.
5. Repeat with the next module, if required, and position it with a 3" minimum overlap, over the previous module. Band at the center of the seal on the outer module.
6. Continue overlapping the modules until the required length of pile has been wrapped, pull the bottom release liner and install the bottom band 2” from the bottom over the center of the seal.
7. Back fill the dredged out area at the bottom of the pile to the required elevation.

A manufacturer meeting these specifications is:

The Tapecoat Company
Evanston, IL
Ph 800-758-6041

A local Supplier for this product is:

Schrader Co. Sales, LLC
1326 5th Street – Suite B-2
Marysville, WA 98270
Ph 425-377-1550
Fx 425-377-0408

Our goal as a company is to provide unsurpassed customer service, employ the most qualified personnel and to operate efficiently and in a safe manner. When you contract BDS for your underwater project you can expect the project to be completed on time, successfully and accident free.

General Service Overview

BDS provides underwater inspection, maintenance, construction and technical support services to customers around the world. Our services are designed to suit the needs of the specific industries served.

Inspection Services (Divers, Remotely Operated Vehicles and Sonar)

Highly qualified inspectors and technicians use site-specific procedures and innovative practices to assess current conditions and assist in projecting long-term maintenance requirements. Our approach combines knowledge of industry requirements with specialized training and diving techniques to assure inspections are relevant to customer needs. BDS inspectors are trained and certified in accordance with applicable industry codes and standards. Manned and/or remotely monitored underwater inspections are routinely performed using the most state of the art equipment available. Often times our inspections are performed in less than desirable conditions - turbid or black water, severe tidal or river currents, and in pipelines or tunnels with penetrations of over 1 1/2 miles from the point of entry. In these types of environments we are required to utilize a varied assortment of imaging tools and systems. We own, maintain and bring to work the most advanced technologies for underwater inspections. In doing so, we are able to perform the most detailed underwater survey on the market.

INDUSTRIES SERVED

- POWER GENERATION
- TUNNELING AND MINING
- HEAVY CIVIL & MARINE CONSTRUCTION
- MARINE SALVAGE
- BRIDGES
- PIERS, WHARFS AND DOCKS
- MARINE TERMINAL
- POWER AND GAS TRANSMISSION
- ENGINEERING FIRMS
- HOMELAND SECURITY
- WASTEWATER
- POTABLE WATER
- SUBMARINE CABLE
- PULP AND PAPER
- DREDGING
- SHIPS HUSBANDRY
- ENVIRONMENTAL SCIENCES
- SUBMARINE CABLE (POWER/TELECOM)

Maintenance & Repair Services

Preventative maintenance and repair services are designed to reduce costs, minimize downtime, and avoid costly unplanned work. Our teams work closely with the customer to ensure maintenance programs are consistent with the facilities unique technical specifications and operating requirements.

Construction & Rehabilitation Services

BDS offers turnkey services for large rehabilitation and construction projects. We also provide diving support to marine construction companies and engineering firms. Either way, you get trained, experienced, knowledgeable personnel working with the resources they need to do the job right.

Technical Support Services

BDS has experience solving complex technical issues. We routinely work with our customers to develop safe, effective solutions geared to your project specific requirements. As a member of your project team, BDS can assist with project specifications, material selection, procedure development, and scheduling.

Marine Salvage Services (Emergency 24/7 Worldwide Response)

With over 20 years of experience BDS performs heavy marine salvage operations and raises the bar for the salvage industry. We assist Coast Guard, corporate and private clients in the recovery of stranded and sunken vessels, wreck removal and harbor clearance, derelict vessel removal and environmental mitigation.

Voice 206-782-6750 Fax 360-993-5581 Visit us on the Web: www.ballarddiving.com

Vessel Services

BDS is known for providing the most advanced undersea technology available for inspection, maintenance and construction. That reputation holds up above water too. An integral part of any diving, ROV or sampling project is the support vessels. This is a logistical item where quality is frequently overlooked, however, we know that safety, reliability, seaworthiness, speed, and comfort are all issues that can make or break a project. We are
used to working in the most extreme conditions on the planet - we want our customers and our personnel to have the upper hand.

Environmental Services

We provide private and public sector clients with marine sample collection services including sediment, water, tissue and hazardous substance.

At BDS we use our extensive knowledge and experience in design, construction and operation of deepwater automated systems monitor a wide spectrum or environmental parameters for water quality and marine sediments. Additionally, BDS has a wide range of work platforms to support our field operations, allowing us to work in any marine environment, from tidal wetlands to the open ocean. Our personnel include skilled staff with backgrounds in deepwater survey, sample collection, vessel operations, navigation and positioning and complex subsea operations.

We continue to develop new technological applications and work with the latest water quality and sediment sampling equipment available to provide accurate and reliable data on a consistent basis.

Voice 206-782-6750 Fax 360-993-5581 Visit us on the Web: www.ballarddiving.com

Known for their determination and problem-solving skills, technological innovations, and exceptional client support, the goal of BDS is to provide the best service combined with appropriate technology, to produce the information you will need for your projects.

Tunneling and Mining Support Services

BDS provides tunnel, shaft, caisson and pipeline construction support services for premier tunneling and mining contractors and joint ventures. BDS has a reputation for managing highly complex tasks in a cost effective and efficient manner. By providing specialty turnkey solutions to contractors requiring hyperbaric equipment and personnel and commercial diving services BDS has become a preferred international provider.

Service Highlight: Heavy Construction - Deep Water Mixed Gas Diving, ROV, Sonar

Project: Cheesman Dam
Location: Dillon, CO
Work Scope: Mixed gas diving gear, multiple hyperbaric chambers, barges, multiple cranes and other equipment were mobilized to a remote, high mountain lake in Colorado. The work scope included cutting away a domed trashrack, salvaging a 115 year old intake valve (35,000lb) for placement in a museum, performing underwater steel burning and concrete removal (hydraulic breaking and 40000 psi water blasting), ROV assisted hydrographic surveys, internal ROV inspection of the intake tunnel system with ultra-accurate sonar dimensioing, three dimensional imaging of the tunnel systems, ROV inspection of trashracks and additional work. All of this work was completed in 180 feet of water at 7000 feet of altitude. This is a perfect example of utilizing traditional diving methods and highly technical underwater robotics systems to accomplish complex underwater tasks in a safe and efficient manner.

Voice 206-782-6750 Fax 360-993-5581 Visit us on the Web: www.ballarddiving.com

Service Highlight: Open Water Inspection and Construction

Project: Hood Canal Bridge Anchor Cable Inspection and Repairs

Customer: Washington State DOT; Doug Stone, Senior Bridge Engineer; (360) 570-2576

Issue: An anchor wire holding the Hood Canal Bridge in place broke. The anchor block is in 350 feet of water.

Work Scope: BDS mobilized personnel, vessels, multiple ROVs and other equipment to the site with 24 hours notice. BDS surveyed the 40' x 20' x 20' anchor block and located components of the wire connection system with an inspection class remotely operated vehicle. BDS then utilized a larger work class vehicle to remove heavy marine growth from the anchor block at the connection point. One hundred percent coverage of sea anemones and other marine life was completely removed. BDS also recovered multiple 85lb. "jewels" (valuable cast steel components of the anchor connection system) that were located in a 45' radius of the block and salvaged from the bottom. These "jewels" were sitting in the mud and sand, half exposed. In house BDS engineers designed Vehicle Assisted Tooling (VAT) to perform the salvage of components. BDS then utilized another VAT to run a messenger line through the yoke of the anchor block. The wire had to be reeved through an 18" diameter sheave, four feet wide. With the messenger in place BDS then assisted Manson Construction in the installation of a new 1 ½" diameter line. A post construction survey was performed after the wire was connected from the anchor block to the bridge and tensioned hydraulically. All tasks had to be accomplished in poor visibility and heavy tidal currents.

Service Highlight: Long Duration Environmental Sampling – Multiple Locations

Project: Power Grab Sampling / Vibracoring, Hanford Reservation, Washington

Customer: Integral Consulting

Scope: BDS mobilized personnel and custom equipment for bottom grab sampling of 330 samples along a 150 mile stretch of the Columbia River using a pneumatically assisted "clam shell" style sampler. Current up to 8 knots and water depths as shallow as 1 foot with 20 knot winds and sub-zero wind chill were just a few of the challenges for this job. Using a combination of DGPS and navigation software BDS operators stayed on position live boating. Live boating was the safest and most efficient means to stay on position and collect samples. All processing was performed on the vessel.

Safety

BDS operations are conducted under the applicable OSHA regulations. Operations incorporate the ADCI Consensus for Commercial Diving and Underwater Operations, as revised. BDS personnel are equipped with USCG approved Work PFD's, harnesses and protective helmets in accordance with the assigned work detail. The crew is equipped with First Aid kits and trained to provide rescue and recovery for personnel working on vessels. A Job Safety Assessment (JSA) routinely conducted.

We pride ourselves on the experience and training levels of our employees and key personnel. All NUC personnel are certified through the ADC (Association of Diving Contractors) as Life Support Technicians, Mixed Gas Diving Supervisors and Mixed Gas Divers, ROV Pilots, ROV Supervisors.

Continued education is required for all personnel associated with field activities from estimators and project managers to field labor. Here is a brief list of employee qualifications:

- ADCE Commercial Dive School Certifications
- Diving Medical Technicians
- US Army Corps of Engineers Unlimited Diving Supervisors and Divers
- Association of Diving Contractors Mixed Gas Diving Supervisors, Life Support Technicians
- National Board of Medicine Certified Hyperbaric Technicians
- HazMat Supervisors (80 Hour)
- OSHA Industrial Safety
- Certified Rigger and Crane Operators
- Oil Spill Management
- Radiological Worker (Level 2)
- Department of Defense Security Clearances
- Nuclear Regulatory Commission Security Clearances
- Confined Space and Confined Space Rescue
- AGC Quality Control and Quality Assurance Training
- Certified Underwater Welding to AWS D3.6, ASME Section IX
- Non Destructive Testing Level 2 and 3 (Ultrasonic, Mag Particle, and Dye Penetrant)
- Underwater Bridge and Substructure Inspection Technicians
- Emergency Oxygen Administration
- First Aid/CPR

Insurance

BDS maintains current policies including:

- General Marine Liability
- Hull and P&I
- Jones Act
- United States Longshore and Harbor Workers Act
- Pollution
- Commercial Auto
- Builders Risk
- Umbrella

Please feel free to call for a current certification.

Experience Modification Rates – The REAL indicator of a company's safety record…

The experience factor is the number that indicates how this company's claims experience compares with the rest of that industry. It's used to raise or lower the premium rate they pay to cover workers' compensation claims costs.

L&I calculates an experience factor by comparing a company's accident costs to the average costs of other companies in the same risk classification. An experience factor greater than 1.0 indicates a company has had higher-than-average claim cost; lower than 1.0 shows lower-than-average claim cost. New businesses usually start out with a factor of 1.0 until they are "experience rated."

01/01/2009	0.6000
07/01/2008	0.6146
01/01/2008	0.6000
01/01/2007	0.6000
01/01/2006	0.6750

Voice 206-782-6750 Fax 360-993-5581 Visit us on the Web: www.ballarddiving.com

BALLARD DIVING & SALVAGE INC

1525 NW Ballard Way   Seattle, Washington   98107
VOICE   206-782-6750 **FAX**   206-782-8944 **EMAIL** Divers@ballarddiving.com

UNDERWATER CONSTRUCTION AND SUBCONTRACTING

Certified Welding to AWS Standards
Underwater Exothermic Burning
Concrete, High Pressure Grouting
Core Drilling, Track Sawing
Diamond Wire Saw
Piling Repair, Wood, Steel, Concrete
Water Jetting and Dredging
Debris Removal
Zebra Muscle Control
Pipeline, Installation and Location
Pipeline Penetrations
Pipeline Pigging
Cable Installation and Location
Diffuser Repair and Installation
Coffer/ Limpet Dam Fabrication & Sealing
Cathodic Protection Engineering Services
Anode / Cathodic Protection
Anode Manufacturing
Outfall Repair and Construction
Trash Rack Repair and Installation
Traveling Water Screen Repair
Sluice and Trunnion Gates
Circ. Water Pumps Intake Screens
Chemical and Air Diffusion Systems
Underwater Painting and Coatings
Piledriving and Marine Construction
Crane Services 0-300 Tons
Ship Husbandry and Repairs
Vessel and Barge Rentals
Surface Mixed Gas Diving 0-299 Feet
Saturation Diving 250-1200 Feet

UNDERWATER INSPECTIONS AND SURVEYING

Bridge Inspections
Scour Investigations
Bathymetric Surveys
-RESON SEABAT 9001
ROV Services
Lock and Dam Inspections
Pipeline and Outfall Locating and Mapping

UNDERWATER INSPECTIONS AND SURVEYING-CONTINUED

Cable Locating and Mapping
Non-Destructive Testing
-Ultrasonic Inspections
-Magnetic Particle Inspections
Ferry Terminals
Tunnels and Aqueducts
Concrete, Steel & Wood Inspection
Ship Husbandry
ABS Class Inspections
Underwater Sediment Sampling
Color Closed Circuit Video
Color and B/W Still Photography
Land and Marine Surveying

CONTAMINATED AND POTABLE WATER DIVING

Raw Sewage / Clarifier
Biological / Chemical / Industrial Effluent
Nuclear Spent Fuel Pools / Reactors
Drinking Water
Water Towers / Stand Pipes/ Reservoirs

ENVIRONMENTAL / REMEDIATION

Shoreline Erosion
Soil Retention and Stabilization
Stream Restoration
Habitat Restoration
Soil and Water Sampling
Waterbars-Diversionary Methods
Vibracore Services
Turbidity Curtains (Installation and Maintenance)

CONTACT INFORMATION

Ballard Diving and Salvage, Inc.
Michael Eakin – Estimator
Office 866-270-1114 x 14
Mobile 971-563-9706
800 NE Tenney Road # 110-530
Vancouver, WA. 98685
www.ballarddiving.com

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APPENDIX E

Bilge Socks – Product Comparison Table, Public Education Documents, & State Endorsement Letters

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Bilge Sock - Oil Removal Comparisons

Manufacturer	Product	Description	Size	Price	Claim-Capacity	10-min. test, .5 qt oil	2-hr. test, .5 qt oil	10 day test to capacity
Encapsulators								
Abtech Industries	Oars Bilge Skimmer	Plastic mesh. Two tubes of porous material inside.	10" x 4" x 2"	$10.00	1 qt	fast	pass	pass
Advanced Aquatic Products	Bilge Bud	White stretchy sock sewn shut over flexible insides. 5" tie cord attached.	3.5" x 7" x 1"	$19.95-23.95 for a 2 pack	.5 qt	medium	fail	pass
Blue Ribbon Environmental	Prozorb Bilge Boom	White stretchy sock outside with loop handle. Flexible inside	14" x 4" dia	$9.96	3 qts.	medium	fail	fail
Lakefront Enterprises	Bilge Sock Captain's Choice (item #403)	White fabric shell with loop handle. Soft pliable pellets inside.	20" x 3" dia.	$11.99	2.5 qts.	very fast	pass	pass
Collectors								
Blue Ribbon Environmental	Polypro Bilge Booms	Plastic mesh outside with loop handle. Packed with "absorbent" material remnants.	13" x 3.75" dia.	$11.00	no claim	slow	pass	No claim
Eagle Marine	Oil Absorbing Bilge Boom	Plastic mesh outside with loop handle. 155" polypro sheet rolled up inside.	14" x 4.25" dia.	$10.99	4 qts.	slow	pass	fail
Seafit	Bilge Oilsorber	Plastic mesh outside with loop handle. 56" polypro sheet rolled up inside.	16" x 3.75" dia.	$9.99	2 qts.	slow	pass	fail
Seafit	Oilsorb	Nylon mesh with a fabric sock inside, packed with loose fibers. Snap shackle on end.	20" x 6.5 dia.	$19.99	6qts	very fast	pass	pass
Starbrite	New Maxi-Boom Bilge Oil-Absorber	Plastic mesh outside with loop handle. 56" polypro sheet rolled up inside.	16" x 3.75" dia.	$6.99	2 qts.	slow	pass	fail
3M	Bilge Pillow	Then fabric shell. Loose fibers inside.	7" x 15" x 1.5"	$9.99	2qts.	fast	pass	pass
Bio Bugs								
Eagle Marine	Bio-Remediating Bilge Boom	Plastic mesh outside with loop handle. 130" polypro sheet rolled up inside.	14" x 4.5" dia.	$11.99	4 qts.	very fast	pass	pass
Petrol Rem	Biosok Bilge Cleaner	Fabric outside, with retrieval cord on one end. Soft sandy feel inside.	9" x 3" dia.	$24.99	.5 qt	slow	fail	pass

Adapted from Boat US Findings Report #34: Pillow Talk - Go Soak Your Bilge, July 2001
http://www.boatus.com/foundation/findings/oil_removal_products.htm

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Stop discharges of oil and fuel into coastal waters— Use a bilge sock!

Oils, gasoline and diesel fuel, when released into the marine environment, are toxic to marine plants and animals. A poorly maintained engine or an accidental spill may cause these products to collect in the boat's bilge, and be discharged into the water when the bilge is pumped.

A bilge sock contains an absorbent material that will remove these petroleum products from bilge water. Place the sock into your bilge. Use the attached loop to secure the sock to avoid interference with the bilge pump. Check on the sock at least monthly and replace when oil or an oily sheen can be seen in the bilge, indicating that the sock has absorbed to capacity. Dispose of used socks properly: remove from bilge, allow to dry, place in a plastic bag and dispose with your household trash. Check with your marina operator with questions about recycling or disposal options at each facility; also check with your harbormaster about disposal options at public facilities.

Not all bilge socks are created equal. These disposal directions apply only to this specific product. Check with the manufacturer for the proper disposal of other products.

Other steps boaters can take to keep coastal waters clean:

- ✓ Prevent leaks by keeping your engine well tuned.
- ✓ Keep your engine clean to spot leaks more easily.
- ✓ Never discharge untreated bilge water directly into coastal waters. It's the law!
- ✓ Never add detergents or emulsifiers to your bilge –when pumped overboard they will degrade water quality.
- ✓ Avoid spills—stay alert when fueling.
- ✓ Do not top off your tank—fuel expands as it heats up!
- ✓ Report spills immediately by calling (800) 424-8802. It's the law!
- ✓ Do not use emulsifiers or dispersants (soaps) to treat a spill. It's the law!

===

The Massachusetts Office of Coastal Zone Management (CZM) is providing these free bilge socks to boaters. This product, Enviro-Bond, was chosen because of its ease of use and disposal, as well as its oil-absorbing capabilities. If your engine is well maintained, one of these bilge socks should last through the boating season. Through this educational program, CZM hopes to encourage boaters to use these inexpensive products on a regular basis.

Although CZM does not expressly endorse or guarantee any particular product or vendor, you may obtain further information on this bilge sock product, including purchasing additional bilge socks from the vendor, by visiting the vendor's website: **www.enviro-bond.com.**

For more information about this project and CZM, check out our website at: www.state.ma.us/czm or call us at (617) 626-1212.

Jane Swift—Governor
Bob Durand—Secretary of Environmental Affairs
Tom Skinner— CZM Director

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BOATS THAT USE BILGE SOCKS HELP TO PROTECT OUR WATERS

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Denise Koch

From: Colin Daugherty <cdaugherty@chadux.com>
Sent: Friday, December 30, 2011 8:29 AM
To: Denise Koch
Cc: John LeClair
Subject: RE: Cost Breakdown for Sorbent Materials

Denise,
The cost details we talked about yesterday are reiterated below. Hope it helps.

All the best,
Colin Daugherty
Response Supervisor
Alaska Chadux Corporation
Office: 907-348-2313
Cell: 907 529-7920
www.Chadux.com

From: Denise Koch [mailto:D.Koch@oasisenviro.com]
Sent: Thursday, December 29, 2011 5:21 PM
To: Colin Daugherty
Cc: John LeClair
Subject: Cost Breakdown for Sorbent Materials

Hi Colin.

Thanks for providing the ball park cost estimate for buying a 20 ft connex, filling it with sorbent material, and shipping it to Dutch Harbor.

I realize that it's a ball park estimate but could you provide the cost itemization (e.g. connex cost, sorbent material costs, shipping cost)?
Conex cost: $3,200-$4,000, FOB Seattle ("One Trip Boxes")
Material Cost: 15" x 18" sorbent pads, 200/bale: $33- You may want to go to bales of 100
Oil Socks, 3" x 4': $39.50/Case of 30.
250 bales pads, 100 cases of socks: $12,200. You may be able to fit more in a 20' conex.
Shipping: 20' conex, Fife WA to Dutch: $5,429 including 30% fuel surcharge.
Misc. dray in Seattle and Dutch: $800 (High end)
Apx. Cost: $22,429.
(Your $22K for 20 ft connex estimate includes purchasing the connex. The DAWG $38.5K 40' connex estimate only includes the rental of the connex to ship the items. I want to make sure that I provide the Trustees with an apples to apples comparison.)

What company would you use to ship the connex?

Are there abandoned or surplus connexs in Dutch that we could use? I'm wondering if it makes more sense to buy the 20 ft connex or just ship it in the connex and offload to storage or connex in Dutch Harbor.
Good boxes are hard to find in Dutch.

Thanks again.

Denise

Denise Koch

OASIS Environmental, Inc., an ERM company
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Juneau, AK 99802

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Denise Koch

From: Scott Bakewell <scott_bakewell@dawginc.com>
Sent: Wednesday, December 14, 2011 11:26 AM
To: Denise Koch
Subject: DAWG

Hi Denise,

Glad that we were able to talk today. The first option I think would be fine but, a lot of time on the water and freight is costly. Freight to West Coast then Sea freight would be the same if not more. I think second option makes a bit more sense. We will have the product made on Washington, we have a smaller manufacturing operation we use out that way from time to time. The product will be comparable, dimensions on the pads will be a bit different and packaging for the socks.

Freight breakdown:

- Equipment: 40' HC
- Pick Up, Truck, Ocean to Port: $8200.00

Special Instructions:

Door to Port: Rate based on Non Hazardous Materials. Shipper/Consignee responsible for loading/offloading. Rate per each container. Live load at Seattle Washington

Product:

PAD114-US 15"W x 18"L Light 38 gal./Case 200/bale $39.00 per bale (500 bales)

- Pads are for use indoors around leaky machinery or equipment or outdoors for environmental applications
- Economy Oil Only Pads are made of a highly-absorbent, fine fiber construction that traps only oily liquids leaving clean water behind
- Oil Only pads float on water even when fully saturated
- Effectively absorbs petroleum-based liquids, not water
- Bright white color makes absorbed liquids making it easy to see
- Incinerable to less than .02% ash; high BTU value (22,000 BTU's per pound)
- White oil only pads are also an economical alternative to gray universal when you have to clean up oil only spills or drips, but don't need to spend the extra cost of universal absorbents
- Available in pads and rolls in multiple sizes

DAWG301-US 3" Dia. x 48"L 12 gal./case 30/Case $54.00 per case (200 cases)

- Dawg® Oil Only Socks remove oil from troughs and vats, indoors or out
- Absorbs oil from water around leaking machines exposed to rain, waste streams and various other oil/water separation applications
- Polypropylene socks are wringable for reclaiming liquids
- Oil absorbent socks ideal for oil spill control, skimming oil off water and oil spill cleanup
- Measures 3" Dia x 48"L
- Comes in 12 pieces per case
- Absorbs up to 12 gal per case

The product configuration is an estimate. Product and freight bases on this quote will be $38,500.00.

Look forward to speaking to you on the 5th!

Best regards,

--
Scott Bakewell
V.P. Sales
Dawg, Inc.
email: scott_bakewell@dawginc.com
web: www.dawginc.com
ph: 800-935-3294 ext: 834966
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fx: 800-545-7297

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
OFFICE OF COASTAL ZONE MANAGEMENT
251 CAUSEWAY STREET, SUITE 900, BOSTON, MA 02114-2136
(617) 626-1200 FAX: (617) 626-1240

December 16, 2002

Bob Bergquist, President
Lakefront Enterprises, Inc.
PO Box 573
North Hampton, NH 03862

RE: Enviro-Bond Bilge Socks

Dear Bob:

CZM's bilge sock program was a huge success during the summer of 2002. With help from harbormasters, watershed groups, local non-profits and others CZM gave out over 18,000 Enviro-Bond bilge socks. As we know, oils, gasoline and diesel fuel, when released into the marine environment, are toxic to marine plants and animals. A poorly maintained engine or an accidental spill may cause these products to collect in the boat's bilge, and be discharged into the water when the bilge is pumped.

The key to the success of the program was the unique properties of the Enviro-Bond polymer. The ability for each sock to permanently encapsulate petroleum products in the bilge allowed boaters to dispose of the used socks with their household trash. The Massachusetts Department of Environmental Protection agreed that if these socks passed their "one-drop test," they could be disposed with household trash, similar to a car's oil filter. The Enviro-Bond polymer passes this test.

Thank you for providing a high quality, effective, inexpensive and easy to use product. Each bilge sock could absorb up to 2 ½ quarts of oil. Therefore, 18,000 socks could have removed over 11,000 gallons of petroleum products from our waterways. The coastal waters of Massachusetts are most likely cleaner today due to the wide array of environmental products available to boaters. It was a pleasure doing business with your company.

Sincerely,

Robin Lacey
Marina Assistance Program

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County of Volusia

Environmental Management
123 West Indiana Avenue • DeLand, Florida 32720-4621
Telephone: (386)736-5927 • (386)254-4612 • (386)423-3303
Suncom (386)377-5927 • Fax (386)740-5193

Dear Marine Supply Business Owner/Manager,

The Environmental Management Department for Volusia County will be distributing sample bilge socks, which are a type of fuel/oil absorption device that is placed within the bilge of a boat, to participating marine supply businesses throughout Volusia County. The socks along with educational literature will be given free of charge to each participating business for display. The sample socks may also be given away as promotional gifts to customers. We are providing educational literature and this quality absorption product for these reasons:

1) To raise awareness in the boating community of the cumulative, detrimental effects of bilge water laden with fuel and oil on the marine environment.
2) To encourage boaters to use absorbent bilge socks, pads or pillows to capture the oil and fuel before it is discharged into the waterway.

The sample product that we are providing also has the additional benefits of:

1) Ease of installation – the sock is a convenient size for even small bilge compartments.
2) Ease of removal – this sock is filled with a polymer that bonds molecularly with oil and fuel, forming a solid that will never drip or leak contaminants back into the water when removed.
3) Ease of disposal – the ENVIRO-BOND sock, which was competitively selected for this program, has been certified by a Florida State Laboratory for landfill disposal and can be put out with household garbage.
4) Added safety – the ENVIRO-BOND polymers trap fuel vapors and reduce dangerous off-gassing by 80% within the first 5 minutes, which reduces the risk of spontaneous combustion and fire.
5) Non-toxic – the polymers in this sock are FDA Food Grade and are non-toxic, non-corrosive and non-carcinogenic, they are also harmless to fish and wildlife.

We hope that you will participate in the program by displaying the educational materials and sample bilge socks. The benefits to your marine supply operation will be:

1) Giving added value to your customers by giving away a few socks, through whatever means you decide (contest, raffle etc.)
2) Added sales of fuel absorption devices.
3) Showing customers your business' concern for the environment and desire to help keep Volusia County beautiful.

This project is funded through a grant with the Florida Department of Environmental Protection Natural Resource Damage Restoration Program. To participate, or for more information, please call Georgia Zern at 904-736-5927 xt. 2839.

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APPENDIX F

FORS Bilge Oil Collector Diagram

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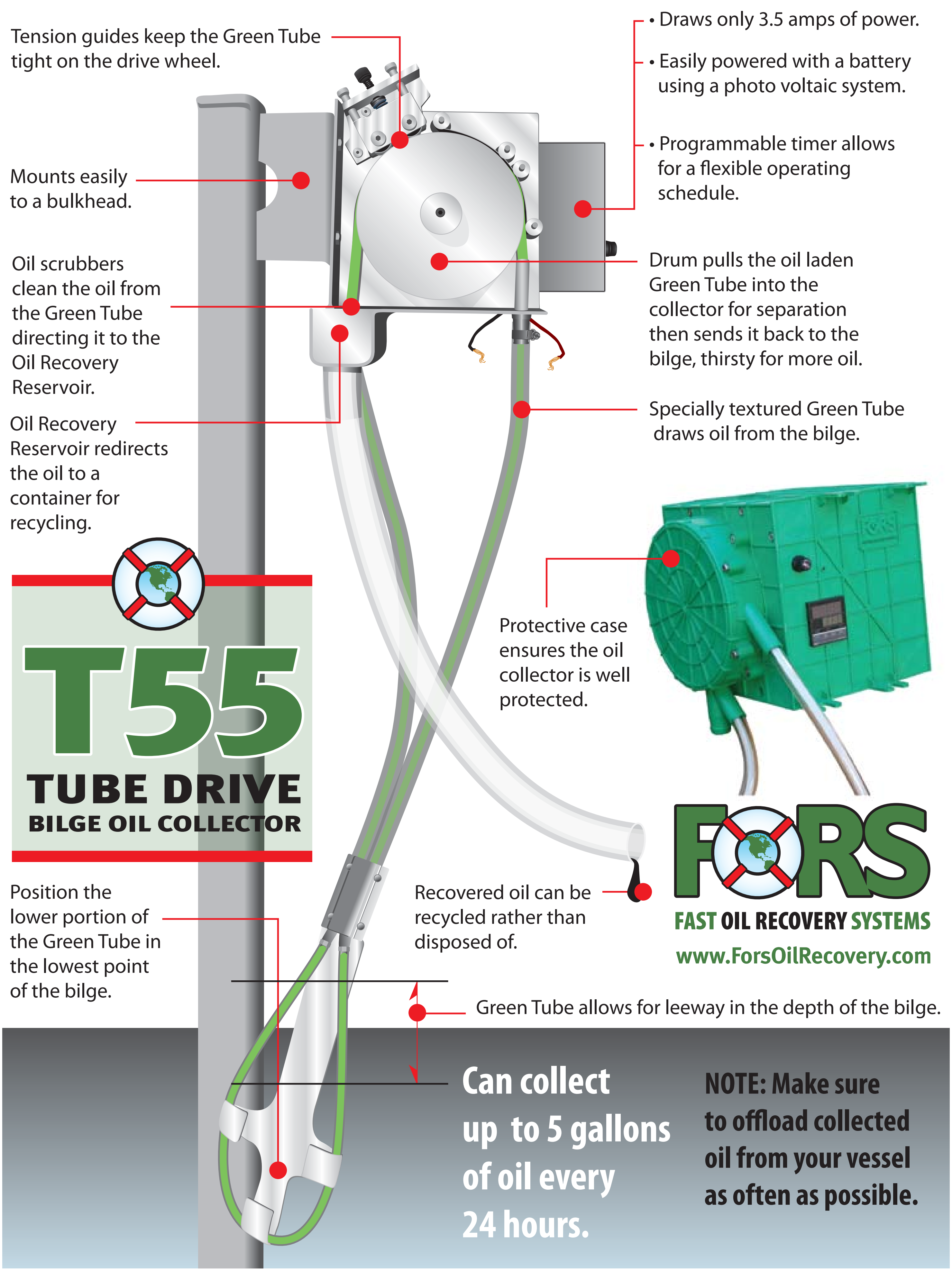

Tension guides keep the Green Tube tight on the drive wheel.
• Draws only 3.5 amps of power.
• Easily powered with a battery using a photo voltaic system.
• Programmable timer allows for a flexible operating schedule.
Mounts easily to a bulkhead.
Oil scrubbers clean the oil from the Green Tube directing it to the Oil Recovery Reservoir.
Drum pulls the oil laden Green Tube into the collector for separation then sends it back to the bilge, thirsty for more oil.
Oil Recovery Reservoir redirects the oil to a container for recycling.
Specially textured Green Tube draws oil from the bilge.
Protective case ensures the oil collector is well protected.
T55
TUBE DRIVE
BILGE OIL COLLECTOR
FORS
FAST OIL RECOVERY SYSTEMS
www.ForsOilRecovery.com
Recovered oil can be recycled rather than disposed of.
Position the lower portion of the Green Tube in the lowest point of the bilge.
Green Tube allows for leeway in the depth of the bilge.
Can collect up to 5 gallons of oil every 24 hours.
NOTE: Make sure to offload collected oil from your vessel as often as possible.

APPENDIX G

Evaluation of Oil Reductions Anticipated from Controls of Major Sources

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Evaluation of Oil Reductions Anticipated from Controls of Major Sources

Major Sources - Annual Inputs (gallons)				
Major Oil Input	**Lower Estimate of Oil Input (gallons)**	**Potential Upper Estimate of Oil Input**	**Average of Lower & Upper Estimates**	**Comments**
Creosote treated pilings	125	1,135	630	
Vessel bilge	329	1,971	1,150	
Major Vessel Oil Spills	1,176	2,041,662	111,479	Vessel oil spills >1,000 gallons from 1981 to 2004. Not annual data. Some years no spills.
Minor Oil Spills	99	1,497	798	

Major Sources Control Evaluation						
Intensive Controls						
Input	**Intensive Controls**	**Estimate of Reduction**	**Total Cost**	**Cost per Gallon Reduced**	**Associated Cost**	**Comments**
Creosote treated wood pilings	Wrap Existing Piles at UMC Dock, Position 3	PAH removal equivalent to 350,000 gallons spilled oil	**$510,000**	**$1.46/gallon** ($510,000/350,000 gallon PAH equivalency)	$75,000 mob/de-mob cost + $8,700 per piling	Assuming 50 pilings wrapped.
Creosote treated wood pilings	Remove and Replace Piles at Spit Dock	PAH removal equivalent to 350,000 gallons spilled oil	**$1,322,500**	**$3.78/ gallon** ($1,322,500/350,000 gallons PAH equivalency)	$300,000 - $460,000 mob costs + $17,250 per piling	Assuming 50 pilings replaced
Vessel Bilge	Free sorbent material distributed at City Harbors	**21,400 gallons absorbed** (38 gallons/case of pads * 500 cases) + (12 gallons/case of socks * 200 cases)	**$30,300**	**$1.42/ gallon** ($30,300 / 21,400 gallons absorbed)	Storage space rental (**$2,846** per year = $1.20 per sq foot * 2,372 sq ft) + Shipping via 40' conex (**$8,200**) + Building post and attach boxes (no estimate) + Distribution of materials (**$100 per day** for several harbors) + **$240** inventory ($120 per inventory 2x per year) + Disposal of used sorbents ($200 per 55-gallon drum).	DAWG, Inc. (100,000, 15"W x 18"L pads) + (6,000, 3" dia x 48"L bilge socks) + disposal bags. Gloves (PPE) extra

Evaluation of Oil Reductions Anticipated from Controls of Major Sources

Major Sources Control Evaluation						
Intensive Controls						
Input	**Intensive Controls**	**Estimate of Reduction**	**Total Cost**	**Cost per Gallon Reduced**	**Associated Cost**	**Comments**
Vessel Bilge	Free sorbent material distributed at City Harbors	**10,500 gallons absorbed** (30 gallons/bale of pads * 250 bales) + (30 gallons/case of socks * 100 cases)	**$12,200**	**$1.16/ gallon** ($12,200 / 10,500 gallons absorbed)	Storage space rental (**$1,200** per year = $1.20 per sq foot * 1,000 sq ft) + Shipping via 20' conex (**$5,400**) + Building post and attach boxes (no estimate yet) + Distribution of materials (**$100 per day** for several harbors) + **$240** inventory ($120 per inventory 2x per year). If you want to purchase 20 ft conex for shipping and storage, it will cost **~$4,000 i**n Seattle. + Disposal of used sorbents ($200 per 55-gallon drum).	Purchase Through Spill Control, Inc. (50,000, 15"W x 18"L pads) + (3,000, 3" dia x 48"L bilge socks) + [potentially extra for disposal bags + gloves (PPE)]
Vessel Bilge	Free sorbent kits distributed at City Harbors	**2,625 gal** (7.5 gal per Salty Dawg Kit * 350)	**$10,150** ($29 per Salty Dawg spill kit * 350)	**$3.87/ gallon** ($10,150/2,625 gallons absorbed)	Storage space rental (~**$400**) + Shipping (**$632** once per year) + Building post and attach boxes (no estimate yet) + Distribution of materials (**$100 per day** for several harbors) + **$240** inventory ($120 per inventory 2x per year) + Disposal costs ($200 per 55-gallon drum).	DAWG, Inc. Salty Dawg Premim Boat kits contain Premium Kit Contains: 15- Oil Only Pads 3 Bilge Socks 2 Pillows 50 Wipers 3 Temporary Disposal Bags 1 Pair Gloves
Vessel Bilge	Fast Oil Recovery Systems	**338 gallons**	**$22,500**	**$67/gallon** ($22,500/338 gallons removed)	Shipping the FORS system to Unalaska is extra.	$900 per ship * 25 ships = $22,500

Evaluation of Oil Reductions Anticipated from Controls of Major Sources

Major Sources Control Evaluation						
Intensive Controls						
Input	**Intensive Controls**	**Estimate of Reduction**	**Total Cost**	**Cost per Gallon Reduced**	**Associated Cost**	**Comments**
Major Vessel Oil Spills (>1,000 gallons)	Prevention of incidents and more efficient response to vessel casualties. More AIS receivers needed to monitor Aleutian vessel traffic. There are gaps in vessel tracking coverage in the area where Selendang spill occurred.	**111,479 gallons** (Average volume of major vessel oil spill from 1981 to 2004)	Unfunded projects that remain include: Akutan (upgrade AIS equipment to extend range and reliability: $80k), Atka (new tracking station $85K); St. George Island: Upgrade AIS site to expand range: $75k	**$0.76/ gallon** ($85,000/111,479 gallons prevented)	MXAK only needs capital funds. They have sufficient funds to operate any new AIS sites.	"Expanded Range" typically means 6,000 - 15,000 additional sq miles of coverage and 20 - 50 miles from shore.
Minor Oil Spills	(2) 99 gallon spill carts + (2) 65 gallon spill kits	328 gallons	**$3,500** [99 gallon carts ($1,350 * 2) + 65 gallon spill kits ($400 * 2)]	**$10.67/gallon** ($3,500/328 gallons absorbed)	Shipping extra	Big spills handled by contractors. New Carl E. Moses harbor has funding for two container vans with oil spill response equipment. Only need kits for existing SBH.
Used Oil Disposal Bldg	Used oil disposal building at existing Small Boat Harbor and the C float by Unisea	Containment for existing outdoor tanks can prevent spills	**$115,000** (8 foot x 10 foot shed with containment)		Since the City already has a contract with North Pacific Fuel to dispose of the waste oil from the Small Boat Harbor, the Parties would not likely pay for the oil disposal costs, unless the presence of a waste oil building increased the volume of oil that was collected and consequently needed to be disposed.	There are 2 portable tanks on a trailer that hold a total of 200 gals of waste oil at the existing SBH. North Pacific Fuel picks up the waste fuel using a vacuum truck when the tanks are full (~3 - 4 months). The larger Carl E. Moses used oil building (34 ft x 20 ft) cost ~$413,000 ($375,000 to construct + ~$38,000 for planning & design). (Source: PND engineers)
Training for More Effective Response	Basic oil spill response training for small spills. (24 hr HAZWOPER)	14 Trained Volunteer Firefighters	**$4,200** ($300 for 14 volunteers)		Class cost varies dependent upon whether it is an on-line course, scheduled in-person course, or a custom scheduled course.	Unalaska Contact: Capt. Jon Droska
	Oil Spill Clean Up Response on-line training	5 Port Staff Members	**$600** $120 per staff member for 5 staff			Requested by former Port Director, Alvin Osterback