Preliminary Evaluation of Probable Costs and Benefits of Proposed Oil Transfer Rules

Prepared for

State of Washington Department of Ecology
Spill Prevention, Preparedness, and Response Program
PO Box 47600
Olympia, WA 98504-7600

By

Northwest Economic Associates
a division of ENTRIX, Inc.
12009 N.E. 99th Street, Suite 1410
Vancouver, WA 98682-2497

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Executive Summary

The objective of this analysis is to evaluate the anticipated benefits and costs of proposed regulations governing oil transfers over navigable waters of Washington State. The new regulations apply to facilities and vessels that transfer petroleum products for commercial and public activities. The regulations were designed in response to legislation in 2004 that adopted a "zero-spill" tolerance toward oil spills.

Expected Costs

Facilities and vessels involved in oil transfers are expected to experience additional costs as they modify operations to comply with the new regulations. One regulation covers several classes of facilities that conduct oil transfers, from large refineries to small marinas. Another regulation covers vessels transferring oil products either with facilities or vessels as bulk cargo, or with other vessels for fueling purposes. Costs associated with the proposed regulations for oil transfers will affect the economic entities engaged in these activities in different ways depending on the magnitude of the costs, the structure of the industry, and the specific firm.

Background on Oil Transfers in Washington State

Large oil companies that own and operate the five oil refineries in Washington State receive crude oil by tanker (as well as pipeline) and process the crude into a variety of products. Many of these products are then transferred again over water to tank barges that transport the products to terminals and tank farms throughout the Northwest. Often the tank barges are owned by transportation firms who will share in responsibility for complying with the new regulations.

Product storage terminals, or tank farms, perform over-the-water transfers to and from vessels. When a product arrives at a tank farm, it either is: (1) distributed inland to businesses via pipeline or tank truck, or (2) stored and eventually transferred back to a vessel for transport. When product is transferred to a vessel from a tank farm, it is considered a bulk cargo transfer. Another form of bulk cargo transfer is called a lightering which generally involves a large tank vessel transferring cargo oil to a smaller tank vessel. A vessel may deliver the bulk cargo to a host of businesses that abut Washington waterways, particularly pulp/paper mills and distribution depots.

Another major activity that involves marine transfer of oil products is that of providing fuel for commercial vessels to be used in propulsion. To this end, some products from refineries are transported to marine fueling terminals that fuel fishing boats and other commercial vessels. Also, mobile tank trucks travel over land to a dock or marina to fuel a vessel. Still another method of providing fuel to ships is to transport fuel over water directly with a tug and tank barge to ships that fuel or “bunker” at a non-fuel dock or at anchor. This latter type of transfer is described as a vessel-to-vessel type of transfer.

Cost Estimates

The following table identifies estimated per firm costs for each category of affected businesses (see Table ES-1). The averages represent the average annual cost over 20 years shown in 2006 dollars. The table also shows the number of firms within each category as well as an aggregate statewide total of expected costs per year. The categories are: Class 1 facilities that are oil refineries; Class 1 facilities that are not oil refineries (usually operating a tank farm); Class 2 facilities that are mobile tank trucks used to conduct fueling activities for vessels at docks; Class 3 facilities that provide marine fueling services to vessels with capacities greater than 10,500 gallons; Class 4 facilities that fuel non-recreational vessels with less than 10,500 gallon capacities; and vessels that transfer oil to other vessels. Public costs of the program are also included.

The estimated costs shown in the table were developed through interviews with industry representatives conducted between January and May 2006. Interviews were conducted in person, over the telephone, and through cooperation with industry groups.

The majority of the costs associated with these proposed regulations will be borne by the largest firms – those that operate oil refineries within the state. In most cases (but not all) the initial costs are associated with establishing a full-circle permanent boom at the dock that can be operated on a regular basis. Other costs include such items as boats used to deploy the boom, dock lighting, and other equipment. The boom operation is also costly to these companies because additional labor will be needed to conduct pre-booming. Average costs of the regulation for this sector are expected to be just under $6 million.

Costs for all sectors are based on costs that will be faced with the regulation in place as compared with costs that would be faced without the regulation in place. For the purpose of this analysis, it is assumed that none of these refineries will incur these costs in the absence of the regulation. However, one of the refineries may be affected by a legal settlement in the near future that would require pre-booming to occur for all transfers at that facility. If this settlement becomes binding, then the costs associated with that refinery pre-booming would no longer be considered costs associated with the proposed regulation since the firm would experience the costs both with the regulation in place and without. As yet, the legal settlement is not binding, and hence the costs of pre-booming are counted among the costs of this proposed regulation.

Other large facilities within Class 1 include large industrial plants such as pulp and paper mills, fuel distributors, and some marine fueling terminals that receive fuels via pipelines. These facilities are expected to respond to the regulations in one of two ways. One possible way to meet the requirement is to provide pre-booming equipment and personnel in-house at the facility. Costs for this approach are expected to average $121,747 annually. The other way that these facilities may respond is with the assistance of an oil spill response organization (OSRO). If an OSRO is used, it is assumed that a typical transfer would cost approximately $2,500 on average for the services of the OSRO to pre-boom, and provide the most costly services needed for compliance. Using transfer data collected by the Washington State Department of Ecology, the total cost to this category of facilities for those using an OSRO is expected to be $585,000. For the entire sector, three firms are assumed to respond with in-house capabilities, plus nine that will use contractors, results in an average annual cost of $79,187 for all 12 firms.

Mobile tank trucks (Class 2 facilities) are expected to pool resources and share the costs of equipment purchases so that boom will now be available at docks where mobile trucks fuel ships. Some firms are expected to comply via in-house provision of a “runner” truck that will carry boom to the transfer dock, and have the driver of the runner truck be trained to meet the new requirements. The latter is a more expensive option. Assuming that 75 percent of firms elect the cheaper cooperative method, total average annual costs are expected to be $29,423 per firm. The statewide total for this sector is expected to be just under $1.03 million annually.

Facilities that meet Class 3 standards are expected to experience additional costs associated with either pre-booming or having boom readily available. These facilities provide fueling services to fishing vessels and other smaller commercial vessels. Four firms have been identified in this category in the state. One, located on the Columbia River, is expected to shift all transfers to Oregon waters as a result of this regulation, leaving an estimated three firms affected. Annual costs to the sector total $72,204 on average to firms, and $216,612 for the State. Class 4 facilities are the many marinas that typically fuel mostly recreational vessels but also occasionally fuel some smaller commercial boats. Regulated for the first time, these marinas are expected to have compliance costs of $2,079 annually.

Table ES-1 Summary of Expected Costs to State of Washington from Proposed Oil Transfer Regulations

Affected Group	Number in State	Average Annual Costs per Firm	Average Annual Statewide Costs
Class 1 Facilities			
Refineries	5	$1,196,892	$5,984,461
Class 1 Facilities			
Other Large Facilities	12	$79,187	$950,240
Class 2 Facilities			
(*Mobile Tank Trucks*)	35	$29,423	$1,029,821
Class 3 Facilities			
(*Marine Fueling Terminals*)	3	$72,204	$216,612
Class 4 Facilities			
(Marine Fueling Outlets)	125	$2,079	$259,830
Vessels	5*	$297,291	$1,486,454
Public Costs			$410,000
Grand Total	**186**		**$10,337,417**

*Other companies operating vessels may be affected by the new regulations, but compliance costs are anticipated to occur at the facilities where these vessels conduct transfers. Therefore just five companies are included in this analysis.

Tugs and barges that transport oil products to and from terminals and refineries may be covered in terms of compliance through the costs that have been counted at the facility sites. That is, many transfers in this industry are between a facility and a tank barge or tank ship. However, vessel-to-vessel bunkering and cargo transfer (lightering) operations will have additional costs associated with pre-booming under the new regulations. It is assumed that a firm that conducts a large number of bunkering operations will provide compliance in-house at a fairly significant cost. However, most firms that transfer infrequently are expected to comply with the new regulations via the assistance of an OSRO. At least five firms have been identified that regularly deliver oil products. Other shipping companies may also be affected, but it is expected that these firms more typically deliver to facilities that will provide the pre-booming capacity. Total annual costs to the sector are expected to be just under $1.49 million annually.

The public cost of the new regulations will come in the form of five new employees at the Department of Ecology (DOE) who will provide inspections of facilities and vessels. These inspectors and the benefits provided to them are expected to cost $410,000 annually.

Expected Benefits

The proposed regulations governing oil transfers in Washington State are designed to reduce the size and magnitude of oil spills that derive from oil transfer activities. The benefits of the regulation therefore are expected to come from a reduction in the costs of oil spills. Oil spills in the future are expected to be either prevented, or reduced in terms of costs, when compared with what is occurring at the present time. To estimate the value of these benefits to the state, first an estimate is developed for the expected transfer-related oil spills in the future without the proposed regulation. Next, an estimate is developed for the expected costs of transfer-related spills with the proposed regulation. Benefits are derived by comparing the two sets of future costs, and the savings in costs are considered to be benefits associated with the regulation.

However, it is somewhat difficult to estimate the value of the reduced "cost" to the public of oil spills into State waters. The public may benefit by not losing as much water-based recreation such as fishing and boating. The public may also gain the value placed on preventing and containing oil spills in principle, regardless of whether or not they ever visit the water. For the purpose of this study, the benefits of the proposed regulations will include a reduction in costs associated with cleaning up oil spills, and a benefit to the public for oil spill prevention and containment.

It is important to realize that these estimates are based on probabilities of oil spills derived from historical data, trends, evidence from other states, and other estimates of the risks of oil spills. Yet if oil spills could be perfectly predicted, they would also be preventable. Hence the nature of this topic contains a greater degree of uncertainty than other types of economic estimates.

Costs of Transfer-Related Oil Spills in Washington

Data show that about 2,700 gallons of oil have been spilled annually in Washington State due to oil transfer procedures by commercial vessels and facilities over the past six years. Data from the 1990's demonstrates a similar spill pattern. In the wake of the Exxon Valdez Oil Spill in 1989, the Oil Pollution Control Act was passed. This raised awareness about oil spill prevention, preparedness, and response, and also altered protocols and regulation within much of the oil industry. Hence data from years prior to 1990 are avoided where possible.

For the purposes of this analysis, a total volume of expected oil transfer-related spills was estimated for the future based on past data and expected future trends. This annual value is higher than actual recent spills because the analysis assumes that the recent past does not include some of the "worst case" scenarios that are possible. A probability distribution was developed to estimate future spills for Washington; over 99 percent of this distribution is based on recent Washington State data with the remainder including worst case scenarios based on national data for large volume transfer spills. A probability distribution was used to estimate future spills on an annual basis. Spills are then assumed to increase in proportion to the projected volume of oil cargo transported in Washington State. The current expected volume of oil spilled annually is 4,571 gallons using this probabilistic approach. By the year 2026, this value is expected to increase to 5,312 gallons.

The costs for oil spills in economic terms is often divided into four general types that may overlap: the costs of cleaning up the spill, the cost of paying penalties and restoring the natural ecosystem, the cost of lost socioeconomic activities such as decreased recreational and commercial fishing opportunities, and lost passive use value. Within these categories there is wide variation as to the magnitude of oil spill costs depending on the size and location of the spill (nearer to shore generally cost more), the type of oil that is spilled (in general more persistent is more costly), and a number of ambient factors such as wind, current, time of day, etc. Passive use value accounts for losses that may be felt even by those who never directly use the environmental services. For example, residents of Washington may place economic value on the pristine shoreline and the existence of orcas even though they may never visit the shoreline nor see an orca. Other species of special interest are those listed as threatened or endangered, such as the Marbled Murrelet. Such economic values are known as non-use or passive use values since they reflect the value of an asset beyond any use.

Work completed by Environmental Research Consulting and other sources suggests that the total costs of oil spills ranges from $1 per gallon to over $4,000 per gallon spilled.[1] Another way to approach the estimation of values when both use values and passive use values are likely to exist is to find out directly how people value environmental protection. This is often done through a survey. A recent study in California estimated the value of a program that would provide readily available boom to catch all spills for the central coast of California. The results showed that California households were willing to pay an average of $76 per household for this service. The study estimated the total economic value to the public of a program that would perform similar preventative and containment functions as the proposed oil transfer regulations. These dollar values represent the value, or benefit to the public of oil spill prevention and containment.

Both passive use values and use values are included in the California estimate and so the estimate should cover the lost beach and recreational use value that accrues to the public as well as the passive use value to the public. It is difficult to know if the estimate is transferable to Washington without conducting a lengthy, location-specific contingent

1 Extrapolated from "Comments on *Draft 2003 Report to Congress on the Costs and Benefits to Federal Regulation*", (Federal Register, Vol. 68, No. 22, pp. 5492-5527).

valuation study like the one completed in California. However, this analysis borrows the California per household value based on similar types of coast line and a similar proposed program. The California estimate could overestimate Washington values because the study was aimed at all spills, and not just the 23 percent of spills related to transfers. Also, the study was conducted in 1995, and baseline conditions in California at the time may have been different. On the other hand, the California number might also underestimate the value of expected public benefit to the proposed Washington oil transfer rule because the program in California was only for a portion of the coastline, while proposed Washington rule will protect the entire state.

Assuming that Washington households would be willing to pay at least as much for a program that would protect the entire state, the total value of regulation for oil transfers is estimated to be on an average $6.28 million per year. This value is derived by updating the $76 per household to current 2006 dollars using the Consumer Price Index, and then assuming that 23 percent (Washington spills that are transfer-related) of this, or $22.23 per household is the amount households would be willing to pay. This amount is spread over a 10-year period (in accordance with the California study) so that Washington households are assumed to be willing to pay $2.23 per year for the program. As the number of households in the state is forecast to increase over the next 20 years, so have the number of households used in the analysis.

Costs Saved with Regulations in Place

It is difficult to estimate how much the costs of oil spills will be reduced with the proposed new regulations. Some spills will be prevented through the additional vigilance required to place the boom in the water ahead of time, and because in general there will be more people watching during a transfer. When it is not safe and effective to pre-boom, firms are required to report to DOE via email or fax why they are not pre-booming, thus alerting DOE to conditions during transfers, and allowing input from DOE on any questionable transfers. Prevented spills will provide the greatest benefit, since all of the cleanup costs will be saved. Based on a study by Environmental Research Consulting,[2] California was found to have prevented 13 percent of the volume of transfer-related spills when the State adopted a regulation requiring prevention measures and pre-booming of transfers.

When spills do occur, despite the best efforts in prevention and the use of containment, there are still benefits from two sources. If a spill occurs when pre-booming has been conducted,

[2] Etkin, Dagmar Schmidt, 2006, “Trends in Oil Spills from Large Vessels in the U.S. and California with Implications for Anticipated Oil Spill Prevention and Mitigation Based on the Washington Oil Transfer Rule.” Prepared for Washington Department 9of Ecology, under Contract No. C040018 by Environmental Research Consulting.

the cost of the spill is reduced through early containment. Also, boom will be available and ready to deploy anytime that it is unsafe and ineffective to pre-boom. Hence when pre-booming is not possible, the new regulations will facilitate the speed of spill containment after the fact.

Through prevention, early containment, and additional training (especially for mobile facilities) a great amount of the expected costs of transfer-related oil spills may reasonably be expected to be reduced. For this analysis, 13 percent of the volume of transfer-related spills is assumed to be prevented, thus saving all of the response costs expected for these spills. All but 15 percent of clean up costs are estimated to be saved for the spills that still occur, and so these cost savings are included among the benefits of the regulations. The total amount of response costs saved annually is estimated to range from $3.8 million to $4.4 million over the next 20 years.

The total potential benefits of the program are estimated to increase from just under $9.3 million to $11.4 million in twenty years. The average yearly amount of benefits over the 20 years in 2006 dollars is $10.37 million per year. Resulting benefits for the years 2007, 2012, 2017, and 2027 are displayed below (see Table ES-2).

Table ES-2
Average Annual Benefits

Benefit Source	2007	2012	2017	2022	2027
Expected Gallons Spilled	4,571	4,676	4,794	5,184	5,312
Response Costs	$3,803,295	$3,891,051	$3,989,267	$4,313,876	$4,420,336
Public Value	$5,479,627	$5,858,506	$6,260,439	$6,644,803	$7,010,821
Total Benefits	**$9,282,922**	**$9,749,558**	**$10,249,706**	**$10,958,679**	**$11,431,157**

Comparing Benefits and Costs

Costs and benefits discussed above are evaluated together through time using a present value estimate. This allows up-front costs to be weighed against the long-run benefits they may support. Values for both future costs and future benefits are discounted depending on how far into the future they are expected to occur. The rate of discount is usually equal to a social rate of time preference which can be estimated using the inflation free bond rate provided by an I-bond. That is, if inflation is removed from the calculations, we can assume that the dollar values presented in 2006 dollars in the current study will be the same (corrected for inflation). Therefore the discount rate provided by the inflation free I-bond gives a good estimate of the social rate of time preference. Table ES-3 shows the expected annual total costs in each of the next 20 years, total benefits in each of the next 20 years, each of these figures discounted to a present value, and the total present value of both benefits and costs over the time period.

Table ES–3
Total Expected Costs and Benefits of Compliance with New Oil Transfer Regulations for Washington State 2007-2026

Year	Total Costs	Total Benefits	Discounted Costs	Discounted Benefits
2007	$12,026,636	$9,282,922	$11,772,353	$9,086,650
2008	$10,001,255	$9,394,803	$9,582,807	$9,001,729
2009	$10,001,255	$9,507,074	$9,380,195	$8,916,702
2010	$10,001,255	$9,619,345	$9,181,866	$8,831,246
2011	$10,048,752	$9,749,558	$9,030,415	$8,761,541
2012	$11,101,880	$9,849,587	$9,765,877	$8,664,285
2013	$10,001,255	$9,949,617	$8,611,689	$8,567,225
2014	$10,001,255	$10,049,647	$8,429,609	$8,470,396
2015	$10,001,255	$10,149,677	$8,251,379	$8,373,832
2016	$10,076,752	$10,249,706	$8,137,889	$8,277,565
2017	$11,401,880	$10,391,501	$9,013,361	$8,214,640
2018	$10,001,255	$10,533,295	$7,738,983	$8,150,676
2019	$10,001,255	$10,675,090	$7,575,355	$8,085,745
2020	$10,001,255	$10,816,884	$7,415,187	$8,019,916
2021	$10,838,752	$10,958,679	$7,866,219	$7,953,256
2022	$11,161,880	$11,053,174	$7,929,453	$7,852,228
2023	$10,001,255	$11,147,670	$6,954,717	$7,751,916
2024	$10,001,255	$11,242,166	$6,807,672	$7,652,337
2025	$10,001,255	$11,336,661	$6,663,735	$7,553,502
2026	$10,076,752	$11,431,157	$6,572,081	$7,455,427
Grand Total Present Value			**$166,680,842**	**$165,640,812**

The results show that estimated costs and benefits in this study are fairly close to one another. The present value of future costs over the next 20 years is estimated to be $166.7 million, while benefits are expected to be $165.6 million. Given this situation, it is most likely that true benefits will outweigh costs for several reasons. First, actual future costs are not expected to be much larger than reported in this study. The costs presented attempt to consider all possible costs that a regulated firm might experience. In reality, firms typically discover new and innovative ways to save money with their compliance efforts. Second, the regulation includes room for firms to propose less costly and more effective means of reducing oil pollution in the unique case of a firm, or a group of firms, that view compliance to the regulation as written to be infeasible. Still, some costs are not included in the analysis, such as potential delays and demurrage fees for ships that must wait to be pre-boomed prior to bunkering. Overall, however, it is expected that estimates represent the high end of actual costs that firms will face.

Estimated benefits on the other hand represent an average value expected from highly variable and difficult to measure set of costs associated with oil spills. The total economic cost of oil spills depends first and foremost on the size of the spill, the type of oil spilled, the location of the spill, and environmental factors such as winds and tides. Benefit estimates developed in this study include savings in clean-up costs on a per gallon basis, and the estimated economic value of oil spill prevention and containment on a per-household basis. Specific losses such as down time for businesses affected by the spill are not included. Neither are specific cultural values, nor firm litigation costs, nor specific endangered species concerns. Furthermore this analysis has not accounted for passive use values accruing to people in other states, and there is evidence that such values exist and can be significant.[3]

Because the benefits and costs are relatively close in value as quantified, it is important to review the guidance documentation for this process. According to RCW 34.05.328, the DOE must,

> *"…(c) determine that probable benefits of the rule are greater than its probable costs taking into account both qualitative and quantitative benefits and costs and the specific directives of the statute being implemented."*

Some types of costs and benefits of this proposed regulation are difficult to estimate quantitatively, but have been described in the analysis in a qualitative manner. Taking the sum total of both quantitative and qualitative information together, the conclusion that probable benefits of the proposed regulation will be greater than the costs is still supported.

Conclusion

Given the uncertainty surrounding the value of estimated benefits and the likelihood that costs will be reduced in coming years, it is the conclusion of this analysis that the benefits of the proposed transfer rules will exceed the costs.

3 See Carson et al. 2003 for a review of such values in the Exxon Valdez case.

1.0 Introduction

1.1 Background

The Spill Prevention, Preparedness and Response Program of the Washington State Department of Ecology (DOE) is proposing revisions to the rules governing oil transfer operations that occur over state waters. The proposed rule changes will create standards for safe oil transfer operations as a strategy to meet a zero spill goal established by the Washington State legislature. Pursuant to RCW 34.05.328, prior to adopting a proposed rule, all agencies of the Washington State government must:

> *"…(c) determine that the probable benefits of the rule are greater than its probable costs taking into account both the qualitative and quantitative benefits and costs and the specific directives of the statute being implemented; (d) determine, after considering alternative versions of the rule and the analysis required under…(c) of this subsection, that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives stated under (a) of this subsection."*

This economic report contains a cost-benefit analysis (CBA) detailing the estimates of the expected costs and benefits that may result from implementing proposed WAC 173.180 and WAC 317.40 [Facility Oil Handling Standards; Vessel Oil Transfer Rule] and, is intended to satisfy RCW 34.05.328.

1.2 Overview of the Analysis

Cost Benefit Analysis (CBA) is a decision-making tool that weighs the total costs of a proposed action against total expected benefits to determine if the action is a sound investment. In addition to capturing market-valued goods and services, CBA assigns values to less tangible elements, such as environmental quality or human health. The time value of money is also taken into account in generating estimates, with expected cost and benefit streams converted to present values.

1.2.1 Principles of Cost Benefit Analysis

Several basic principles used in the practice of CBA are briefly described below. One deals with setting up the analysis, another deals with how monetary benefits are assigned to an environmental amenity, and several principles govern the method used to aggregate future costs and benefits into a present value.

With and Without Project

Perhaps the most common use of benefit cost analysis is to evaluate the public investment of funds to develop water resources. The methodology was outlined by the U.S. Water Resources Council in what may be the most widely used and cited statement on the topic, *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.* The six-step planning process identified in the volume is to:

1. Specify the problem,
2. Forecast the conditions in the study area relative to the problem,
3. Form alternative plans,
4. Evaluate the effects of the alternative plans,
5. Compare the alternative plans, and then
6. Select a recommended plan based on the comparison of the alternatives.

In regards to step 4 above, this is to be done by evaluating the difference between conditions "with" the alternative in place and conditions in the study area "without" the alternative.[4]

In the case of the proposed regulation, a "without project" analysis would address the continuation of the existing regulation which does not involve increased prevention measures and pre-booming, nor does it heavily regulate Class 2 (mobiles), Class 3, Class 4 facilities, or vessels transferring cargo oil. This scenario would include continued oil spilled in the same

4 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, U.S. Water Resources Council, 1983, pg. 3.

volume and frequency as has occurred in the past. The "with" project scenario will instead attempt to evaluate all of the costs and benefits associated with the new regulations.

Methods of Measuring Environmental Quality

One of the motivations for developing CBA methodology was the difficulty associated with investing in environmental improvement projects because they provide benefits that do not necessarily have a monetary return, while they often do have tangible monetary costs. A further difficulty is that costs of environmental degradation (e.g. loss or degraded water supply) are only felt after the damage has occurred. Hence, some of the benefits of protecting the environment may be related to the costs of environmental damages avoided, but these costs are difficult to know in advance.

To remedy this difficulty, techniques called *nonmarket valuation* attempt to place a monetary value on a service provided by natural resource, or to somehow quantify in money terms a value that society places upon an environmental asset. As the methods of nonmarket valuation have developed over the past sixty years, they have been used more and more frequently in federal economic decision-making for natural resource planning purposes, in benefit-cost analyses,[5] and in Natural Resource Damage Assessment.[6] For a more detailed review of these techniques, consult Freeman, (2003). Such methods include the hedonic property value technique, which analyzes property values for differences that can be linked to environmental amenities. Another method assumes the value people place on a trip to the beach or to go fishing is approximately equivalent to the costs that they pay for gas, lodging, food, etc. This method, called the travel cost method, is most commonly used to better understand the values people place on recreation such as boating, hunting, fishing, and wildlife viewing.

Still another method depends on surveys where people are asked what they would be willing to pay to preserve use of (or the existence of) a resource, or willing to accept to give up the use or existence of a resource. This method is often used to estimate the values of ecological system services, or species preservation or other types of benefits that are less tangible to most people. One such intangible value is called 'existence value' – which is the value people place on natural assets whether or not they ever plan to use the resource.

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5 Office of Management and Budget Circular A-94, "Benefit Cost Analysis of Federal Programs; Guidelines and Discounts" 57 FR 53519, Nov. 1992.

6 "Natural Resource Damage Assessments" Department of the Interior, Final Rule, 59 FR 14262, March 25, 1994.

Benefits, Costs, and Time

Perhaps the most useful element of the CBA framework is that it allows decision-makers to address how benefits and costs are distributed through time. With environmental protection projects, this may mean facing costs in the near future and trading those for benefits in the distant future. The same principle is used in nearly all investment decision-making, because most investments involve a trade off between costs now and benefits later (or vice versa). Future costs and benefits are collapsed into a present value using a social rate of discount, which discounts the future benefits and costs depending on when they are anticipated to occur.[7]

Discounting is appropriate because humans tend to prefer the present over the future. For example, who prefers a gift of $5,000 in ten years over the same gift today? Perhaps some would but very few. The reasons for this are many. One reason is that the future is uncertain, and anything could happen in five years. Another reason is that the $5,000 today can be invested and expected to increase over the time period so that it will be worth much more in five years. For example, if the $5,000 were to earn 3 percent interest per year, it would be worth $6,720 at the end of ten years. The interest earned represents the *opportunity cost* of using capital. In application, a project can be thought of as something which will bring a stream of benefits to the public during each future year, and which will also bring annual costs.

1.2.2 Types of Expected Costs

Firms are expected to experience additional costs beginning in the first year of regulation. Purchases such as equipment, labor, personnel training, and recordkeeping and administrative efforts are expected. Understanding that no two businesses are identical and will not approach compliance exactly the same, assumptions concerning the behavior of how facility and vessel businesses will respond to the proposed regulations are needed. These assumptions generally pertain to calculating compliance cost estimates for a typical business,

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[7] Discounting future benefits and costs for use in CBA involves a few fairly simple equations. Consider an anticipated benefit, b, that is expected to arrive n years in the future. What is the benefit worth to someone today? Using a discount rate r, the present value (PV), of this benefit is equal to: $PV = \frac{b_n}{(1+r)^n}$

For a stream of benefits, the present value of a stream of benefits over a number of years can be summed. For example, the present value of a stream of benefits over the next twenty years can be written:

$$PV = \sum_{n=0}^{20} \frac{b_n}{(1+r)^n}$$

acknowledging that there is flexibility to achieve compliance and, making assumptions about what would happen in the absence of the regulation.

1.2.3 Types of Expected Benefits

The benefits of the proposed regulations are that future transfer-related oil spills in Washington State waters will be reduced in incidence, and the costs associated with those spills will also be reduced. The costs of oil spills are anticipated to decrease for several reasons. Response costs should be reduced greatly, as well as natural resource restoration costs, socioeconomic costs, and non-use value losses will be mitigated. In addition to the reduction in response costs, the other reduced costs are measured collectively as the gain in oil spill prevention and containment.

1.3 Overview of Marine Oil Transportation and Spills in Washington State

With five operating oil refineries, several busy international commercial ports, a vital thriving commercial fishing industry, and one of the most efficient inland barge transportation systems in the country, Washington State's oil transfers occur in a wide variety of contexts and locations. Crude oil arrives at refineries for processing in large tank ships; oil products are loaded onto tank barges and tank vessels for cargo transport throughout the west coast; and container ships, fishing processors and other large ships purchase fuels in the state, receiving these fuels and lubricants from terminals, mobile tank trucks and barges, terminals and tank farms.

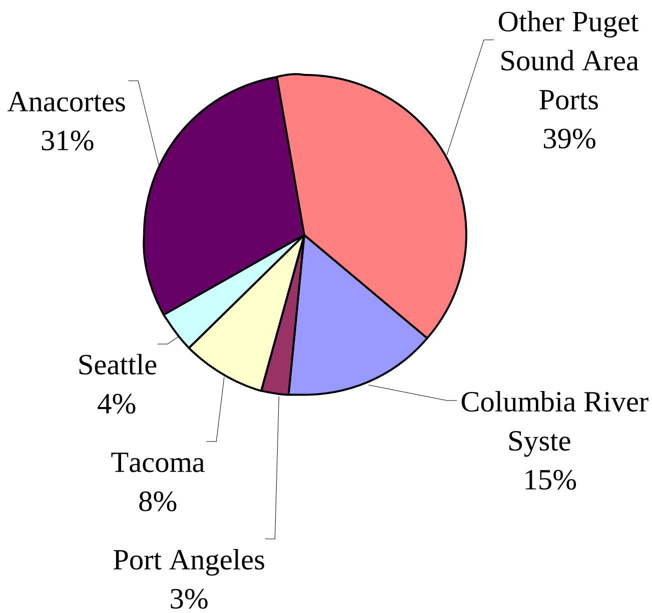
An overview of petroleum freight traffic is available from the U.S. Army Corps of Engineers which collects data on a port by port basis. Figure 1 shows that the Puget Sound area accounts for 39 percent of petroleum freight traffic within the state, Anacortes accounts for 31 percent, and the Columbia River System 15 percent. Yet these numbers tell us little about the types and numbers of transfers.

Transfer data were collected for six months by the DOE. A good summary of these data are available in a document produced by the agency.[8] The data were collected throughout Washington State for the period between December 2004 and June 2005. Although this does not reveal much about trends in transfers through time, some estimate of the types of transfers, the locations, and products transferred can be inferred from these data. For

8 Washington State Department of Ecology, 2005, "Oil and Fuel Transfer Over Waters of the State of Washington: A Report to the Legislature," Spill Prevention, Preparedness and Response Program.

example, the data cover six months, and document 4,683 transfers. It is likely that there are more than twice this many transfers in one year, as there are possibly more transfers occurring in Summer months, but for estimation purposes, twice is a safe assumption. This brings the total number of transfers to 9,366 in one year, and the estimated volume of transfers to 160 million barrels, or 6.7 billion gallons transferred annually.

Figure 1
Washington Petroleum and Petroleum Product Freight Traffic by Port, 2003



Source: United States Army Corps of Engineers, Navigation Data Center, Waterborne Commerce Statistics Center, "2003 Waterborne Commerce of the United States."

Of all estimated State transfers, 49 percent are done for the purpose of fueling or bunkering ships, 41 percent involve bulk cargo transportation, and 10 percent are related to exchanging oil for lubrication on ships. The volumes of transfers are somewhat different, with cargo accounting for 88 percent of the total transfer volumes, and bunkering accounting for 12 percent. The volume of lubricating and waste oil transferred is less than one tenth of a percent of the total (see Figures 2 and 3).

Figure 2
Purpose by Number

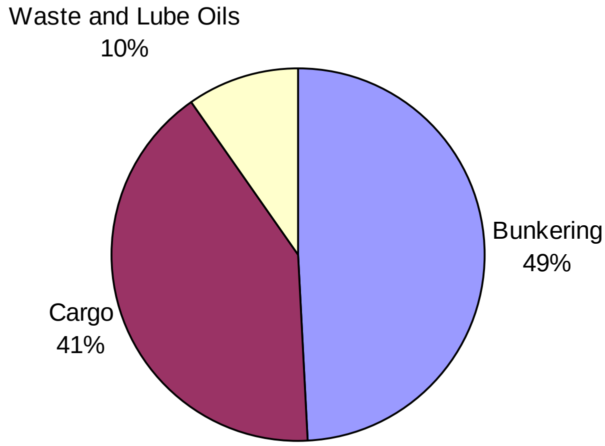
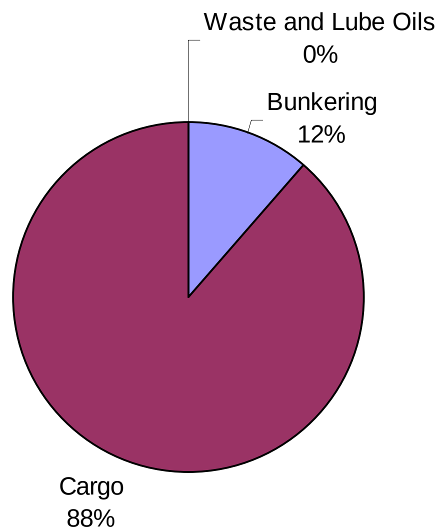


Figure 3
Purpose by Volume



For the purpose of understanding the activities of the different sectors, a different breakdown of the data is illustrative. Transfers of the vessel-to-vessel nature (whether bunkering or lightering) accounted for 18 percent of total transfers, and 9 percent of total volume. Fueling at docks accounted for 33 percent of transfers, and 4 percent of volume. Waste oil and lubricating oil transfers accounted for 10 percent of transfers, and 0 percent of volume, and crude to refineries accounts for 2 percent of transfers, and 39 percent of total volume transferred (see figures 4 and 5). This leaves 28 percent of transfers, and 48 percent of volume transferred which must involve cargo transport of refined products.

Figure 4
Transfer Type by Number

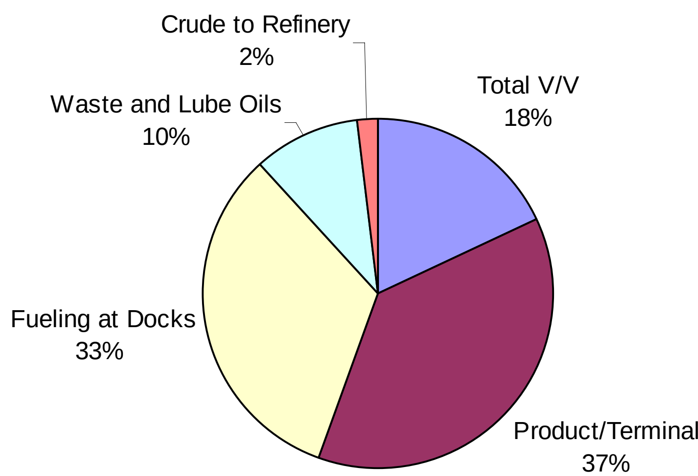
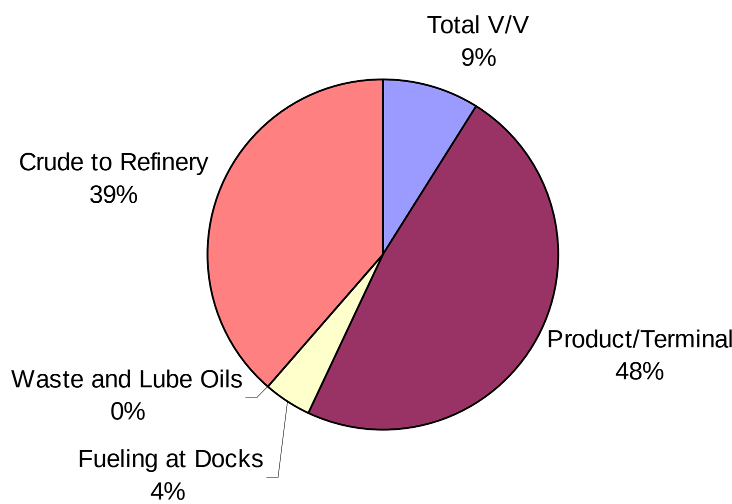


Figure 5
Transfer Type by Volume



Of these transfers, it is assumed that many transfers involve vessels that receive products from a refinery and transport these to terminals and tank farms. However, some of the transfers may be from a terminal or tank farm to another location. For illustration we might assume that (as an example) 65 percent of transfers in this category involve leaving a refinery, 30 percent arrive at tank farm or terminal, and 5 percent were transfers occurring from a non-refinery terminal to another facility or tank farm.

1.4 Summary of Proposed Rule Changes

The proposed rule changes will affect both facilities and vessels that transfer oil over navigable waters of Washington State. This section outlines the new requirements for each of five different affected business types: facilities, marine fueling terminals, mobile facilities, marine fuel outlets, and vessels. Most of these sectors are currently complying with federal regulations enforced by the U.S. Coast Guard, and with existing state regulations. The federal regulations (46 U.S. Code) were strengthened by the Oil Pollution Act of 1990 requiring greater numbers of personnel for oil transfers, and 33 Code of Federal Regulations (CFR) requiring more and stronger steps be taken to prevent oil spills by commercial handlers and shippers of oil products. Parts 154, 155 and 156 of 33 CFR apply to vessels and facilities that conduct bulk oil or hazardous material transfers. These rules provide flexibility for the Coast Guard Captain of the Port to impose additional requirements depending on port-specific needs. These regulations define the standards for safe oil transfers that include topics such as safe transfer procedures, emergency shutdown, transfer restrictions, communication, watchstanders, recordkeeping, personnel qualifications, advance notice of transfers, and transfer containment and response standards.

In general, all oil transfers that will occur at greater than 500 gallons per minute (gpm) are termed Rate A transfers, while lower speed transfers are termed Rate B. For all Rate A transfers, pre-booming will newly be required as long as it is both safe and effective to do so. This will include a majority of the transfers at Class 1 facilities and most vessel to vessel transfers. If it is not safe and effective to do so, different vessel and facility classes will need to be ready to deploy boom in the event of a spill, and are required to have additional boom available and on the scene within one hour. In all cases, personnel conducting transfers will need to have appropriate training in oil transfer safety, hold pre-transfer conferences, and ensure that loading procedures and adequate communication between vessel and facility are established prior to and during a transfer. Furthermore, Rate A deliverers must develop and submit for approval to Ecology the threshold environmental determining factors will need to be developed for each location. This threshold analysis will allow each location to have a standard to be used to determine whether or not it is safe and effective to pre-boom.

Rate B transfers will need to either comply with the pre-booming as described in the new regulation, or with the alternative measures outlined therein. In general, the alternative measures involve having boom available to be deployed, and all equipment needed to deploy and clean up a spill if one occurs.

All affected parties will also have the option to develop their own alternative compliance measures to be used when pre-booming is not safe and effective. A plan for alternative compliance may be submitted to DOE for approval as long as the plan provides the equivalent or greater level of environmental protection as the proposed regulation.

2.0 Technical Analysis of Costs

For the purpose of the cost benefit analysis, costs are compared with and without the new proposed regulations. Costs are measured from a baseline of the existing required actions of regulated parties. The costs of the proposed regulations are the additional costs or expenditures that will need to be made in order to comply with the proposed regulations.

2.1 Methodology

To gauge the potential impacts of the new rules, interviews with business owners/managers, government employees, and non-governmental organizations were conducted. To protect businesses and elicit accurate information, data obtained in the course of these interviews is confidential but anonymously applied quantitatively and qualitatively throughout this analysis.

Each of five sectors (Class 1, 2, 3, 4 Facilities, and Vessels) was analyzed separately addressing several topics: the impacts of the proposed regulations; cost categories, equipment, labor, personnel training, and recordkeeping and administrative efforts; statewide economic impacts; and the economic implications of additional costs. Taking from interviews, compliance cost estimates were calculated for a typical business within each sector. Statewide impacts were developed by multiplying the cost for a typical business by the number of businesses in that particular sector.

2.2 Class 1 Facilities – Refineries

The Washington State Department of Ecology (Ecology hereinafter) defines a Class 1 facility as

"…any structure, group of structures, equipment, pipeline, or device, other than a vessel, located on or near the navigable waters of the State that transfer oil in bulk to or from a tank vessel or pipeline, that is used for producing, storing, handling, transferring, processing, or transporting oil in bulk; and does not include any: railroad car, motor vehicle, or other rolling stock while transporting oil over the highways or rail lines of this state; underground storage tank regulated by Ecology or a local government under chapter 90.76 RCW; a motor vehicle motor fuel outlet; a facility that is operated as part of an exempt agricultural activity as provided in RCW 82.04.330; or a marine fuel outlet that does not dispense more than three thousand gallons of fuel to a ship that is not a covered vessel, in a single transaction."

Class 1 facilities fall into one of two categories - refineries and non-refineries. This section assesses the potential economic impacts to refinery Class 1 businesses from the Facility Oil Handling Standard (WAC 173-180) proposed by Ecology. Section 2.3 assesses the potential economic impacts to non-refinery Class 1 businesses.

There are five Class 1 refineries in Washington State that meet the required criteria, with a total of approximately 1,700 employees. All of the refineries are located on the Washington State coastline. All refineries accomplish a variety of oil transfer operations: crude oil is transferred via tank vessel to the refinery, refined products are transferred to tank barges and to tank vessels, and ships are fueled or bunkered. The five refineries are: BP Cherry Point and Conoco Phillips in Ferndale, WA, Shell and Tesoro in Anacortes, WA, and U.S. Oil in Tacoma, WA.

2.2.1 Potential Compliance Costs

The primary impacts to this sector lie in facility modification, purchasing of additional boom and sorbents, hiring and training additional personnel for pre-booming duties, and purchasing and maintaining additional boats to use during pre-booming.

The biggest cost factor for the refineries is pre-booming. One facility currently pre-booms the transfer area for all persistent and non-persistent oil using a semi-circle boom that does not completely encircle any vessel. Another does not pre-boom any transfers. Another encircle booms all vessels and all oils.

Significant annual cost increases will also be due to additional required spill response and prevention equipment. All of the recordkeeping and transfer restriction regulations are currently being met by the facilities in this sector, which adds no additional cost at this time.

2.2.2 Technical Analysis of Compliance Costs

The primary costs associated with the rule change can be divided into equipment, labor, and miscellaneous cost categories, with equipment and labor comprising the majority of the increase in costs.

Equipment

The types of equipment that would need to be purchased as a result of the proposed rules include booms, facility modifications for a semi or full circle boom, boats and possibly an oil spill tracking buoy. Facility operators/owners estimate initial capital expenditures for facility modifications to average $2.1 million because this is a significant expenditure of capital, it is assumed that funding for this item will not come from operating expenses, but that firms will need to either borrow, or give up interest on that sum of money. The interest rate used is the current prime lending rate.[9] Boom would have to be completely replaced about every 10 years, or an average annual maintenance and replacement cost of $370,000. This analysis assumes the average cost of two boats would be approximately $175,000 and it would need to be replaced every 15 years. Further, four of the five facilities would purchase oil spill tracking buoys at $2,000 each.

Labor

Cost increases to labor include the potential need to hire and average of 10 additional employees per refinery at an average rate of $40,000 per year each for pre-booming duties. Estimated labor requirements vary by facility from two additional employees at one facility to a high of 18. These new employees would need to be highly skilled and have extensive training. In addition to the needed salaries, benefits are added to the cost of the employees at an additional 35 percent to cover vacations and sick days, health care benefits, and other indirect costs associated with additional employees.

The average firm costs based on discussions with four of the five facilities in this sector are shown in Table 1 for the initial year of the rule change, and five, ten, fifteen, and twenty years following the rule change.

9 http://www.bankrate.com/brm/ratewatch/wsjPrimeRate.asp. Accessed on 5/24/06.

Table 1
Average Firm Cost

Cost Item	Year 1	Year 5	Year 10	Year 15
Labor	$539,771	$539,771	$539,771	$539,771
Booms maintenance and replacement	$370,000	$370,000	$370,000	$370,000
Capital expense and facility modification. for full circle boom	$213,890	$213,890	$213,890	$213,890
Boat O&M	$100,000	$100,000	$100,000	$100,000
Boats - 2	$175,000			$175,000
Oil spill tracking buoy	$2,000		$2,000	
Total	**$1,400,661**	**$1,223,661**	**$1,225,661**	**$1,389,661**

2.2.3 Statewide Costs

The firm costs are compiled in Table 2 to show the total Statewide Class 1 refinery facilities sector costs, which range between $5.9 and $6.7 million per year, after the initial year.

Table 2
Total Sector State Costs

Cost Item	Year 1	Year 5	Year 10	Year 15
Labor	$2,698,853	$2,698,853	$2,698,853	$2,698,853
Boom maintenance and replacement	$1,850,000	$1,850,000	$1,850,000	$1,850,000
Capital expense and modification for full-circle boom	$855,559	$855,559	$855,559	$855,559
Boat O&M	$500,000	$500,000	$500,000	$500,000
Boats - 2	$787,500			$787,500
Oil spill tracking buoy	$10,000		$10,000	
Total	**$6,701,911**	**$5,042,899**	**$5,050,899**	**$6,492,899**

2.2.4 Economic Implications

The proposed rules will create a statewide increase of costs to this sector of around $5.0 and $6.5 million per year. However, if a pending legal settlement proceeds, it is possible that the costs to this sector could be reduced by at least 20 percent. The settlement could bring about pre-booming at one of the refineries, which could then exclude the costs of pre-booming at that refinery. These facilities may not absorb all of the costs but may pass along some of the costs to clients. Also, these are not insignificant costs because refineries do not operate on large profit margins and are subject to the variability of crude oil prices already. The additional employment of at least 50 people does provide jobs in this sector, which is beneficial to the State.

2.3 Class 1 Facilities – Non Refinery

Class 1 facilities are defined in Section 2.2, which discusses the refinery Class 1 businesses in Washington State. This section assesses the potential economic impacts to non-refinery Class 1 businesses. Non-refinery Class 1 facilities can be categorized into two groups - terminals and others. A terminal is generally a "tank farm" where refined products are delivered, usually via vessels, for temporary holding before distribution or transport. Terminals perform over-the-dock transfers to and from vessels. The other non-refinery Class 1 facilities are businesses that receive products used to perform routine business operations. For example, pulp and paper mills rely on oil products to operate the mills.

Non-refinery Class 1 facilities are currently regulated by federal agencies, such as the EPA and Coast Guard, and the Washington State Department of Transportation. Class 1 facilities typically transfer at a rate greater than 500 gallons per minute (gpm), subjecting them to "Rate A" transfer containment and recovery standards that require the pre-booming of all transfers when conditions are considered safe and effective. If conditions are not safe and effective, all Rate A transferors must:

> *" (i) Have access to boom four times the length of the largest vessel at the transfer location. (ii) Deploy boom, identified in (a)(i) of this subsection, sufficient to completely surround the vessel(s) and facility/terminal dock area directly involved in the oil transfer operation or the portion of the vessel and transfer area where oil may spill into the water that provides for maximum containment of spilled oil. (iii) Deploy the boom with a minimum stand-off of five feet away from the sides of a vessel. This stand-off may be modified for short durations needed to meet a facility or ship's operational needs. (iv) Check the boom positioning periodically and adjust the boom as necessary throughout the duration of the transfer and specifically during tidal changes and significant wind or wave events. (v) Have personnel trained in the proper use and maintenance of boom and recovery equipment. (vi) Have the following recovery equipment available on-site:*
>
> *(A) Containers suitable for holding the recovered oil and oily water;*
> *(B) Nonsparking hand scoops, shovels, and buckets; and*
> *(C) Enough sorbent materials and storage capacity for a seven barrel oil spill appropriate for use on water or land."*

The proposed regulations focus on controlling the spread of oil in the event of a spill by having boom in place before and during a transfer, or *pre-booming*. Pre-booming is not currently stipulated in existing regulations and poses as the biggest impact to non-refinery Class 1 businesses.

2.3.1 Technical Analysis of Compliance Costs

There are two preferred approaches to compliance, according to interviews with non-refinery Class 1 business owners/managers, 1) "in-house", or 2) contract out. Strategy 1, the in-house approach, requires a business to possess all the necessary equipment and trained personnel to perform regular pre-booming activities. This strategy requires investments in labor and equipment, including at least one skiff, additional labor, boom, and other equipment standards. A business that frequently performs transfers is more likely to adopt Strategy 1, as compared to Strategy 2.

Strategy 2 expects businesses to contract out compliance to a specialty firm, most likely an oil spill response organization (OSRO). Strategy 2 does not require a business to invest in any additional equipment or labor, but realizes these costs in a contractor's price per transfer. Strategy 2 relies completely on a contractor for compliance and an estimate of $2,500 per transfer is assumed to satisfy all the proposed regulations.[10] Businesses that perform occasional transfers will be lured towards Strategy 2.

To assess compliance costs for Strategy 1, costs were divided into four general categories: equipment and technology, labor, personnel training, and recordkeeping and administrative efforts. Total costs for each strategy are compared and discussed at the end of this section. For each category, Table 3 below presents the set of compliance costs a typical business employing Strategy 1 is expected to incur. The following details each cost category, beginning with response equipment standards.

Table 3
Compliance Costs by Category for Businesses Adopting Strategy 1

Cost Category	Initial Cost	Years 1 - 4	Year 5
Response Equipment	$43,750	$8,750	$23,750
Personnel Training	$0	$0	$0
Additional Labor	$108,000	$108,000	$108,000
Administrative Efforts	$0	$0	$0
Total	$151,750	$116,750	$131,750

10 Per transfer estimate derived from personal communication with OSRO firms operating in the State of Washington.

Equipment Standards

Each non-refinery Class 1 is responsible for having “access to boom four times the length of the largest vessel at the transfer location.” It is assumed from interviews that 1,000 feet of boom is the standard of compliance. Furthermore, this analysis assumes that boom requires replacing from general wear-and-tear every 5 years. At $15/foot, a business can, therefore, expect to incur $15,000 every fifth year from boom standards compliance.

A small boat, or *skiff*, will be needed to disperse boom before the transfer and tend it during the transfer. This analysis prices a skiff at $20,000 and assumes replacement every 15 years.

The last items of equipment are sorbent materials. The proposed regulations require each facility to have “enough sorbent materials and storage capacity for a 7 barrel spill appropriate for use on water or land.” A “bundle” of sorbent materials can collect a little over two gallons of product, and goes for about $68 per bundle. Businesses are expected to purchase sorbent materials on a per need, or *rolling*, basis throughout any given year. Therefore, a non-refinery Class 1 is expected to pay $8,750 annually to comply with the last proposed equipment standard. No cost is assigned in the initial year because all businesses claimed already being in compliance with the sorbent materials regulation.

Labor

Additional labor is only required by those businesses employing Strategy 1. Taking from interviews, each business is anticipated to hire 2 additional employees to perform compliance tasks. At an annual salary for these employees at $40,000, and an additional 35 percent of annual salary to account for benefits, a business is expected to incur $108,000 annually for additional labor.

Personnel Training

Non-refinery class 1 facilities are required to meet the standards for emergency response [29 CFR 1910.120] instituted by the Occupational Safety and Health Administration (OSHA) and the Coast Guard’s person-in-charge qualifications [33 CFR 154.710]. The proposed regulations do not introduce any new training standards, but encourage businesses to apply or modify existing training programs. Therefore, this analysis does not attribute a cost to the proposed personnel training standards, because non-refinery class 1 facilities already operate in compliance.

Administration and Recordkeeping

All non-refinery Class 1 businesses will perform in-house compliance to meet the administrative and recordkeeping standards. However, facility owners/managers do not expect to incur any significant costs from the proposed regulations. Albeit the proposed administrative rules introduce detailed regulatory additions to the operations manual, training program, routine drills and exercises, and certification of qualifications program, Class 1 businesses perceive compliance as a negligible task. Therefore, no cost is assigned to these rules, for businesses do not expect to spend more time meeting the standards of the new regulations than they already are.

2.3.2 Statewide Costs

There are an estimated 12 non-refinery Class 1 businesses operating in the state of Washington. Of these 12 businesses, 3 are terminals that perform transfers routinely and are anticipated to adopt Strategy 1. As shown in Table 4 below, the statewide compliance burden for these businesses is approximately $1.04 million.

The businesses employing the services of contractors, Strategy 2, are expected to pay $2,500 per transfer. Therefore, calculating statewide impacts is not a question of number of businesses but the total number of transfers. Based on data made available from the DOE it is estimated that 234 total transfers will be performed each year using Strategy 2, so the statewide compliance burden is approximately $585,000 annually.

Table 4
Statewide Compliance Burden

	Average Annual Cost	Number of Businesses	Total Statewide Compliance Burden
Strategy 1	$151,750	3	$455,240
Strategy 2	$2,500/transfer	9	$585,000
Total	N/A	12	$1,040,240

2.3.3 Economic Implications

Some businesses that receive products infrequently will seek delivery from alternative sources, such as tanker trucks. This forecast is based on the behavior of facilities in recent years that have discontinued over-the-water transfers as regulations increased.

2.4 Class 2 - Mobile Facilities

A Class 2 facility, or *mobile facility*, is "rolling stock such as a truck, railcar, or other mobile device used to transfer oil to a non-recreational vessel." This section assesses the potential economic impacts to Class 2 businesses operating in the state of Washington resulting from proposed regulations regarding the transfer of oil to and from mobile facilities.

Mobile facilities transfer both persistent and non-persistent products to a wide range of commercial vessels, but predominantly handle non-persistent lube oils and lots of lighter oils. The advantages that mobile facilities offer vessel clients are versatility of transfer location and time saved from extended docking. However, mobile facilities are restricted by the size of payload with most truck tank capacities under 10,000 gallons. For example, if a vessel with the capacity of 30,000 gallons wishes to be fueled by mobile facilities, three trucks may deliver individual payloads to complete the single transfer. Most of the transfers from mobile facilities occur at rates of less than 500 gpm, or in other words rate B transfers.

2.4.1 Potential Compliance Costs

About one fourth of mobile facility businesses are integrated within a company that also performs fixed transfers, such as a Class 3 facility. Applying data from a 2005 Ecology report to the Washington State Legislature, it is estimated that approximately 35 mobile fueling and delivery businesses operate in Washington.[11] Numerous interviews with these businesses were conducted in the course of this analysis, and on average, each business owns seven trucks and employs nine drivers. Most of these companies employ fewer than 50 total employees and are considered small businesses.

Mobile facilities are currently regulated by the Coast Guard and Washington Department of Transportation. The proposed regulations, however, call for more compliance efforts in addition to existing regulations. Figure 6 below provides the proposed compliance options for mobile facility deliverers, and for all Rate B deliverers.

[11] Washington State Department of Ecology, May 2005, Oil and Fuel Transfer Over Waters of the State of Washington: A Report to the Legislature. Olympia, WA.

Figure 6
Proposed Compliance Options for a Class 2 Facility (Rate B transfers) [12]

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Rate B Pre-booming

I) Prior to starting the oil transfer operation the deliverer must:

i. Deploy boom that completely surround the vessel(s) and facility/terminal dock area directly involved in the oil transfer operation or the portion of the vessel and transfer area where oil may spill into the water that provides maximum containment of spilled oil;

ii. Deploy boom with a minimum stand-off of five feet away from the sides of a vessel. This stand-off may be modified for short durations needed to meet a facility or ship's operational needs;

iii. Check boom positioning periodically and adjust the boom as necessary throughout the duration of the transfer and specifically during tidal changes and significant wind or wave events;

iv. Have personnel trained in the proper use and maintenance of boom and recovery equipment.

II) Have the following recovery equipment available on-site:

i. Containers suitable for holding the recovered oil and oily water;

ii. Non-sparking hand scoops, shovels, buckets; and

iii. Enough sorbent materials and storage capacity for a 2 barrel oil spill appropriate for use on water or land;

III) Within 1 hour of being made aware of a spill, the deliverer must completely deploy an additional 500 feet of boom. This boom may be used for containment, recovery, or protection.

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Rate B Alternative Measures

I) Prior to starting the oil transfer operation the deliverer must:

iv. Have access to boom sufficient to completely surround the vessel(s) and facility/terminal dock area directly involved in the oil transfer operation or the portion of the vessel and transfer area where oil may spill into the water that provides maximum containment of oil from the transfer containment area;

v. Have personnel trained in the proper use and maintenance of boom and recovery equipment;

II) Have the following recovery equipment available on-site:

i. Containers suitable for holding the recovered oil and oily water;

ii. Non-sparking hand scoops, shovels, buckets; and

iii. Enough sorbent materials and storage capacity for a 2 barrel oil spill appropriate for use on water or land

III) Within one hour of being made aware of a spill, the deliverer must be able to complete deployment of an additional 500 feet of boom for containment, protection or recovery.

IV) Within 2 hours of being made aware of a spill, the deliverer must have an additional 500 feet of boom available on-scene for containment, protection, or recovery.

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Mobile facilities are quickly able to respond to fueling requests at a wide variety of locations. Pre-booming every mobile delivery would require a separate work crew to follow the facility to every transfer location, set the boom in place, tend the boom in a skiff during transfer, collect the boom after transfer, and clean it. In short, pre-booming would greatly reduce the business advantage of a mobile facility which offers quick and flexible deliveries. Managers/owners of mobile facilities indicated during interviews that they would cease mobile deliveries if forced to pre-boom each mobile transfer because of the cost and time burden. Therefore, this analysis focuses on the compliance costs associated with the

[12] Articles 4 and 5 of WAC 173-180-215.

alternative measures, assuming from interviews that this is the avenue most businesses will take.

The remainder of this section discusses three impacts: 1) a technical analysis of each cost category - equipment, labor, personnel training, and recordkeeping and administrative efforts; 2) an assessment of the statewide economic impacts; and 3) a discussion of the economic implications of additional costs, or how businesses are expected to behave and manage any new compliance costs.

2.4.2 Technical Analysis of Compliance Costs

To gauge the potential impacts to Class 2 businesses, interviews with 11 different business owners and managers were conducted during this analysis. Taking from these interviews and observing how businesses comply to very similar regulations in California,[13] it is assumed that a business is likely to adopt one of two compliance strategies; it may either (1) have a truck or *runner* vehicle follow each mobile facility to the transfer location with the appropriate boom and equipment, or (2) store the required equipment at locations where transfers are concentrated and routine.

The primary difference between these two methods is that Strategy 1 is an “in-house” approach, whereas Strategy 2 allows for mobile facility businesses to cooperate and share the costs of equipment and storage. Which compliance strategy a business adopts will be based on many factors, but whether or not the mobile facilities are linked with fixed facilities, or how integrated the service is with other services, plays a large role. A business that only performs mobile deliveries will be more inclined to adopt Strategy 1 because it will be less able to enter into a cooperate agreement (“co-op” hereinafter) with other businesses that own fuel docks where equipment can be stored. Businesses that do not own fixed facilities are typically larger fleet-style trucking businesses. In California most businesses utilize Strategy 2 to comply with very similar state regulations, but it is worth noting that these businesses also typically cover substantially more ground than a Washington business would.

Strategy 2 imitates the way that oil spill response organizations (OSROs) behave.[14] OSROs stash equipment in numerous places where an oil spill is most likely, or where transfers are most frequent. In the event of a spill, equipment is locally accessible and only labor is needed. This approach reduces response time, which is an advantage considering the new regulations stipulate an hour for response in the event of a spill. Businesses that conduct transfers at popular, routine locations will be likely to adopt the co-op approach.

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13 Personal communication with Jason Reichert, Washington State Department of Ecology, on 2.10.2006.

14 Personal communication with Director of Marine Spill Response Corporation (MSRC) on 2.8.2006.

Broad assumptions about the cooperative behavior of mobile facility business operators have been made for the purpose of this analysis. It is assumed that businesses that adopt Strategy 2 will cooperate to share the cost of compliance, particularly equipment and storage. Accounting for the geographic location of high traffic transfer locations, the number of mobile facility businesses operating in Washington, and data collected by Ecology, it is anticipated that of 35 entities, 25 will form into five separate co-ops with five businesses each sharing a portion of the compliance burden.[15]

Equipment and Technology Capabilities

Two types of equipment and technology are required by the proposed regulations: response equipment and emergency shutoff capabilities. Every business owner/manager reported that they currently own at least 500 feet of containment boom and enough sorbent materials to recover a two barrel spill, or about 37 "bundles". However, this analysis considers that boom needs to be replaced every five years and sorbent materials are replaced on a per need, or *rolling*, basis.

Strategy 1 requires a business to purchase only a single set of response equipment, but also a runner vehicle to transport the equipment to the transfer location. This approach calls for an initial investment of approximately $20,000 for the acquisition of a runner vehicle. Assuming the vehicle travels 39,000 miles annually (150 miles per work day), an annual operating cost of roughly $17,400 is assigned for fuel, maintenance, and depreciation.[16] Furthermore, it is assumed a business will replace the runner vehicle every 15 years. A business adopting this strategy is most likely already in possession of the required length of boom and sorbent materials, so an initial purchase of these items is not expected and no cost is assigned. However, as stated above, response equipment is anticipated to be replaced due to general wear-and-tear, and a business employing Strategy 1 can expect to pay roughly $7,500 every five years for boom and $2,500 annually for sorbent bundles.

Strategy 2 requires storing response equipment at the locations where transfers are most frequent. Based on a typical business of this kind, it is assumed that each mobile facility business has eight locations where routine transfers occur. Rather than each business storing response equipment at each of the eight locations, it is anticipated that these businesses will behave cooperatively to share the burden of compliance. Assuming a five business cooperate the cost of storing response equipment will be divided five ways. Using this approach, the

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15 This assumption is based on communications with mobile facility businesses, particularly the approximate number of routine transfer locations and associations with other like businesses. Ecology approved assumption on 4.27.2006.

16 This figure is based on the U.S. Internal Revenue Service rating of $.445/mile, assuming the runner vehicle travels 150 miles every business day.

initial total equipment and storage investment is approximately $114,500 with $22,900 assigned to each of the five businesses in the co-op.

The annual cost of storing equipment at eight locations is an estimated $25,000, assuming a rate of $300 per month, or $3,600 per year for each of the eight storage units. Each location would need to replace containment boom every five years due to general wear-and-tear and sorbent materials on a rolling basis due to use and disposal. Therefore, the co-op can expect to incur $45,000 annually and $105,000 every five years in equipment and storage, or $9,000 annually and $21,000 every five years for each business in the co-op.

Regardless of which strategy used, the majority of businesses intend to rely on the services of an OSRO to be able to deploy 500 additional feet of boom within 2 hours in the event of a spill. Mobile facility businesses are not required to retain an OSRO, but most have general agreements in the form of letters of intent with one. This relationship operates on a "no use, no pay" standard where a mobile facility business does not pay their OSRO a monthly or annual retainer, but enters into an agreement to employ the OSRO's services in the incident of a substantial spill. Therefore, mobile facility businesses are anticipated to purchase 500 feet of boom and rely on their OSRO for the additional 500 feet of boom.

In the event of a spill, the proposed technological standards require each mobile facility to be capable of stopping the flow of oil immediately by means of an emergency shutoff device, or "kill switch". Every mobile facility business interviewed stated that their mobile facilities were already equipped with a suitable emergency shutoff device and in compliance with the proposed regulation. Therefore, this analysis attributes no compliance cost to this technological standard.

Labor

Additional labor is only anticipated if a business elects compliance Strategy 1. Strategy 1 would need an additional full-time employee to tend the runner vehicle. It is anticipated that this employee would be paid an average annual salary of about $40,000 and receive an additional $14,000 (35 percent of salary) in benefits. Under Strategy 1, hiring additional labor represents the largest cost burden, both initially and annually.

Personnel Training

The proposed regulations require personnel trained in the proper use and maintenance of boom and recovery equipment. A training program must also be established and submitted to Ecology for certification. Based on the industry interviews, it is assumed each business, regardless of which strategy it employs, will set aside one work day per year to drill and train personnel. With an average of nine employees per business, who receive

$40,000 annually and $14,000 in benefits, a business can expect to incur $1,870 annually in training compliance.

Administration and Recordkeeping

Mobile facility owners/managers do not expect to incur any significant costs from the proposed regulations regarding administration and recordkeeping. Albeit the proposed administrative rules introduce detailed regulatory additions to the operations manual, training program, routine drills and exercises, and certification of qualifications program, Class 2 businesses perceive compliance as a negligible task. Therefore, no administrative cost is assigned to these strategies. The total cost of compliance strategies 1 and 2 are summarized below (see Tables 5 and 6).

Table 5
Compliance Costs for Strategy 1

Cost Category	Initial Cost	Years 1 - 4	Year 5
Response Equipment*	$37,402	$22,401	$29,901
Personnel Training	$1,869	$1,869	$1,869
Additional Labor**	$54,000	$54,000	$54,000
Administrative Efforts	$0	$0	$0
Total	$93,272	$75,717	$83,271

* Estimates include annual operating cost ($17,400) for runner vehicle.
** Figure based on a $40,000 annual salary with a 35 percent benefits value added.

Table 6
Compliance Costs for Strategy 2

Cost Category	Initial Cost	Years 1 - 4	Year 5
Response Equipment	$21,035	$9,035	$21,035
Personnel Training	$1,869	$1,869	$1,869
Additional Labor	$0	$0	$0
Administrative Efforts	$0	$0	$0
Total	$22,908	$10,908	$22,908

To provide a more detailed profile of impacts to Class 2 businesses, a weighted average was calculated. It was assumed that 75 percent of businesses will adopt Strategy 2, while 25 percent adopt Strategy 1. Table 7 below presents the weighted averages for each cost category a typical Class 2 business can expect to incur.

Table 7
Average Compliance Costs*

Cost Category	Initial Cost	Years 1 - 4	Year 5
Response Equipment	$25,129	$16,129	$22,628
Personnel Training	$1,869	$1,869	$1,869
Additional Labor	$13,500	$13,500	$13,500
Administrative Efforts	$0	$0	$0
Total	$40,498	$31,498	$37,997

* Figures will not sum due to weighted averages.

2.4.3 Statewide Costs

Statewide estimates were calculated for the two possible compliance strategies that typical businesses may adopt, and multiplied by the number of mobile facility businesses in Washington. The size and behavior of Washington's mobile facility industry is largely based on a 2005 Ecology study that collected six months of transfer data from 27 mobile facility businesses.[17] This data is subject to inaccuracy; however it represents the most comprehensive empirical information available. Ecology estimates 30-35 mobile facility businesses are operating in Washington.[18] This analysis assumes a conservative approach and considers this sector to be composed of 35 businesses.

Regardless of strategy, the compliance cost schedule for mobile facility businesses follows a five year cycle. Table 8 below presents the compliance cost schedule for mobile facility businesses, Washington's mobile facility industry, and cost implications on a per transfer, barrel, and gallon basis. Table 9 also shows the costs to the state assuming that 25 percent of the Class 2 firms use Strategy 1, and 75 percent use Strategy 2.

[17] Washington State Department of Ecology, May 2005, Oil and Fuel Transfer Over Waters of the State of Washington: A Report to the Legislature. Olympia, WA.

[18] Personal communication with Jason Reichart. Washington State Department of Ecology, approved assumption on 4.27.2008.

Table 8
Compliance Cost Schedule
for Mobile Facility Businesses and Washington State*

	Initial Cost	Years 1-4	Year 5
Total Cost per Business	$40,499	$27,123	$37,998
Total Cost to Mobile Facility Businesses Statewide	$1.42 million	$949,321	$1.33 million
Avg. Cost per Transfer	$511	$343	$480
Avg. Cost per Barrel Transferred	$0.90	$0.60	$0.85
Avg. Cost per Gallon Transferred	$0.021	$0.014	$0.02

* Weighted averages applied, see Table 7.

2.4.4 Economic Implications of Proposed Regulations

The proposed regulations will burden Washington's mobile facility businesses, but it is not anticipated that the regulations will force businesses to discontinue operations. It is expected that mobile facilities will retain their market niche of delivery location flexibility and time saved, partly because vessels have grown dependent on this style of transfer and partly because the estimated compliance cost is considered manageable.

Vessel clients who employ mobile facilities already pay a per gallon premium for the services of mobile facility transfers. Consumers range from commercial fishing vessels to tugboats to the Seattle ferries, but generally have a tank capacity under 10,000 gallons which agrees with the 10,000 gallon capacity of a mobile tank truck. The premium is currently estimated to be $0.06 to $0.08 per gallon transferred.[19] The expected increase of approximately $0.02 per gallon (see Table 8) best represents the probable premium increase a Class 2 business will apply.

The proposed regulations would create higher operating, or *overhead*, costs for a Class 2 business in the form of equipment, training, and in the case of Strategy 1, more labor. These costs are likely to be internalized by a firm, and in turn will be passed on to customers in the form of higher premiums for mobile facility deliveries.

Washington's Class 2 industry established itself after the 1989 Exxon Valdez spill, when Class 1 and 3 businesses came under strict Federal regulations [33 USC § 2701-2761 and 40 CFR 300]. Mobile facilities are regulated to a lesser degree by the U.S. Coast Guard at this time with operations manuals, some training, and response manuals. These mobile facilities

19 Premium estimate derived from personal communications with Class 2 businesses.

exploited an entrance into the market when fixed facilities became regulated and passed on the new overhead costs to consumers, who then began utilizing the services of mobile facilities more often. To gauge consumer response to higher mobile delivery premiums, estimates need to be weighed against the prices of competing fixed facilities. Considering that fixed facilities are expected to incur higher compliance costs from the proposed regulations than Class 2 businesses, it is assumed that mobile facility businesses will not lose their critical consumer base. Therefore, Washington's mobile facility industry is not expected to be significantly diminished in response to the implementation of the proposed regulations.

2.5 Class 3 Facilities – Marine Fueling Terminals

Class 3 facilities are defined by DOE as,

> *" . . . a facility that: a) Transfers to a vessel with a capacity to hold 10,500 or more gallons of oil whether the vessel's oil capacity is used for fuel, lubrication oil, bilge waste, or slops or other waste oil; b) Does not transfer oil in bulk to or from a tank vessels or pipeline; and c) Does not include any: Railroad car, motor vehicle, or other rolling stock while transporting oil over the highways or rail lines of this state; underground storage tank regulated by Ecology or a local government . . .; a motor vehicle motor fuel outlet; or a facility that is operated as part of an exempt agricultural activity . .."*

This sector comprises businesses, often referred to as "jobbers," that purchase their products from the refineries in Washington State and operate fixed fuel docks (primarily diesel and lube oil, with some gasoline). Clients include barges and fishing and touring vessels (e.g. whale watching) that meet the capacity requisite. Many of these facilities also provide mobile fueling services; however that part of their enterprise is covered in another section. This section discusses only the fixed facility part of these companies. There are four facilities in Washington State that have been identified as meeting the required criteria, with a total of approximately 70 employees. Two are located on Lake Union in Seattle, one is located in Westport, and the fourth is located in Ilwaco.

2.5.1 Potential Compliance Costs

This sector is currently not required to perform any pre-booming, and the majority of the additional costs to be borne by this sector due to the proposed rule change are related to the pre-booming or alternative measures requirement, which requires the facility to have boom ready and available to deploy, as well as recovery equipment on hand in case of a spill. No Class 3 facilities are currently pre-booming transfers and may face significant annual cost increases due to the additional required spill response and prevention equipment. One of the facilities, located near an Oregon port, would likely shift its service to the larger vessels across the river to its Oregon facility and cease delivering fuel to vessels with greater than 10,500 gallon capacity. All of the recordkeeping and transfer restriction regulations are currently being met by the facilities in this sector, which adds no additional cost at this time.

The new proposed rules have several elements which are new requirements to Class 3 facilities. The sections of the proposed rules which pertain to Class 3 Facilities are Sections A and B. Section A requires recordkeeping; specifically new in this section is that records required from this rule need to be maintained and available for inspection by DOE for 3 years, except that the pre-load plan and Declarations of Inspection need only be maintained for one month. Section B includes the requirements for all facilities, including Class 3 facilities. New regulations in this section include 24-hour notice of transfers to DOE, when possible, in addition to the transfer containment equipment requirements.

All of the Class 3 facilities interviewed have maximum transfer rates of less than 500 gallons per minute (gpm). Therefore the Rate B requirements apply for all Class 3 facilities. The Rate B requirements include specific requirements for pre-booming oil transfers when it is safe and effective to do so, with an alternative of requiring the deliverer to have enough sorbent materials and storage to recover a two barrel spill, and enough boom (at least 500 feet), equipment, and trained personnel to deploy within 60 minutes of any spill, with 1,000 total feet of boom deployed within two hours.

Also included for all facilities are more limited work hours for personnel (not more than 16 hours in a 24 hour period and no more than 38 hours in a 72 hour period). Transfer procedures under this rule require the completion and review of the preload plan in a face-to-face preload conference, and requires the facility to refuse or stop a transfer with any vessel not cooperating and/ in compliance. There must be at least two portable radio devices available for use between the Class 3 facility and the vessel, and an air horn for emergency signals.

The primary impacts to this sector lie in the purchasing of additional boom and sorbent materials, hiring additional personnel for pre-booming or boom deployment duties, and potentially purchasing additional boats to use during boom deployment.

2.5.2 Technical Analysis of Compliance Costs

The primary costs associated with the rule change can be divided into equipment, labor, and miscellaneous cost categories, with equipment and labor comprising the majority of the increase in costs.

The types of equipment that would need to be purchased as a result of the proposed rules include booms, sorbent materials, and possibly boats and two-way radio communication equipment. Class 3 facilities in the state currently have approximately 300-1,000 feet of boom. Facility operators/owners estimate boom costs at $15 per foot for 400-700 feet, resulting in an average cost of approximately $8,250. This boom would have to be replaced about every 5-7 years and maintained for a total cost of $13,333 every 5 years. Additional sorbent materials each firm would need to purchase under the proposed rules would be minimal, at an approximate cost of $2,500 for the 36-37 bundles required to recover a two barrel (84 gallons) spill, at $68 per bundle. This analysis assumes the cost of a skiff would be between $5,000 and $10,000, and it would need to be replaced every 10 years.

Cost increases to labor include the potential need to hire one additional employee to conduct pre-booming and/or spill response duties for each facility at approximately $50,000 per year plus benefits. These new employees would need to be highly trained and have HAZMAT, HAZWOPER, and may need forklift, truck driving, boat handling, and any additional requirements needed to be in a boat keeping the boom away from the fueling vessel.

The average firm costs based on discussions with three of the four facilities in this sector are shown in Table 9 for the initial year of the rule change, and five, ten, fifteen, and twenty years following the rule change.

Table 9
Average Firm Cost

Cost Item	Year 1	Year 5	Year 10	Year 15	Year 20
Labor	$67,500	$67,500	$67,500	$67,500	$67,500
Boom	$8,250	$13,333	$13,333	$13,333	$13,333
Skiff	$6,667		$6,667		$6,667
Sorbent materials	$2,499	$2,499	$2,499	$2,499	$2,499
Total	$84,916	$83,332	$89,999	$83,332	$89,999

2.5.3 Statewide Costs

The firm costs are compiled in Table 10 to show the total statewide Class 3 facilities sector costs, which are greater than one half million dollars per year.

Table 10
Total Sector State Costs

Cost Item	Year 1	Year 5	Year 10	Year 15	Year 20
Labor	$202,500	$202,500	$202,500	$202,500	$202,500
Boom	$24,750	$40,000	$40,000	$40,000	$40,000
Skiff	$20,000		$20,000		$20,000
Sorbent materials	$7,497	$7,497	$7,497	$7,497	$7,497
Total	$254,747	$249,997	$269,997	$249,997	$269,997

2.5.4 Economic Implications

The proposed rules will create a statewide increase of costs to this sector of nearly half a million per year. If the proposed rules are implemented as currently stated, one of the four firms in this sector stated that it would cease all fueling transfers to vessels with a capacity greater than 10,500 gallons and perform those transfers at its Oregon facility. The other facilities would not absorb the costs they would incur and would have to pass along the costs to its clients. We estimate the statewide annual transfers from Class 3 facilities total approximately 560. With annual costs of $0.55 - $0.59 million the cost per transfer for Class 3 facilities is approximately $870. This may or may not lead to customers changing fueling locations from Washington State to Oregon or Canada. Another critical feature is that these facilities service the resident fishing boat fleet in Puget Sound. Typically, these fishing vessels are all small family businesses and are already vulnerable to a great deal of economic variability due to the uncertainty in fish populations and weather. Furthermore, they form a key link in the economic chain formed by the seafood industry in Seattle, which is one of the largest in the country.

If customers do change fueling locations, the customer base and total transfer amount for these facilities will decline and a greater price increase would be necessary to recover the additional costs related to the rule change.

2.6 Class 4 Facilities - Marine Fueling Outlets

Ecology defines a Class 4 facility, or a *Marine Fueling Outlet*, as,

> *"… a facility that: a) Transfers to a vessel with a capacity to hold less than 10,500 of oil whether the vessel's oil capacity is used for fuel, lubrication oil, bilge waste, or slops or other waste; b) Does not transfer oil in bulk to or from a tank vessel or pipeline; and c) Does not include any: Railroad car, motor*

vehicle, or other rolling stock while transporting oil over the highways or rail lines of [the state of Washington]; underground storage tank regulated by Ecology or a local government under chapter 90.76 RCW; or a motor vehicle motor fuel outlet; a facility that is operated as part of an exempt agricultural activity as provided in RCW 82.04.330."

This section assesses the potential economic impacts to Class 4 businesses operating in the state of Washington resulting from the Ecology proposed regulations regarding the transfer of oil at marine fueling outlets.

This sector is mostly comprised of marinas and docks that fuel private pleasure boats and smaller commercial vessels used for tourism and recreation (i.e. whale watching and fishing charters). The operations of these facilities consist of fueling pleasure boats the vast majority of the time, and fuel the occasional charter or sight-seeing boat. The new regulations only apply to businesses that are fueling non-recreational vessels, and while most marine fueling outlets (MFOs) fuel pleasure boats, it is difficult to gauge the number of MFOs that also perform services to commercial boats. Therefore, a conservative range is applied in estimating how many businesses statewide will be impacted by the proposed regulations, as discussed below.

Compliance cost estimates were obtained primarily through interviews with MFO owners or managers throughout the State. Nearly 20 businesses were contacted, but only seven interviews were considered applicable to this analysis. These seven businesses routinely fueled commercial vessels, along with pleasure boats, and will be affected by the proposed regulations. Other businesses reported that they only fuel the occasional commercial vessel; responses from these businesses were taken into account, but not included in quantitative analysis. Marine Fueling Outlets and marinas across Washington were contacted in attempt to generate a good sample set, but five of the seven businesses were located in the Puget Sound/San Juan Island region. The significance of collecting data from a concentrated pocket of businesses, relative to the entire state, is explained below.

This section has four categories: 1) a description of impacts of the proposed regulations; 2) a technical analysis of each cost category - equipment, labor, personnel training, and recordkeeping and administrative efforts; 3) an assessment of the statewide economic impacts; and 4) a discussion of the economic implications of additional costs, or how businesses are expected to behave and manage any new compliance costs.

2.6.1 Potential Compliance Costs

The proposed regulations for MFOs pertain to oil spill response readiness, spill prevention training (i.e. safe handling procedures), and posting emergency spill contact information. In drafting the proposed regulations, Class 4 facilities are distinguished from the other facility classes because MFOs are generally small operations, which are vulnerable to regulatory burdens. MFOs are currently unregulated operations, so all new compliance efforts are considered costs directly attributable to the proposed regulations. Figure 7 below displays the proposed regulations for MFOs.

It is not expected that the regulations for MFOs will force businesses to discontinue operations. Most MFOs are already in compliance, if not exceeding the proposed standards. The most burdensome aspect of the regulations is the equipment standards, but as the following section will describe, these costs are considered nominal to the typical MFO.

2.6.2 Technical Analysis of Compliance Costs

This section details the compliance costs a typical MFO can expect to incur. Costs are divided into four categories: response and recovery equipment, personnel training, additional labor, and recordkeeping and administrative efforts. The proposed equipment standards represent the majority of new costs.

Response and Recovery Equipment

The proposed regulations insist each MFO have enough spill response and recovery equipment in standby condition to recover a 25 gallon spill. Specifically, the regulations call for each MFO to have at least 200 feet of boom, sorbent materials, non-sparking hand scoops, shovels, and buckets, and protective clothing.

Most of the businesses interviewed were already in compliance with the equipment standards and are not expected to incur new equipment costs in the inaugural year of the proposed regulations. However, this analysis assumes boom requires replacement every 5 years and sorbent materials are continually replenished on a per need, or *rolling*, basis. The next time a facility purchases response and recovery equipment it is considered a compliance effort.

Figure 7
Proposed Regulations for Class 4 Facility Oil Transfers

I) Response and Recovery Equipment: The owner or operator of each Class 4 facility must ensure that cleanup of at least a 25 gallon spill can occur by having all of the following:

- *i. Response and recovery equipment maintained in a standby condition and available to the receiving vessel:*
  - *a. Sufficient and appropriate boom of no less than 200 feet available in the standby position;*
  - *b. Oil spill absorbent materials appropriate for use in water and on land;*
  - *c. Non-sparking hand scoops, shovels, and buckets;*
  - *d. Containers suitable for holding the recovered oil and oily water; and*
  - *e. Protective clothing and other appropriate personal protective gear necessary to safely respond to an oil spill.*

II) Trained Personnel: The owner or operator of each Class 4 facility must:

- *i. Provide annual training for employees involved in an oil transfer operation, that at a minimum includes:*
  - *a. Dangers and safe practices regarding the petroleum products transferred at that location;*
  - *b. Safe and effective use and handling of response and recovery equipment; and*
  - *c. Spill notification procedures.*
- *ii. The facility must train all new employees with oil transfer duties within 90 calendar days from the date of hire.*
- *iii. Keep a record of the training at the facility and make the record available to Ecology upon request.*

III) Spill Notification Information: The owner or operator of each Class 4 facility must provide spill notification information in a wallet-sized card for each employee or posted at the dock for fueling customers. The notification information must include:

- *i. Required notifications of RCW 90.56.280;*
- *ii. A phone number for a spill response contractor; and*
- *iii. If the facility is not always manned, a 24-hour phone number where an employee of the facility can be reached to assist with the spill cleanup.*

IV) The owner or operator of each Class 4 facility must ensure that all oil transfer equipment is properly inspected and maintained, in accordance with WAC 173-180-205.

V) Class 4 facilities, also known as Marine Fueling Outlets, that are transferring less than three thousand galls of oil in a single transaction are exempt from advance notice equipment for oil transfer operations as described in RCW 88.46.160.

VI) Semiannual Reporting: Class 4 facilities must report all bulk oil transfers conducted at the facility.

VI) Compliance Schedule: Class 4 facilities must implement the requirements in subsections (1) and (2) of this section within 90 calendar days from the effective date of this chapter. Class 4 facilities must implement the remaining requirements on the effective date of this section.

The price of boom is approximately $15 per foot and assuming a business replaces the full 200 feet of boom, an MFO will incur an equipment compliance cost of $3,000 every five years. The proposed regulations require MFOs to have enough sorbent materials to recover a 25 gallon spill. A “bundle” of sorbent materials is able to recover an estimated 2.3 gallons of oil each, so about 11 bundles would recover a 25 gallon spill. Therefore, a MFO is expected to incur an annual equipment compliance cost of roughly $750 for sorbent materials, with an additional $3,000 every five years to replace boom.

Personnel Training

The proposed regulations require MFOs to train personnel in the safe practices of petroleum product transfers, safe handling of response and recovery equipment, and spill notification procedures. All interviewed MFOs drill personnel annually on these procedures and are already in compliance with the proposed regulations. However, like equipment, training exercises are considered a compliance effort and new cost.

Most MFOs are seasonal businesses, which experience a swell in spring and summer clientele. To meet this seasonal demand, a typical MFO will hire and train an additional two to seven seasonal employees. Also, one to three year-round employees also instruct or partake in training exercises, so a MFO is assumed to annually drill a total of three to ten employees on oil spill safety, response and recovery. Year-round employees typically enjoy a higher salary than seasonal employees, bringing the weighted hourly average pay to roughly $12.80 per employee in training.[20] MFOs typically set aside a full day early in season for training; therefore, drilling three to ten employees for eight hours would cost an MFO $300-$1,025 per year, depending on the size of staff.

Labor

All MFOs are expected to comply with the proposed regulations without acquiring additional employees. Therefore, this analysis does not attribute a compliance cost to labor.

Administrative and Recordkeeping

The proposed regulations require MFOs to retain training records and spill notification information in a wallet-sized card for each employee or posted at the dock for fueling customers. Interviewed businesses do not anticipate any additional costs for these requirements; therefore, no compliance costs are attributed to recordkeeping or administrative efforts.

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[20] Seasonal typically make $11/hour, while year-round employees average $20/hr.

2.6.3 Statewide Costs

There are approximately 250 marinas and docks in the state of Washington, but the majority of these businesses solely serve private pleasure-boats. The MFOs that will be impacted by the proposed regulations are those that service the occasional fishing charter and sight-seeing boat (i.e. whale watching). A typical MFO's clientele is greatly comprised of servicing, mooring, and fueling pleasure-boats, with the occasional fueling of a commercial boat. The majority of MFOs interviewed stated that 99 percent of their business is derived from these services. Only a handful of MFOs regularly fuel commercial boats and these are primarily located in the Puget Sound/San Juan Islands where tourism and recreation traffic is heavy.

Determining how many of the purported 250 docks and marinas will be classified as MFOs and regulated by Ecology is difficult to assert. For the purposes of this study it is assumed that between 50 and 200 businesses will be affected by the proposed regulations. Therefore, if a typical MFO is expected to incur $4,000-$4,800 every five years and $1,000-$1,800 annually in compliance costs, the statewide impact is approximately $50,000-$355,000 annually and $200,000-$955,000 every fifth year. Table 11 below presents that total cost by category for a typical MFO and the anticipated statewide impact.

Table 11
Compliance Costs by Category and Statewide Impact Estimates

Cost Category	Rate	Years 1 - 4	Year 5
Equipment			
Boom	$15/ft.; 200 feet	$0	$3,000
Sorbent Materials	$68/bundle; 11 bundles	$748	$748
Training	$12.80/hr; 8 hours		
Low Estimate	3 employees	$307.20	$307.20
High Estimate	10 employees	$1,024	$1,024
Total for Typical MFO			
Low Estimate		$1,055	$4,055
High Estimate		$1,772	$4,772
Statewide Impacts			
Low Estimate	50 MFOs	$52,750	$202,750
High Estimate	200 MFOs	$354,400	$954,400

2.6.4 Economic Implications

Considering the majority of MFOs are already in compliance with the proposed regulations, these businesses will not be forced to adjust their operations. Businesses in this sector are anticipated to behave in the same manner they did in the absence of the proposed regulations. Furthermore, the proposed regulations are based on spill readiness, response, and recover and do not stand to interfere with an MFO's routine operations.

2.7 Vessels

A separate regulation is proposed that will govern the oil transfer activities of vessels as opposed to facilities. The vessel rule will apply to bulk oil transfers to or from a tank vessel, a cargo vessel, a passenger vessel, or a facility. The rule will not apply to oil spill recovery vessels engaged in spill response activities or to a vessel's internal oil transfers.

Although all oil transfers that occur in Washington State waters will somehow involve a vessel, some of the major costs associated with pre-booming transfers, or with alternative measures are likely to be borne by the facilities when the transfer involves a facility. However, it is the deliverer that is responsible for compliance, and so in cases where a vessel is delivering at a facility that does not have pre-booming and compliance services in-house, the onus will be on the vessels when delivering. Large tank ships that deliver crude oil to the refineries located in Puget Sound are not expected to be affected much by the new regulation because the cost of pre-booming most of these transfers will be covered by the receiving facilities (see Class 1 facilities – Refineries, above). Similarly, when tank barges move oil products from the refineries to other terminals and facilities, or from one facility to another, some costs will be covered through the facility procedures discussed previously.

However, when vessel-to-vessel transfers occur, these will also need to be pre-boomed when safe and effective. In this case there will be additional costs associated with setting the boom in place, retracting it after the transfer, and/or having boom at the ready when it is not safe or effective to pre-boom. Primarily, the vessel regulation will affect tug and barge operations that are involved in both transport of oil products in bulk as cargo, as well as transporting various fuels to other vessels for use in propulsion. The latter activity is known as bunkering, and frequently occurs when a ship is at anchor. When a vessel transfers oil as cargo to another vessel, this is known as lightering, and these transfers will also be affected by the regulation. Finally, vessels of all types including container ships and passenger vessels that bunker in Washington waters may be affected in cases where pre-booming delays a bunker or lighter operation for longer than is currently typical for such transfers.

Based on data collected by the DOE, about 18 percent of the oil transfers in Washington are conducted from vessel-to-vessel, accounting for approximately 9 percent of the volume of oil transferred. Of the vessel-to-vessel transfers recorded, 90 percent were bunker transfers, and 10 percent involved transferring products as cargo. The transfer data collected for DOE covered just one half of the year 2004, from December through June. Assuming there would be as many transfers in the second half of the year; this implies that annually just under 1,700 vessel-to-vessel transfers would occur, with 1,542 of these being bunker operations.

Both types of transfers are carried out mostly by tug and barge operators or towing companies, of which there are five or six that operate within the state. Each has a geographic or product market niche, and one company has recently left the bunker market due in part to increased regulation. Four of the companies were interviewed for this cost analysis.

2.7.1 Potential Compliance Costs

Current regulations require that vessels conducting bunkering, lightering, or cargo operations have boom ready for deployment. The new regulations will require that Rate A deliverers pre-boom whenever it is safe and effective to do so. Furthermore, if a spill happens, the delivering vessel must be able to have four times the length of the receiving vessel in boom into the water within 2 hours. If it is not safe and effective to pre-boom then the delivering vessel must have boom sufficient to completely encircle the vessel within 1 hour, and four times the length of the largest vessel in the water within 2 hours. In each case, the boom must be readily available, and if not already on the vessel, available very nearby to be deployed within 2 hours.

As with some of the other sectors, two strategies are likely to be developed to bring vessel companies into compliance. Strategy 1 would be to outfit the vessels so that pre-booming could occur on a regular basis within the firm. To accomplish this, bunkering, lightering, and cargo transfers would need additional personnel, equipment, and boats to conduct the deployment and retraction of boom. The personnel will need training; the equipment will need to be maintained. Strategy 2 would be when the firm elects to contract out the delivering vessel pre-booming and compliance to an OSRO if the receiving facility does not have the capacity. It is very difficult to know which Strategy will be employed by which firms. The costs below are estimated for a firm with 10 barges that engages in a large number of transfers. Additional costs are also estimated for cargo transfers that would occur with the assistance of an OSRO, and for lightering operations that would use an OSRO.

2.7.2 Technical Analysis of Compliance Costs

For Strategy 1, it is assumed that a towing firm will need to purchase additional boom, and $15 per foot is a recommended price to use for boom. Assuming the firm will need at least 2,000 additional feet of boom per barge, this implies a cost of $30,000 per barge for boom. Additional charges of $7,000 will be needed for maintenance and storage of the boom which will need to be repurchased once every 5 years. A hydraulic boom reel and power pack at $25,000 is estimated to be needed and will last for 15 years. Also, a one-time gas freeing procedure would be needed per barge before a boom reel could be mounted on a barge. This is estimated to cost $40,000 per barge, and is estimated by spreading the costs over a 20 year period, and including a discount rate of 8 percent.

A skiff will need to be purchased, and replaced every 10 years. The estimated price for a boat of sufficient size to be able to pre-boom vessels during bunkering and lightering is $30,000.

It is anticipated that one additional person will be hired and trained per barge totaling $67,500 in additional costs. This amount covers salary and benefits such as vacation and health care, and including the costs of recruiting, hiring, and retaining the employee. For this analysis it is also assumed that ten barges are operating within the firm that elects Strategy 1 and conducts vessel to vessel bunkering and lightering operations.

Costs to receiving vessels are assumed to be negligible. There may be additional costs to receiving vessels if they are delayed for additional time waiting to pre-boom and for the boom to be retracted. If so, this could delay vessels up to 2 hours. However there are so many factors that affect ship scheduling that it is nearly impossible to estimate the number of times this would happen. Also, receiving vessels may end up paying for the additional costs that the bunkering vessel incurs, but for the purpose of the cost benefit analysis, the ultimate difference in costs will be the same regardless of which entity ends up paying for it. The costs of a firm with 10 barges using Strategy 1 are summarized in Table 12 below.

Table 12
Bunkering Cost Breakdown

Cost Item	Year 1	Year 5	Year 10	Year 15	Year 20
Labor	$675,000	$675,000	$675,000	$675,000	$675,000
Boom, O&M	$370,000	$70,000	$70,000	$70,000	$70,000
Anchors	$2,500			$2,500	
Boom Reel	$66,204	$66,204	$66,204	$66,204	$66,204
Boats	$300,000				
Total	**$1,413,704**	**$811,204**	**$811,204**	**$813,704**	**$811,204**

2.7.3 Statewide Costs

The total statewide cost for this sector is developed with the assumption that one firm will have costs as outlined above. For the additional cargo and lightering activities that will occur at facilities not already prepared for pre-booming, Strategy 2 will be employed, or an OSRO will be contracted. For activities in this sector, an estimated 100 other cargo transfers are expected to occur within this sector, each requiring the services of an OSRO, at $2,500. Also, 134 lightering operations are anticipated throughout the state per year, it is assumed that these will be pre-boomed with the use of an OSRO. The anticipated annual cost of the Strategy 2 service is $585,000 per year.

The total costs to the state are estimated to be $1.9 million for the first year, and just under $1.5 million on average over 20 years (as reported in 2006 dollars). Results are displayed in Table 13.

Table 13
Statewide Costs of Vessel Sector

Cost Item	Year 1	Year 5	Year 10	Year 15	Year 20
Strategy 1	$1,413,704	$811,204	$811,204	$813,704	$811,204
Strategy 2 Cargo	$250,000	$250,000	$250,000	$250,000	$250,000
Strategy 2 Lightering	$335,000	$335,000	$335,000	$335,000	$335,000
Total	**$1,998,704**	**$1,396,204**	**$1,396,204**	**$1,398,704**	**$1,396,204**

2.7.4 Economic Implications

The additional costs that firms in this sector face may have impacts in the markets for bunkering and lightering services. At this point it is not clear to what degree they may come to pass. The bunkering market for ships is a function of scheduling, availability, price and a number of other factors. Therefore, if the industry attempts to pass the additional costs along to their customers, there is a potential to lose market share. The reason this may happen is because substitute locations for fueling are available if bunkering at anchor becomes too expensive. For foreign vessels, they can bunker in Asia or other international locations. If this happens, it is likely that the quantities of fuel purchased ("stems") will be reduced as vessels shift to purchasing their larger stems elsewhere. For vessels that will not transit the Pacific, there are still options such as Oregon, and Vancouver B.C. Additional costs in the

Washington market have the potential to drive some of the Washington bunker market to either of these locations. In particular, because the Columbia River is half in Washington and half in Oregon, it is likely that (for example) the Port of Vancouver upper anchorage, which is located in Oregon waters, could become the preferred refueling location while the lower anchorage is in Washington waters.

2.8 Public Sector Costs

The public sector also has costs associated with the proposed regulations. The new regulation will require that six full-time employees be added to the DOE department of Spill Prevention and Preparedness. The total cost (including benefits) for these employees is $410,000 per year.

2.9 Summary of Costs

A summary of total costs to all sectors within the state is shown in Table 14. Total average annual costs to the State of Washington for the next 20 years are just under $10.34 million (reported in 2006 dollars).

Table 14
Summary of Expected Costs to
State of Washington from Proposed Oil Transfer Regulations

Affected Group	Number in State	Average Annual Cost per Firm	**Average Annual Statewide Costs**
Class 1 Facilities *Refineries*	5	$1,196,892	**$5,984,461**
Class 1 Facilities *Other Large Facilities*	12	$79,187	**$950,240**
Class 2 Facilities (*Mobile Tank Trucks*)	35	$29,423	**$1,029,821**
Class 3 Facilities (*Marine Fueling Terminals*)	3	$72,204	**$216,612**
Class 4 Facilities (*Small Marinas*)	125	$2,079	**$259,830**
Vessels	5	$297,291	**$1,486,454**
Public Costs			**$410,000**

3.0 Technical Analysis of Benefits

With the proposed regulations the costs of spills will be decreased, and in general the decreased costs comprise the anticipated benefits of the regulation. Costs are expected to decrease through decreased incidence of spills, as well as through decreased costs that stem from containing the remaining spills quicker than would otherwise have occurred.

Following a review of literature on the costs of oil spills and the benefits of oil spill prevention, this chapter covers data on the history of oil transfer spills in Washington State. The frequency, size, source, and causes of oil transfer spills are analyzed. Using this historical data combined with oil spill costs and prevention benefits, the current and expected future costs of transfer-related spills are analyzed. The benefits of spill prevention and containment are estimated based on how the scenario will differ with the regulations in place.

3.1 Costs of Oil Spills

Previous studies of oil spill costs have considered the costs of previous oil spills, the costs of hypothetical oil spills, and costs of average oil spills. These costs often include the costs of cleaning up oil spilled, the cost of restoring the natural ecosystem, and the cost of lost socioeconomic uses of natural system. These cost estimates are reviewed below and assist in better understanding the costs of future oil spills in Washington State. Also reviewed are several studies regarding the value to society of effective oil spill prevention programs. This latter category includes "non-use" values and/or passive use values that capture the public desire to protect natural resources regardless of whether or not they will ever "use" the resource in a tangible way.

3.1.1 Response Costs

Response, or clean up costs, include the costs of preventing further oil release, salvage of unspilled oil, containment of spilled oil, protection of sensitive areas, removal of spilled oil, decontamination of equipment, and disposal of oil and contaminated objects. These response actions require equipment, supplies, and logistical support. Based on data from oil spills of over 50 gallons in the United States between 1980 and 2002, average response costs in the United States have historically varied from approximately $50 per gallon to over $400 per gallon.[21]

Response costs for oil spills in Washington State are available from two recent oil spills in Puget Sound: the Point Wells Spill and the Dalco Passage Spill. The 4,700 gallon Point Wells Spill occurred in December 2003 during transfer operations. Response costs for this spill totaled over $4.5 million, or $957/gallon[22]. The Dalco Passage Spill occurred in October 2004; the cause of the spill is still under investigation. The response costs for the Dalco Passage spill are not yet known but they are currently projected at $1.9 million.[23] The volume of this spill has also not yet been determined, and hence per gallon estimates of clean up costs are not yet available though it is believed that these cleanup costs may approach $2,000 per gallon.

The wide variation in per gallon response costs is due to the specific circumstances surrounding each oil spill. Research on the relative influence of different factors on the cost of cleanup indicates that the most important determinant of response cost is typically the location of the spill.[24] In particular, proximity to a shoreline greatly determines the cost of oil spill clean up. It has been estimated that when oil reaches the shore, as much as 90 to 99 percent of the total cleanup and rehabilitation costs are associated with shoreline cleanup.[25] Both the Dalco Passage Spill and the Point Wells Spill resulted in significant oiling of

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21 Source: Etkin, Dagmar Shmidt, 2004, "Modeling Oil Spill Response and Damage Costs", Environmental Research Consulting. The EPA Basic Oil Spill Cost Estimation Model (EPA BOSCEM) draws on historic spill cost information and includes oil spill characteristics such as oil type, volume, and location to estimate oil spill costs.

22 Washington State Department of Ecology News Release, 2005, "Point Wells oil spill draws $577,000 in penalties", website: http://www.ecy.wa.gov/news/2005news/2005-082.html, last accessed May 8, 2006.

23 The Tacoma News Tribune, 2005, "Tacoma lawyer named to council on oil spills", website: http://www.washingtonports.org/members_only/newroundups/august2005/082505.htm#tacoma, last accessed May 8, 2006.

24 Etkin, Dagmar Schmidt, 1999, "Estimating Cleanup Costs for Oil Spills", Paper #168, 1999 International Oil Spill Conference.

25 Etkin, Dagmar Schmidt, 1998, "The Costs of Cleanup For Port Oil Spills", *Port Technology International*, Vol. 8: p. 237-242. ICG Publishing Ltd., London, UK.

shorelines. Additionally, both spills were in environmentally sensitive areas, causing oil spill clean up costs to be relatively high. Because transfers typically take place either in port or near shore, the cleanup cost of transfer spills will typically be relatively high. Also, since many areas of the Puget Sound and the Columbia River are defined as environmentally sensitive, clean up costs for oil spills in these areas will typically be relatively high.

Another important factor affecting the cost of cleaning up an oil spill is the type of oil spilled. Heavier crude and fuel oils are relatively more expensive to clean up than light refined products such as gasoline and diesel.[26] Heavier oils can persist and travel great distances in the marine environment due to their non-volatile components and high viscosity. In contrast, light, refined products do not persist long in the marine environment due to the rapid evaporation of volatile components and their tendency to disperse naturally.[27] As is the case for most of the oil spills in Washington State, the oil spilled in the Point Wells incident was heavy oil. (Of the Washington State spills recorded in the last 6 years with known oil products, 96 percent were either crude oil or bunker oil).

Finally, although total response costs increase as spill size increases, the response cost per gallon tends to first increase and then decrease as spill size increases.[28] This relationship is largely due to the large costs that are associated with the initial mobilization of personnel and equipment that are required to respond to a spill. The Dalco Passage and the Point Wells Spills were larger than most transfer spills in Washington State, indicating that many transfer spills in Washington may result in even larger per gallon response costs.

Recent reported response costs of oil spills in Washington State as well as the general characteristics of Washington State transfer spills (occurring in ports or near shoreline, often in environmentally sensitive areas, consisting typically of heavy oil types, and of small average size), it is expected that the clean up costs of oil transfer spills in Washington will continue to exceed the historical average. Additionally, recent efforts by the Washington State Oil Spill Advisory Council and the Department of Ecology have resulted in high clean up standards for response efforts. Based on these factors, this analysis assumes that future Washington oil spill response costs will average $957 per gallon, the response cost of the Point Wells Spill.

[26] Etkin, Dagmar Schmidt, Worldwide Analysis of Marine Oil Spill Cleanup Cost Factors Etkin June 2000

[27] White, I.C. and F.C. Molloy, 2003, “Factors that Determine the Cost of Oil Spills”, The International Tanker Owners Pollution Federation Limited, London United Kingdom.

[28] White, I.C. and F.C. Molloy, 2003, “Factors that Determine the Cost of Oil Spills”, The International Tanker Owners Pollution Federation Limited, London United Kingdom. Etkin, Dagmar Schmidt, 1999, “Estimating Cleanup Costs for Oil Spills”, Proceedings of the 1999 International Oil Spill Conference.

3.1.2 Socioeconomic Costs

Socioeconomic costs of oil spills include impacts to property, loss of use of natural resources for recreational or subsistence purposes, and loss of income or increased expenses in such industries as fishing, tourism, and shipping. Sectors and resources particularly at risk of impact are ports, commercial fishing and shell-fishing, Tribal Nation resources and subsistence fishing, parks and recreation, and tourism. The socioeconomic costs of oil spills depend largely on the success of the response operation to prevent oil from reaching culturally and economically important resources, the type and persistence of the oil spilled, and the season of the spill.[29] Some examples of socioeconomic costs by oil type shown in Table 15, suggest that these costs can range from $53 per gallon to $955 per gallon.

For the purpose of this study, estimates of socioeconomic costs for transfer-related oil spills in Washington State were developed by Environmental Research Consulting.[30] The results of this research concluded that an average of $568 per gallon was lost in socioeconomic value for historic transfer–related spills.

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[29] Etkin, Dagmar Schmidt, 2005, "Socioeconomic Cost Modeling For Washington State Oil Spill Scenarios: Part II", Environmental Research Consulting.

[30] Etkin, Dagmar Schmidt, 2006, "Trends in Oil Spills from Large Vessels in the US and California with Implications for Anticipated Oil Spill Prevention and Mitigation Based on the Washington Oil Transfer Rule, Environmental Research Consulting.

Table 15
Summary Socioeconomic Costs by Quantity and Oil Type

Oil Type	Volume (Gallons)	Socioeconomic Cost 2005$ / Gallon
Volatile Distillates	<500	$69
	500-1,000	$281
	1,000-10,000	$425
	10,000-100,000	$191
Light Fuels	<500	$85
	500-1,000	$350
	1,000-10,000	$531
	10,000-100,000	$212
Heavy Oils	<500	$159
	500-1,000	$637
	1,000-10,000	$955
	10,000-100,000	$531
Crude Oil	<500	$53
	500-1,000	$212
	1,000-10,000	$318
	10,000-100,000	$149

Source: Etkin, Dagmar Schmidt, 2004, "Modeling Oil Spill Response and Damage Costs", Environmental Research Consulting.

3.1.3 Environmental Damage Costs

Environmental damages are costs borne by the public that are due to the degradation of natural resources (e.g. adverse effects on marine species and habitat) and the loss of ecosystem services. While response and socioeconomic costs of oil impose direct financial costs which can be quantified by the cost of the lost oil and the response, and claims by third parties, environmental damages do not result in observable economic costs.

Economists have developed several methods to evaluate these damages. One method estimates damage costs by quantifying the costs to restore equivalent resources and/or ecological services. In a model of oil spills in the San Francisco bay, crude and diesel spills have the highest environmental damage costs, while gasoline would result in the lowest per gallon cost (Etkin, 2004). Table 16 shows how typical environmental costs vary by oil type according to work done by Environmental Research, Inc.

Table 16
Summary Base Environmental
Damage Costs by Quantity and Oil Type

Oil Type	Volume (Gallons)	Environmental Damage 2005$ / Gallon
Volatile Distillates	<500	$51
	500-1,000	$48
	1,000-10,000	$37
	10,000-100,000	$32
Light Fuels	<500	$90
	500-1,000	$85
	1,000-10,000	$74
	10,000-100,000	$69
Heavy Oils	<500	$101
	500-1,000	$96
	1,000-10,000	$90
	10,000-100,000	$80
Crude Oil	<500	$96
	500-1,000	$92
	1,000-10,000	$85
	10,000-100,000	$77

Source: Etkin, Dagmar Schmidt, 2004, "Modeling Oil Spill Response and Damage Costs", Environmental Research Consulting.

As an example, the 1986 *Apex Houston* crude oil spill off of the coast of Central California resulted in large oiling mortalities of seabirds. This incident was one of the first large natural resource damage claims, with a settlement of $6.4 million in 1994, or 8.63 million in 2006 dollars.[31] As the spill size was 25,800 gallons, the per-gallon NRDA cost was $248/gallon in 1994, or the equivalent of $334 in 2006 dollars.

Recent studies regarding the relative contribution of response, socioeconomic, and environmental damage costs indicate that environmental damage costs typically comprise only a modest component of the total cost of an oil spill.[32] In Washington State, parties

31 Carter, Harry R., et al, 2003, "The 1986 Apex Houston Oil Spill in Central California: Seabird Injury Assessments and Litigation Process", *Marine Ornithology*,31: 9-19.

32 Etkin, Dagmar Schmidt et al, 2003, "Financial Implications of Hypothetical San Francisco

responsible for oil spills typically pay a penalty and some environmental damage costs. For the recent Point Wells spill, a total of $151 was assessed in both penalties and damages.

3.1.4 Summary of Response, Environmental, and Socioeconomic Costs

Summary values for oil spills have also been developed depending on the type and volume of oil spilled. These values are estimates of how the sum of socioeconomic costs, environmental damages and cleanup costs combine on a per gallon basis (See Table 17).

Table 17
Summary of Cleanup, Environmental,
and Socioeconomic Oil Spill Costs by Quantity and Oil Type

Oil Type	Volume (Gallons)	Costs Per Gallon 2005$
Volatile Distillates	<500	$229
	500-1,000	$437
	1,000-10,000	$568
	10,000-100,000	$281
Light Fuels	<500	$265
	500-1,000	$523
	1,000-10,000	$692
	10,000-100,000	$357
Heavy Oils	<500	$670
	500-1,000	$1,142
	1,000-10,000	$1,453
	10,000-100,000	$992
Crude Oil	<500	$360
	500-1,000	$513
	1,000-10,000	$610
	10,000-100,000	$422

The total value of these types of costs for future spills in Washington on a per-gallon basis might total $957 per gallon for clean up costs, plus $568 per gallon for socioeconomic plus $151 for environmental damage plus fees. The total cost per gallon would be $1,676. However, it is not clear whether such estimates are inclusive of the passive use values held by the public.

3.1.5 Non-Use, or Passive Use Values

The total value of a resource or natural site is a composite of both the use values and the nonuse values. This is explained in slightly more technical terms in the following definition of “compensable value” from the Department of the Interior’s Final Rule regarding Natural Resource Damage Assessments either from a discharge of oil into navigable waters under the Clean Water Act or a release of a hazardous substance under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (59 FR 14262):

> *(c) Compensable value. (1) Compensable value is the amount of money required to compensate the public for the loss in services provided by the injured resources between the time of the discharge or release and the time the resources and the services those resources provided are fully returned to their baseline conditions. The compensable value includes the value of lost public use of the services provided by the injured resources, plus lost nonuse values such as existence and bequest values. Compensable value is measured by changes in consumer surplus, economic rent, and any fees or other payments collectable by a Federal or State agency or an Indian tribe for a private party's use of the natural resources; and any economic rent accruing to a private party because the Federal or State agency or Indian tribe does not charge a fee or price for the use of the resources.*
>
> *(i) Use value is the value of the resources to the public attributable to the direct use of the services provided by the natural resources.*
>
> *(ii) Nonuse value is the difference between compensable value and use value, as those terms are used in this section.*

This is consistent with most economic thinking, that Total Economic Value (TEV) is equal to the sum of Use Value, and Non-use Value. However, there is a category known as “indirect use value” which is connected to the biological services provided by the ecosystem to support habitat and other ecosystem functions. Because of this economic grey area, (is it use, or nonuse?) economists as well as ecologists recognize that measuring TEV directly has some merit over trying to measure separate components of value.

A recent study of nonuse values related to the Exxon Valdez (see Carson et al., 2003) updated information from a stated preference, or contingent valuation (CV) survey conducted after the Exxon Valdez Spill. The authors point out that such surveys are the only way to evaluate nonuse value and they point out that while the methodology has received criticism, the criticism has been more about measurement techniques rather than theoretical difficulties. Prior to establishing the final rule regarding oil spills and CERCLA, the National Oceanographic and Atmospheric Administration convened a Blue Ribbon Panel led by Nobel Laureate Economist Kenneth Arrow and Robert Solow. That panel concluded that CV studies provide “useful information” for damage assessment, provided “stringent guidelines” were followed.

In the recent update on the original Valdez study, the authors point out that the original study reported an estimate of 2.8 billion (1990) dollars as the total passive use value lost in the spill. However, since the original study, improvements in estimation techniques have led to a theoretically improved estimate of average willingness-to-pay for non-use values. This estimation yields a passive use loss of 4.87 billion (1990) dollars. Yet another technique which adjusted for some uncertainty and misperceptions in the original study would have yielded the result of 7.19 billion from the same data. This 7.19 billion in 1990 translates into 11.0 billion in 2006 dollars. The authors point out too, that that the values from the Exxon Valdez study, and the Oil Pollution Control Act in 1990, (stating clearly the need to compensate for passive use values), serve as an *ex ante* decision-making tool, and may be responsible for greater investments in avoiding oil spills. Other places in the world do not have such decisive policy statements.

Another more recent study, conducted with the same rigor as the above study, and by the same authors, involved a contingent valuation study for an oil spill prevention program in Central California.[33] The survey asked people what they would be willing to pay to support a governmental program that would provide a ship carrying cleanup supplies to escort every oil barge that passed through the central coast. During the survey, respondents were shown pictures of the wildlife, especially waterfowl that would be put at risk. The results of the survey showed that the average household was willing to pay a one time payment of $76 to provide such containment that would protect an oil spill from arriving at the coast for a period of ten years.

A considerable amount of literature has been devoted to the topic of passive use values in oil spill prevention. Some of this literature is critical of the methods used in these studies, and some of the criticism has been addressed (see Carson et al., 2004, Appendix L). However, aside from the compensation issue, for the purpose of estimating the value of oil spill prevention ex ante, or prior to the event of an oil spill, the robust estimates provided by this household level study (albeit in California) are the best available data to use in approximating the value of a similar prevention program in Washington State.

3.2 Overview of Oil Spills in Washington

Oil spill data from the United States Coast Guard (USCG) and the Washington Department of Ecology (DOE) were utilized to estimate annual oil transfer spills into navigable waters of Washington State. The Puget Sound Command of the USCG provided data on transfer spills

[33] Carson, Richard T., Michael B. Conaway, W. Michael Hanemann, Jon A. Krosnik, Robert C. Mitchell and Stanley Presser, 2004, Valuing Oil Spill Prevention: A Case Study of California's Central Coast, Kluwer Academic Publishers.

occurring in the Puget Sound between 2000 and 2005, while DOE provided data on transfer spills from DOE-regulated facilities or vessels occurring between 1998 and August 2005. The 2000 to 2005 data from these two sources were combined, removing any duplicate records and any records related to oil transfer spills from recreational vessels as these are not regulated by the proposed transfer rules. As complete transfer spill data for the Columbia River and coastal areas outside of Puget Sound were not available, the dataset does not include all oil transfer spills in Washington during this six year period.

Transfer spills are just one of many potential types of oil spills. To place oil transfer spills in context, data on all oil spills was compared to the data on transfer spills. For the Puget Sound region, the USCG provided data for all oil spills and as well as transfer-related spills. Between 2000 and 2005, transfer-related oil spills accounted for 21 percent of all oil spills in the Puget Sound. If not for the 4,700 gallon Point Wells spill in 2003, however, the percentage of transfer spills of all spills between 2000 and 2005 would be 13 percent, not 21 percent.

Table 18
Transfer Spills Relative to All Oil Spills
Puget Sound Oil Spill Data: 2000 - 2005

	Year						
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**Total**
All Spills							
Volume of Spills	8,279	16,386	11,825	10,678	4,102	8,313	59,583
Number of Spills	562	594	465	389	483	536	3,029
Volume Spills / Transfer	14.7	27.6	25.4	27.4	8.5	15.5	19.7
Transfer Related Spills							
Volume of Spills	1205	5284	718	4979	247	98	12,531
Number of Spills	75	78	58	34	49	27	321
Volume Spills / Transfer	16.1	67.7	12.4	146.4	5.0	3.6	39.0
Transfer Percent of Total							
Volume of Spills	15%	32%	6%	47%	6%	1%	21%
Number of Spills	13%	13%	12%	9%	10%	5%	11%

Source: United States Coast Guard Spill Database, Data received by personal communication with LT. Christina Grimm, Puget Sound Command, on February 16, 2006.

3.2.1 Description of Washington Oil Transfer Spills

The available data for 2000 to 2005 related to 282 transfer spills, which resulted in 15,800 gallons of oil spilled into waters of the state. On an annual basis, there were an average of 47 spills resulting in 2,642 gallons of oil spilled. The three spills over 1,000 gallons recorded from 2000 to 2005 accounted for 65 percent (10,300 gallons) of total transfer oil spill volume. The largest spill recorded during this period was a spill of 4,700 gallons December 2003 at Point Wells. While the larger transfer spills comprised a majority of the volume of oil spilled, approximately 75 percent of recorded oil spills were eight gallons or less.

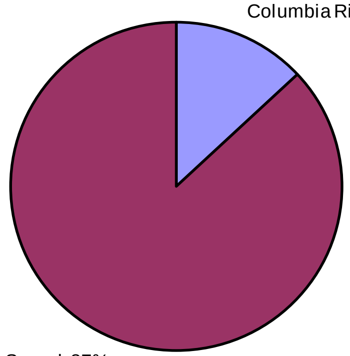
To generalize the annual pattern of oil transfer spills during this timeframe, spills were categorized by spill size to develop a spill size distribution. Fifteen categories of spill volume were created, with the smallest category being spills of 0 to 2 gallons and the largest category being 3,500 to 5,500 gallons. Table 19 provides this size distribution. This distribution results in a very similar average annual spill volume (2,674 gallons) to the actual average volume (2,642 gallons) recorded during 2000 to 2005.

Table 19
Average Annual Size Distribution of Recorded Oil Transfer Spills
Washington State 2000 – 2005

Spill Volume	Number of Spills	Percentage of Spills in Category	Average Spill Size in category	Average Volume in Category
0 – 2	164	58.16%	1	27
>2 -8	49	17.38%	5	41
>8 – 20	38	13.48%	14	89
>20 – 30	9	3.19%	25	38
>30 – 60	5	1.77%	45	38
>60 – 70	0	0.00%	65	0
>70 – 100	0	0.00%	85	0
>100 – 300	8	2.84%	200	267
>300 – 600	4	1.42%	450	300
>600 – 700	0	0.00%	650	0
>700 – 800	2	0.71%	750	250
>800 – 1,250	0	0.00%	1025	0
>1,250 – 1,750	0	0.00%	1500	0
>1,750 – 3,500	2	0.71%	2625	875
>3,500 – 5,500	1	0.35%	4500	750
	282	100%	56	2,674

Of the 282 spills in the dataset, the vast majority were recorded in the Puget Sound area. Only 8 spills (3 percent) accounting for 13 percent of the spill volume were recorded in the Columbia River (see Figure 8). The Columbia River figures may be understated, since only the statewide DOE transfer spill dataset was available for Columbia River spills.

Figure 8
Location Distribution of Recorded Oil Transfer Spills by Volume, Washington State 2000 - 2005



3.2.2 Causes of Oil Transfer Spills

The DOE dataset and the Coast Guard dataset differ in the way spill causes were recorded. DOE data included information on what type of operation was occurring at the time of the spill, while the Coast Guard data included what type of vessel or facility was the responsible party. Several of these categories overlap; for example, an operation such as discharging or loading cargo usually involves tank vessels and fixed facilities and bunkering often involves a barge. If it is assumed that discharging and loading cargo includes all fixed facility spills, these spills comprise 27 percent of all transfer spills. Tank vessels alone account for 38 percent of transfer spills. Tank vessel spills are also of the largest average size at over 430 gallons per spill. Fishing vessel spills account for the largest percentage of spills, 24 percent, but due to a small average spill volume, only comprise 15 percent of total spill volume. An overview of the oil spill data by cause is displayed in Table 20.

Table 20
Responsible Party/Operation during Oil Spill:
All Data 2000 - 2005

Responsible Party/Operation	Percentage Occurrences	Percentage Volume	Average Spill Size
Fixed Facility	4%	21%	352
Fishing Vessel	24%	15%	38
Tank Vessel	5%	38%	432
Tug/Barge	10%	1%	5
Bunkering	7%	14%	123
Discharging/Loading Cargo	6%	6%	54
Other	44.3%	6.2%	19

3.2.3 Expected Volume of Annual Spills

The oil transfer spill dataset for Washington State includes only the years 2000 to 2005. During this period there were three spills between 1,000 gallons and 5,000 gallons, but there were not any spills of very large magnitude. Very large transfer spills do occur, and while they are rare, large spills dominate total spill volumes. For example, a recent study analyzing transfer spills from large vessels occurring in the United States between 1985 and 2004 found that 53 percent of total volume spilled during these 20 years was the result of one oil transfer spill: the 1990 T/V Mega Borg lightering spill which resulted in 3.9 million gallons of oil being spilled into the Gulf of Mexico.

In Washington State, the largest transfer spill in the last twenty years was a spill of 7,500 gallons in 1986. A study of Washington oil discharge scenarios estimated that the most likely-worst-case discharge from oil transfers in Washington State would be a spill of 155,000 gallons from a tank barge.[34] This same study estimated that the worst possible oil transfer spill could be as large as 3 million gallons. While large spills are possible in Washington State, the 2000 to 2005 dataset does not include such low probability spills. To estimate the total expected annual volume of oil transfer spills, it is therefore necessary to enhance the spill size distribution developed from the 2000 to 2005 dataset (Table 21) to include large volume, low probability spills. Two additional spill size categories were added to the fifteen categories: a category of 7,500 to 10,000 gallons, and a category of 155,000

34 Etkin, Dagmar Schmidt, 2006, “Trends in Oil Spills from Large Vessels in the U.S. and California with Implications for Anticipated Oil Spill Prevention and Mitigation Based on the Washington Oil Transfer Rule,” Prepared for Washington Department 9of Ecology, under Contract No. C040018 by Environmental Research Consulting.

gallons. As a spill of 7,500 gallons has already occurred in the last 20 years, it was assumed that a spill between 7,500 and 10,000 gallons could occur every 25 years. A category of 155,000 gallons was also included to represent the most likely worst case scenario. It was assumed that this worst case scenario would occur every 100 years.[35] By including these two spill categories and their associated probabilities, the average expected spill volume is 4,571 gallons per year.

In addition to accounting for high volume, low probability spills, it is also necessary to consider whether the average annual number of oil spills will change in the future. The number of oil spills is assumed to be directly related to the number of vessel transits and to the amount of oil being transported in Washington State waters. As both vessel transits and oil transported are projected to increase, it is expected that in the absence of changes in oil transfer practices, the number of oil spills will rise in the future.

Table 21
Average Annual Size Distribution of Recorded Oil Transfer Spills
Washington State 2000 – 2005

Spill Volume (gallons)	Number of Spills	Percentage of Spills in Category	Average Spill Size in category	Average Volume in Category
0 – 2	164	58.09%	1	27
>2 -8	49	17.36%	5	41
>8 – 20	38	13.46%	14	89
>20 – 30	9	3.19%	25	38
>30 – 60	5	1.77%	45	38
>60 – 70	0	0.00%	65	0
>70 – 100	0	0.00%	85	0
>100 – 300	8	2.83%	200	267
>300 – 600	4	1.42%	450	300
>600 – 700	0	0.00%	650	0
>700 – 800	2	0.71%	750	250
>800 – 1,250	0	0.00%	1025	0
>1,250 – 1,750	0	0.00%	1500	0
>1,750 – 3,500	2	0.71%	2625	875
>3,500 – 5,500	1	0.35%	4500	750
>5,500 – 7,500	0	0.00%	6500	0
>7,500 – 10,000		0.09%	8750	350
155,000		0.02%	155,000	1,550
All Spills	282	100.00%	63	4,571

[35] To compute the percentage of all transfer spills that would fall in each of the new categories, the probability of a spill occurring in any given year was multiplied by the annual number of spills per year (47 spills per year). As simply including these two new categories would result in the probability of all transfer spills exceeding 1.0, the original 15 categories were rebalanced so that the probability of all spills remained at 1.0.

The number of projected vessel transits by vessel type is presented in Table 22 for the years 2005 to 2025. Over the next twenty years, transits by oil tankers are expected to increase by 11 percent, while transits in all other vessel categories are expected to rise by at least 24 percent. Container ships show the largest rise in transits with a 71 percent increase.

Table 22
Vessel Transit Forecast for the Puget Sound 2005 - 2025

	Year					% Increase
Transits by Vessel Type	**2005**	**2010**	**2015**	**2020**	**2025**	**2005-2025**
Bulk Carriers	5547	6065	6632	7255	7939	43%
Container Ships	2620	2762	3246	3816	4486	71%
Other Vessels > 3000 GT	2992	3153	3326	3510	3712	24%
Other Vessels 300 - 3000 GT	180	193	211	225	245	36%
Barges (Laden)	201	215	229	246	264	31%
Tankers (Laden)	579	590	604	622	641	11%

Source: Regulatory Assessment: Use of Tugs to Protect Against Oil Spills in the Puget Sound Area

The quantity of cargo oil being transported in Washington State waters is projected to increase by 16 percent over the next twenty years.[36] For this analysis it was assumed that bulk oil cargo volume was the best available metric to estimate the number of future oil transfer spills. Table 23 shows how the expected number of oil spills, and subsequently the expected oil spill volume, rise each year proportionate to the volume of bulk oil cargo transported over waters of the state.

[36] BST Associates, Paul Chilcote, and Global Insight, 2004, "2004 Marine Cargo Forecast", http://www.washingtonports.org/Trade/tradecover.htm.

Table 23
Projections of Marine Bulk Petroleum Cargo Transports and Oil Spills Per Year 2005 – 2025 (Metric Tons)

Year	WA Bulk Petroleum Cargo	Percentage Increase from 2005	Expected Spills Per Year	Expected Spill Volume Per Year
2005	42,906		47	4,571
2006	42,902	100%	47.0	4,570
2007	43,100	100%	47.2	4,591
2008	43,298	101%	47.4	4,612
2009	43,496	101%	47.6	4,633
2010	43,896	102%	48.1	4,676
2011	44,118	103%	48.3	4,700
2012	44,339	103%	48.6	4,723
2013	44,561	104%	48.8	4,747
2014	44,782	104%	49.1	4,771
2015	45,004	105%	49.3	4,794
2016	45,736	107%	50.1	4,872
2017	46,469	108%	50.9	4,950
2018	47,201	110%	51.7	5,028
2019	47,934	112%	52.5	5,106
2020	48,666	113%	53.3	5,184
2021	48,906	114%	53.6	5,210
2022	49,146	115%	53.8	5,235
2023	49,387	115%	54.1	5,261
2024	49,627	116%	54.4	5,287
2025	49,867	116%	54.6	5,312

3.3 Analysis of Benefits of Proposed Rule

3.3.1 Expected Oil Transfer Spill Costs (Baseline)

Based on expected annual spills developed above, future costs of oil spilled in Washington during transfers are estimated by totaling the sum of response costs, and total economic values. To do this, the expected clean up costs are $957, which is the value of cleanup from the Point Wells spill, but is expected to be much smaller than the cleanup costs associated with the recent Dalco spill. Still, these costs are larger than some cleanup costs and are expected to approximate a middle value.

In addition to these costs, the total economic value of oil spill prevention is approximated by extrapolating from the spill prevention study conducted in California. Ideally, a similar study would have been conducted in Washington to measure oil spill prevention, and those values could be used, yet such studies are costly to conduct. In lieu of such available data, the central California study provides the most appropriate data from which to estimate the total economic value of similar oil spill prevention in Washington.

It is assumed that households in Washington State are also willing to pay $76 in 2004, which updates to $97.09 in 2006 dollars for a program that would provide a similar function to the Washington coast. That is, the transfer rule provides not that a spill would not happen, but rather that it will be contained quickly – just as in the California case. However the Californians were offered a program that would contain all spills, and in Washington, the transfer related spills are only expected to represent 23 percent of all spills, and so 23 percent of the per household estimate is appropriate for use in this study. This brings the per-household value of oil contained by transfer spills to an estimated $22.33 to be spread over ten years. The ten years is because households in the California study were asked what they would be willing to pay for a program lasting ten years. This assumption suggests that Washington State households would be willing to pay $2.23 per year for the benefits provided by the oil transfer regulation.

By using the California study data, the socioeconomic "use" values described above can not also be included in the calculation of benefits because these include commercial use values such as fishing and tourism, as well as the recreational use values that the public does not pay for, such as beach use. Meanwhile, in the California study, some of the total value of the program described to respondents derives from passive nonuse values, but some also derives from use values such as beach use. Hence there is a possibility of double counting.

To avoid the double counting it would be ideal to know what percent of the California study public values were derived from passive use, and what was derived from anticipated use of the resources, such as recreation. However there is little literature on this topic. Two studies of freshwater economic values provide suggestions. Whitehead and Groothius (1992) determined that the total economic value for improving water quality in the Tar-Pimlico River, in North Carolina was $25.00 in 1991 dollars per household per year for non-use value, and $35.00 in 1991 dollars for use value. An earlier study (Sanders et al., 1990) found that non-use value represented 80 percent of total value. Because there is no better guidance in this area, the total economic value is best preserved as is from the California study, without attempting to distinguish use from nonuse value. In doing this, it is also prudent to exclude both typical estimates of per-gallon socioeconomic costs, and environmental costs. The latter may also include passive use values, and the former some use values.

3.3.2 Expected Spill Cost Savings and Prevention Benefits with Regulation

It is not clear how much of the response costs of oil spills will be reduced with the proposed new regulations. Some reduction in spills may result from additional vigilance required because the boom must be placed in the water ahead of a transfer, and because there will be more people watching during a transfer. When it is not safe and effective to pre-boom, firms are required to report to DOE via email why they are not pre-booming, thus alerting DOE to conditions during transfers, and allowing input from DOE on any questionable transfers. Besides the obvious cost and environmental protection prevention provides, most of the reductions in spill costs will come from transfer containment in two forms. Primarily, if a spill occurs when pre-booming has occurred, the cost of the spill will be reduced through early containment. Secondarily, through the new regulations, boom will be ready to deploy anytime that it is unsafe and ineffective to pre-boom. Hence when pre-booming is not possible, the new regulations will facilitate the speed of spill containment after the fact.

From the work by Environmental Resources Consulting, Inc. for this study, an estimated 13 percent of spills are expected to be prevented, based on analysis of spill incidence reduction in California in the time since a similar oil transfer rule was adopted. The response costs of those spills are therefore entirely counted as benefits, or savings. For the rest of the expected future spills, they are expected to occur but be contained rapidly. In such cases, some clean up costs will still be required although these will be greatly reduced. It is assumed that 15 percent of the $957 per gallon costs will still be needed to clean up the contained oil.

Through prevention, early containment, and additional training (especially for mobile facilities) a great amount of the expected costs of transfer-related oil spills may reasonably be expected to be reduced. The total potential benefits of the program are estimated to average $12 million per year. Resulting benefits for the years 2007, 2012, 2017, and 2027are displayed below (see Table 24).

Table 24
Average Annual Benefits

Benefit Source	2007	2012	2017	2022	2027
Expected Gallons Spilled	4,571	4,676	4,794	5,184	5,312
Cleanup Costs	$3,803,295	$3,891,051	$3,989,267	$4,313,876	$4,420,336
Public Value	$5,479,627	$5,858,506	$6,260,439	$6,644,803	$7,010,821
Total Benefits	**$9,282,922**	**$9,749,558**	**$10,249,706**	**$10,958,679**	**$11,431,157**

3.4 Summary of Benefits

The expected benefits of the proposed regulation will average $10.37 million in 2006 dollars per year over the next 20 years. These benefits increase with the number of households in Washington, and as the number of gallons of spilled oil saved increases. Estimates cover the savings in avoided cleanup costs, and the total economic value of the program to households. The latter should include public resource use values as well as passive, or nonuse values associated with preventing oil spills.

Several types of economic values have not been included in this report due to lack of reliable data or methodology. For example, additional potential nonuse or passive use values may accrue to people living in other states. Another type of benefit that could be derived from this regulation might be litigation costs and down time incurred by firms that spill oil. Also detailed values of endangered species such as the recently-listed Orca were not specifically included, though the passive use values may include some of this value. The same argument applies to Tribal religious and cultural values – these were not addressed specifically, but may be included in part through the public value estimates.

4.0 Summary and Conclusion

The purpose of this analysis has been to estimate the expected costs and benefits that may result from implementing proposed WAC 173.180 and WAC 317.40 [Facility Oil Handling Standards; Vessel Oil Transfer Rule] and, is intended to satisfy RCW 34.05.328. The expected costs and benefits are displayed in Table 25 showing the value of each for 20 years in the future. Using a discount rate, these values are aggregated into one present value total that allows for a comparison between benefits and costs. This allows costs in all years to be weighed against the benefits they may support, though both costs and benefits may fluctuate from year to year. The rate of discount is usually equal to a social rate of time preference which can be estimated using the inflation free bond rate provided by an I-bond. That is, if inflation is removed from the calculations, we can assume that the dollar values presented in 2006 dollars in the current study will be the same (corrected for inflation). Then the discount rate provided by the inflation free I-bond gives a good estimate of the social rate of time preference. The current rate is 2.16 percent.

The results show that estimated costs and benefits in this study are fairly close to one another. The present value of future costs over the next 20 years is estimated to be $166.68 million, while benefits are expected to be $165.64 million. Because these values are relatively close, it is important to review the guidance documentation for this process. According to RCW 34.05.328, the DOE must,

> *"…(c) determine that probable benefits of the rule are greater than its probable costs taking into account both qualitative and quantitative benefits and costs and the specific directives of the statute being implemented;"*

Following this guidance, it is determined that probable benefits will outweigh probable costs for several reasons. First, actual future costs are not expected to be any larger than reported in this study. The costs presented address the costs that a regulated firm is expected to experience in the coming years. However, firms typically discover new and innovative ways to save money with their compliance efforts. Second, the regulation includes room for affected parties to propose less costly and more effective means of reducing oil pollution in cases where a firm or a group of firms finds compliance with the regulation as written to be impractical or infeasible. Within the regulation, reference to this approach is called alternative compliance. For these reasons, it is expected that estimates represent the high end of actual costs that firms will face.

Estimated benefits on the other hand represent an average value expected from highly variable and difficult to measure estimates of costs associated with oil spills. In particular, passive use values are very difficult to know without conducting a lengthy, location-specific contingent valuation study like the one completed in California. This analysis borrows the California per household value based on similar types of coast line and a similar proposed program. These estimates could over-value the true Washington values because they were designed to prevent all spills and not just some, as the proposed regulations do. However, the California number might also underestimate the value of the oil transfer rule because the program in California was only for a portion of the coastline, while the oil transfer rule will protect the entire state.

Furthermore this analysis has not accounted for several types of benefits that are difficult and very costly to estimate. These include passive use values accruing to people in other states, litigation costs to firms, and detailed endangered species and cultural value estimates.

4.1 Conclusion

As with any assessment of future costs and benefits, there are a number of uncertain factors that will affect the true outcome of this regulation.[37] The ability to predict what would happen with, and without the regulation is limited by uncertainty and by the lack of detail in available data. However, the conclusions of this report are based on the best data and information available at this time.

Given the uncertainty surrounding the value of estimated benefits and the likelihood that costs will be reduced in coming years, it is the conclusion of this analysis that the benefits of the proposed transfer rules will exceed the costs.

[37] For example, at present it is possible that one refinery will need to pre-boom all transfers as the result of a legal settlement. If so, the costs of pre-booming at this refinery in the future would not be counted as part of the "with regulation" scenario since they would still have to without the regulation. A preliminary estimate of this change suggests that the present value of costs would be reduced from $166 million to $144 million, while benefits would remain the same at $165 million.

Table 25
Total Expected Costs and Benefits of Compliance with New Oil Transfer Regulations for Washington State 2007-2026

Year	Total Costs	Total Benefits	Discounted Costs	Discounted Benefits
2007	$12,026,636	$9,282,922	$11,772,353	$9,086,650
2008	$10,001,255	$9,394,803	$9,582,807	$9,001,729
2009	$10,001,255	$9,507,074	$9,380,195	$8,916,702
2010	$10,001,255	$9,619,345	$9,181,866	$8,831,246
2011	$10,048,752	$9,749,558	$9,030,415	$8,761,541
2012	$11,101,880	$9,849,587	$9,765,877	$8,664,285
2013	$10,001,255	$9,949,617	$8,611,689	$8,567,225
2014	$10,001,255	$10,049,647	$8,429,609	$8,470,396
2015	$10,001,255	$10,149,677	$8,251,379	$8,373,832
2016	$10,076,752	$10,249,706	$8,137,889	$8,277,565
2017	$11,401,880	$10,391,501	$9,013,361	$8,214,640
2018	$10,001,255	$10,533,295	$7,738,983	$8,150,676
2019	$10,001,255	$10,675,090	$7,575,355	$8,085,745
2020	$10,001,255	$10,816,884	$7,415,187	$8,019,916
2021	$10,838,752	$10,958,679	$7,866,219	$7,953,256
2022	$11,161,880	$11,053,174	$7,929,453	$7,852,228
2023	$10,001,255	$11,147,670	$6,954,717	$7,751,916
2024	$10,001,255	$11,242,166	$6,807,672	$7,652,337
2025	$10,001,255	$11,336,661	$6,663,735	$7,553,502
2026	$10,076,752	$11,431,157	$6,572,081	$7,455,427
Grand Total Present Value			**$166,680,842**	**$165,640,812**

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