Ecological Risk Assessment: Consensus Workshop

Environmental Tradeoffs Associated With Oil Spill Response Technologies

Mexico – United States Pacific Coastal Border Region

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A Report to the US Coast Guard, District 11

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Ecosystem Management & Associates, Inc.

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LIST OF ABBREVIATIONS, SYMBOLS, AND ACRONYMS

Term	Abbreviation, Symbol, or Acronym
American Petroleum Institute	API
Area Contingency Plan	ACP
Automated Data Inquiry for Oil Spills	ADIOS
Centigrade	C
Compact Disk	CD
Consensus Ecological Risk Assessment	CERA
Ecological Risk Assessment	ERA
Ecosystem Management & Associates, Inc.	EM&A
Environmental Protection Agency	EPA
General NOAA Oil Modeling Environment	GNOME
Incident Command	IC
Intermediate Fuel Oil	IFO
Liter	L
National Research Council	NRC
Nautical mile	nm
Meters	m
Mexico – United States	MEXUS
National Oceanic and Atmospheric Administration	NOAA
Office of Spill Prevention and Response (CA)	OSPR
Parts per million	ppm
Square Kilometers	Km^2
United States	US
United States Coast Guard	USCG
United States Fish and Wildlife Service	USFWS

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Executive Summary

In June/July 2006, the United States Coast Guard (USCG) District 11 sponsored a workshop to evaluate the relative risk to natural resources from various oil spill response options (on-water mechanical recovery, dispersant application, and on-shore mechanical recovery) compared to natural recovery, which in the context of the workshops refers to oil removal by natural processes only. The spill scenario involved a release of approximately 70,000 gallons of Intermediate Fuel Oil (IFO) due to an accident five nautical miles west of Point Loma, CA. The hypothetical date for the release was late June.

The workshop involved participants from both the United States (US) and Mexico, and was designed to emphasize cooperative decision-making when a spill in US waters threatened shoreline resources in both countries and when consideration of dispersants would lead to increased risk to valuable offshore resources in Mexican waters. The workshop consisted of two three-day workshops separated by approximately one month. At the initial meeting three focus groups analyzed natural recovery and on-water mechanical recovery. At the second workshop the groups evaluated dispersant use at two levels of effectiveness (75% and 25%) and on-shore mechanical recovery.

The participants concluded that on-water mechanical recovery, in this scenario, was unlikely to be effective in reducing shoreline impacts. While dispersants offered some benefits to the shoreline, the groups did not agree as to the magnitude. All groups concluded that protection of the Tijuana Slough was a high priority, and that the current strategy of placing a berm across the entrance to prevent contamination was a critical element of the response plan. If this was not successful cleanup would be very difficult, if not impossible. Environmental concerns were largely driven by the risk to sea birds, and secondarily to intertidal invertebrates. When dispersants were used there was an increased risk to sensitive offshore habitats and water column resources, especially around the Coronado Islands, but the concerns were not ranked above a moderate level by any group.

Participants felt that additional cooperative efforts of this type were important, and helped build the international interactions necessary for successful planning and response. They also emphasized that, if dispersants are to be considered as an option, there must be extensive planning and exercises to familiarize stakeholders with the issues, so that decisions can be made in a timely fashion.

1.0 Objectives of the Mexico – United States Pacific Coastal Border Region Workshop

1.1 Background and Process

In 1998, the United States Coast Guard (USCG) began sponsoring efforts to develop a comparative risk methodology to evaluate oil spill response options. Interest in selecting response options based on a risk/benefit analysis predates the 1998 initiatives, but the current effort is different in that it emphasizes a consensus-building approach to evaluate risks and benefits.

Headquarters, USCG (G-MOR, now G-RPP) sponsored the development of a guidebook on this process. The document, *Developing Consensus Ecological Risk Assessments: Environmental Protection in Oil Spill Response Planning. A Guidebook*, is available from G-RPP (Aurand *et al.*, 2000). It can also be downloaded from the contractor's web site at www.ecosystem-management.net. To date, the process has been used to evaluate spill scenarios at 13 locations in the United States (US). The reports prepared for the workshops held since 2002 are also available on the listed website.

The process is designed to help planners compare ecological consequences of specific response options, especially in nearshore or estuarine situations. This is particularly important for consideration of dispersants and in-situ burning, which present difficult analytical issues. The process focuses on ecological "trade offs" or cross-resource comparisons. Through a structured analytical approach participants find "common ground" for evaluating impacts and they develop defensible logic to support their conclusions. The process is consistent with the US Environmental Protection Agency's (EPA) Ecological Risk Assessment (ERA) guidelines (US EPA, 1998), but emphasizes development of group consensus among stakeholders. The process uses a series of analytical tools specifically developed for use in a group environment. It is designed as a planning tool and should not be used during an actual event. However, knowledge gained by participants in the consensus-building process facilitates real-time decision-making.

Training usually involves two 2- or 3-day workshops lead by a facilitator. The ideal size is 25 to 30 participants, including spill response managers, natural resource managers and trustees, subject matter experts, and non-governmental organizations. The goal is to achieve consensus interpretations of potential risks and benefits associated with selected response options based on a scenario developed by local participants. Time between the two workshops is used by participants to research issues of concern before developing final conclusions. The process focuses heavily on achieving a consensus interpretation of the available technical information. Therefore, it is important to have broad stakeholder representation in the decision process; otherwise, the workshop results may not be accepted by all the stakeholders who might be involved in an actual spill event in the future.

The workshop process includes three primary phases - **problem formulation, analysis,** and **risk characterization**. Details of the process are described in the Guidebook. In the first phase, **problem formulation**, participants develop a scenario for analysis, identify resources of concern along with associated assessment thresholds, and prepare a conceptual model to guide subsequent analysis. In the **analytical phase**, participants characterize exposure and ecological effects. The conceptual model, developed in the problem formulation phase, directs the analysis using standard templates and simple analytical tools that define and summarize the analysis for each resource of concern and each response option. Finally, participants complete a **risk characterization**. During this phase, participants interpret their results in terms of the costs and benefits of each response option to overall environmental protection as compared with natural recovery (i.e., baseline).[1]

1.2 Sponsor's Objectives

The Mexico – US Pacific Coastal Border Region workshop was sponsored by USCG District 11 (Alameda, CA) on behalf of the Mexico – US Pacific (MEXUS PAC) Joint Response Team. The objectives of the meeting were to improve oil spill response strategies and to enhance existing oil spill contingency planning for the southern San Diego/Northern Baja area. The goal of the workshop was to use a pre-established scenario to help identify those natural resources at risk during the simulated spill and to address the benefits and inherent tradeoffs associated with different response tools. Through the experience with the Consensus Ecological Risk Assessment (CERA) process and its methodology, the sponsors hope that resource and response agency stakeholders in both the US and Mexico will be better able to engage in effective risk assessment and tradeoff identification in future pre-spill and spill specific consultations. This should result in a better relationship amongst stakeholders in the two countries, a better understanding of resource trustee and response agency concerns, more timely and effective response decisions, and hopefully greater resource protection and recovery. The workshop also served as the annual MEXUS PAC exercise activity for 2006.

1.3 Participants

A total of 39 individuals from 22 organizations attended the workshops. Their names and affiliations are included in Appendix A. At the first workshop in June the participants were divided into three focus groups. Essentially all participants at the first workshop returned for the second. The periods attended by each participant and the Focus Groups they participated in are all indicated in Appendix A.

1.4 Organization of the Report and the Associated Compact Disk

This report is one of a series of files on a Compact Disk (CD) prepared as a project deliverable product. The report summarizes the results of the workshops, and presents the conclusions of the participants. It is formatted to be printed as an independent, double sided report. In addition, the CD contains copies of some of the presentations made at the workshops by the sponsors or by subject matter experts, as well as copies of documents provided as reference material by the sponsors. These files are cited at appropriate locations in the text of the report.

[1] In the context of the Consensus Ecological Risk Assessment (CERA) process, "natural recovery" refers to oil removal solely by natural processes.

2.0 Overview of Workshop Events

This training exercise consisted of two 3-day workshops. The first workshop was held from 27 to 29 June, and the second from 18 to 20 July, 2006.

At the first workshop the meeting began with introductions of the participants from both Mexico and the United States, and welcoming comments from the senior members of each delegation. The value of such international cooperative efforts was emphasized. This was followed by a presentation on the basic elements of the CERA process by Dr. Don Aurand, Ecosystem Management & Associates, Inc. (EM&A) (see CERA Overview and/or CERA Overview-Spanish Version on the workshop CD) followed by a discussion of the information developed prior to the meeting by the Steering Committee concerning the scenario, the resources at risk, and the response options to be considered. The discussions held by the Steering Committee were reviewed by LT Heather Parker-Hall (USCG District 11), who noted that the objective was to develop a scenario which would reasonably threaten shoreline resources in both Mexico and the US and would allow consideration of dispersant use. The details of the scenario and the results of the National Oceanic and Atmospheric Administration (NOAA) trajectory and fate modeling using the General NOAA Modeling Environment (GNOME) model and the Automated Data Inquiry for Oil Spills (ADIOS) model (see the Oil Spill Scenario file[2] and the Surface Oil Trajectory file on the workshop CD). The Steering Committee recommended that the group evaluate four response options, natural recovery (necessary as an analytical baseline), on-water mechanical recovery, use of dispersants (at two levels of effectiveness), and on-shore mechanical recovery.

Participants were generally comfortable with the basic elements of the spill scenario, however there was considerable discussion concerning efficiency assumptions to be used when discussing on-water mechanical recovery and the use of dispersants. For mechanical recovery an efficiency of 15% was selected, based on estimates ranging from 5 to 20%. At the beginning of the discussion, the Steering Committee suggested the use of 10%, based on historical data suggesting average recovery in the 5% to 10% range for spills in open ocean environments. Factors entering into the recommendation included reduced efficiency as sea state, wind speed and currents increase (booms are generally ineffective in waves greater than 4 feet and currents greater than 1.5 knots), limitations due to weather and visibility, concerns over storage capacity, and the inability to skim effectively during darkness. Participants discussed this issue at length, with some sentiment that since this was a near shore spill conditions might be favorable for more effective operations. On the other hand, most of the available skimmers are in Long Beach, CA and will take approximately 12 hours to arrive on site. In this scenario that means they will arrive late on the first day, and the oil arrives at the shoreline on the morning of the second day. Given all these considerations, participants felt that assuming 15% recovery was appropriate.

For dispersants, previous workshops in California have generally used two effectiveness levels, in order to evaluate a range of possible results. In this case, the Steering

[2] The "Oil Spill Scenario" PowerPoint presentation includes the basic information on the oil spill, as well as a summary of the results of the trajectory and weathering analyses for the surface slick alone, and for the use of dispersants at an effectiveness of 25% and 75%. The dispersant use portion was not presented until the third day of the first workshop, at the introduction of the dispersant option. An expanded version of the same presentation was given on the opening day of the second workshop, which contained some additional information on dispersant use. Only the second version of the presentation is included on the workshop CD.

Committee recommended evaluation of two levels, 25% and 75% effectiveness. A number of participants questioned the use of the 75% value. It was explained by the Steering Committee spokesperson, LT Heather Parker-Hall, that the 75% effectiveness value was not meant to imply that it was expected to be achieved, but rather to allow the analysis of a "worst case" situation for water column exposure. Dr. Aurand (Facilitator, EM&A) added that the limited field data that is available does suggest that, for smaller spills, and for targeted areas of larger spills, such levels are sometimes achieved and should therefore be considered because the water column exposures could occur. He also mentioned that, if the new proposed Coast Guard regulations for oil spill removal capacity requirements are implemented, sufficient equipment will be available to fully treat this size spill in the time frame proposed in the scenario. Participants agreed to consider both levels, although several felt that the issue of expected actual effectiveness would need to be discussed further when the recommendations were developed.

The final response option which was discussed at this time was on-shore mechanical recovery. A number of local participants contributed information. The consensus was that in this scenario shore line recovery would be very labor intensive, involving a lot of people with shovels, sorbents, buckets, etc. It is likely that mechanical equipment would only be heavily utilized in the Imperial Beach area, where such equipment is already used to clean the beach of trash. There was a concern that too much reliance on heavy equipment would remove too much clean sand as well. There was considerable discussion about how to evaluate shoreline protection strategies, since a key element of the local response plan is to build a berm across the entrance to the Tijuana Slough to prevent oil from entering the estuary. Participants considered whether they wanted to include that strategy as a given for every response option, or whether they would prefer to evaluate response options without its implementation and then consider the results of adding it to the response. The decision was made to use the latter approach, primarily because it would give participants a sense of the potential impacts if for some reason the berming strategy could not be implemented. If successful, the placement of the berm would essentially eliminate impacts from oil entering the estuary. It was noted, however, that water quality could be impaired if the berm was left in place too long.

When discussions about the response options were completed, Dr. Aurand reviewed the draft Resources at Risk table which had been prepared prior to the meeting (see Section 3.3 and Appendix B). Only minor changes were requested by participants.

The facilitators then reviewed the concept of "thresholds" with the participants, and suggested that the criteria listed on the "Final Thoughts on Thresholds" slide in the CERA process briefing offered conservative guidance for their discussions later in the process. There were no objections. The guidelines were as follows:

- Organisms (birds, turtles, marine mammals) on the water surface should be considered affected if they are likely to be in contact with sheen.
- Shoreline habitat should be considered to be affected if there is between 10 to 100 grams of oil or emulsified oil per square meter.
- Organisms in the water column can be evaluated by the criteria presented in Table 4.1.

Dr. Aurand reviewed a draft risk ranking matrix with the participants. The draft matrix is a standard five by four matrix which is presented to all workshops as a starting point for discussions. It is presented as Figure 8.2 in the Guidebook, without any cell aggregation boundaries for high, medium or low levels of concern. The final matrix, presented as Figure 4.1, represents minor changes from the draft risk matrix for the time to recovery scale (overall scale lengthened from seven to ten years), while the percentage of resources affected scale was unchanged. As part of the risk ranking discussion the participants examined the issue of the reference population. In order to estimate the percent of a population affected, a base population must be assumed, and experience in previous workshops has demonstrated that unless this issue is explicitly addressed, group scores can vary widely because of different baseline assumptions. The participants agreed that the definitions they would use for the different levels of population baseline units would be "Local (L)" – defined as individual estuaries, islands, or other specific geographic locations; "Regional (R)" – defined as northern Mexico and southern California; and "Continental (C)" – defined as Northern Hemisphere or greater.

Day two began with a review of the results to date, followed by a presentation by Dr. Aurand on oil spill basics.[3] Presentations on local resources were then given by regional or national experts. Judy Gibson and Don Brubaker (US Fish and Wildlife Service (FWS)) gave a presentation entitled "Oil Spills: USFWS Role in Spill Response," which reviewed the ecological resources of the Tijuana Slough (see Oil spills and the Tijuana Slough on the workshop CD). They were followed by Clemente Jimenez, a biologist with the Secretaria de Marina (Mexican Navy), who gave an overview entitled "Resources of the Coronado Islands" (see Coronado Islands (Spanish) on the workshop CD). Finally, Dr. Alan Mearns (NOAA HazMat) presented a talk on the Tampico oil spill, which occurred in 1957 along this area of the Mexican coast, and was qualitatively studied for several years (see Tampico Oil Spill on the workshop CD).

When these presentations were completed, the facilitators reviewed the procedures for evaluating the baseline response option (natural recovery/no intervention) and the participants were divided into three focus groups (see Appendix A). The remainder of the day was spent evaluating the natural recovery option.

The third day of the workshop was spent completing the evaluation of natural recovery and then on-water mechanical recovery. The latter discussion was preceded by a presentation by Dr. Aurand (see footnote 3) and discussion by the group as to local resources for on-water recovery. After completing the evaluation of those two response options, an introduction to dispersant operations was presented by Dr. Coelho (Facilitator, EM&A) late in the day. Finally, the participants developed a list of issues that they felt needed to be addressed at the beginning of the next workshop, and identified organizations or individuals who would obtain the information:

- Participants requested a presentation on the CA Dispersant Action Plan (Yvonne Addassi – CA Office of Spill Prevention and Response (OSPR)).
- Additional information on recent dispersant applications in the Gulf of Mexico, especially information on proximity to shore, location and depth (Facilitators).
- Additional information on the risk of seafood tainting (Alan Mearns – NOAA HazMat).

[3] The presentations "Oil Spill Basics", "On-Water Mechanical Recovery", "Dispersant Overview" and "Recent Dispersant Research" are part of a dispersant training course that is offered by EM&A. More information on these presentations may be obtained by contacting EM&A directly.

- If possible CD copies of the local Area Contingency Plan (ACP) (USCG).
- Model runs for dispersed oil at 25%, 50% and 75% effectiveness (NOAA HazMat).
- If possible, extend the modeling environment further south toward Ensenada (NOAA HazMat).
- Discussion of international agreements which exist concerning dispersant use in the US near the border and how they affect Mexico (CA OSPR and USCG).
- Fish toxicity data which will help interpret impacts of dispersed oil on farmed tuna (Mike Sowby – CA OSPR).
- Information on purchasing dispersants (Facilitators).
- What percentage of oil spills (in the medium to large size range) have been actually treated with dispersants (Facilitators)?
- Email attendee list and scoring sheets to date to all participants (Facilitators).

The second workshop (18-20 July 2006) began with a movie entitled "Introduction to Dispersants and Their Application," prepared by Oil Spill Response Limited. When the movie was completed, Dr. Aurand reviewed the results of the natural recovery risk ranking, with particular emphasis on resources where the three groups had widely different scores (see Section 4.0 for further details). This was followed by presentations to address the assignments made at the end of the first meeting. Yvonne Addassi (CA OSPR) gave a presentation on the CA Dispersant Use Plan (see CA Dispersant Use Plan on the workshop CD) and provided two handouts, a copy of her presentation and a "Pre-Approval Zone Dispersant Use Flowchart" which is discussed in the presentation and included in the Plan. She also provided participants with copies of the plan on CD. The USCG then provided participants with copies of the ACP, also on CD.

Following Ms. Addassi's presentation, Dr. Aurand reported on dispersant use world-wide on medium to large spills. In order to address this question he had contacted Dr. Jim Clark (Exxon Mobil Research and Engineering), who tracks dispersant use for his company. According to Dr. Clark there is no recent compilation of dispersant use statistics, although it would probably be possible to develop an estimate from the data published in the Oil Spill Intelligence Report. He did estimate that dispersants were used once or twice a year on a large spill somewhere in the world. For smaller spills, his estimate was that dispersants were used on less than 5% of the total spills worldwide. Of course, many spills are not appropriate for dispersant application in the first place, either because of the location, conditions, or the nature of the oil. Dispersant use also varies widely by geographic region. In West Africa, Dr. Clark indicated that dispersants are frequently used (3 to 4 times per year), perhaps on as many as 25 to 30% of all spills. In Singapore dispersants are used on 5 to 10% of all spills. Last year there was also one use in Central America. Dr. Aurand then summarized a paper prepared for the 2005 International Oil Spill Conference (Henry, 2005), which reviewed dispersant use in the Gulf of Mexico from 1990 to 2004.

In the afternoon there was an open discussion of the terms of the MEXUS agreement, which governs cooperative oil spill decision-making. This was followed by a brief discussion on the toxicity of dispersed oil to fish by Mr. Mike Sowby, CA OSPR. This was in response to concerns over possible effects on tuna in the aquaculture facilities near the Coronado Islands. In brief, research sponsored by CA OSPR has demonstrated that adult fish are relatively insensitive to oil, and he did not feel that a brief exposure would have any biological consequences.

Dr. Coelho then reviewed previous presentations on the use of dispersants and their biological effects (see footnote 3), and presented a summary of the results of a cooperative dispersant effects research program (see Section 7 from CROSERF and Section 8 from CROSERF on the workshop CD).[4] Finally, Dr. Alan Mearns reviewed the scenario with respect to dispersant use (see footnote 2) using his presentation and the trajectory movies. There were three QuickTime movies related to this discussion. They are; "Dispersant at 25% Effectiveness," "Dispersant at 75% Effectiveness," and "Dispersant at 75% Effectiveness Near the Coronado Islands." The last movie is an expanded view of the trajectory near the islands. All three are on the workshop CD. He then presented a review of seafood tainting issues, using Spanish slides prepared for an earlier joint Mexico – US meeting (see Seafood Tainting (Spanish) on the workshop CD). This presentation was followed by a discussion of how to deal with tainting during the risk ranking process (this was not important prior to evaluating use of dispersants). It was agreed that participants would only consider the actual risk (including consumption of contaminated seafood), not perceived risk, which is always a concern at oil spills and often leads to fisheries closures. The day concluded with the individual workgroups evaluating the use of dispersants at 75% effectiveness.

On day 2 Dr. Mearns told the participants that he would provide two relevant papers on dispersant use that he had authored for inclusion on the workshop CD (see Dispersed Oil Model and Dispersing Near Shore in CA Current on the workshop CD). Walter Nordhausen (CA OSPR) gave a presentation on work currently underway to improve the modeling of dispersed oil plumes offshore California by comparing model results to dye study results. The focus groups then completed the evaluation of dispersants by ranking the 25% effectiveness dispersant option.

At this point, the focus groups were asked to summarize their conclusions concerning the use of dispersants versus on-water mechanical recovery. Group 1 indicated that they felt the use of dispersants at the high effectiveness would remove the threat to some shoreline areas, because the time to recover and the percentage of the resource affected would both decrease. Group 2 did not see that much of a benefit to the shoreline, and was concerned about the new risks to the habitats around the Coronado Islands when dispersants were used. Group 3 also felt that the benefits to shoreline recovery with dispersants would not be that significant, but pointed out that a lot of that was due to the conditions in the scenario. They were not particularly concerned about dispersed oil impacts to the area around the Coronado Islands because the concentrations were so low. They felt the benefits of dispersant use at 25% effectiveness were almost identical to natural recovery. All three groups felt the on-water mechanical recovery was unlikely to have any effect on the magnitude of shoreline impacts.

Dr. Aurand then gave an overview presentation on shoreline removal and oil recovery, which was supplemented by comments from participants from the local oil spill response industry. Participants were reminded that they were to consider that the mouth of

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[4] CROSERF stands for "Chemical Response to Oil Spills: Ecological Research Forum" which was a working group of state, federal and industry representatives focused on improving and coordinating research on chemical tools for oil spill response. A summary report is currently in final review for publication at the American Petroleum Institute, Washington, DC. The chapters provided here a from the draft of this report, and are for the use of the participants only.

the Tijuana Slough was not closed, and as a result the estuary was oiled. Participants then returned to their focus groups to evaluate this final option.

Day 3 was devoted to reviewing the results for all of the response options considered, and developing the lessons learned (see Section 5).

3.0 Exercise Scenario and Basic Analytical Information

3.1 Exercise Scenario

After considering a variety of options, the Steering Committee developed a scenario which would allow for consideration of the options of interest to the Steering Committee, as presented in Section 1.2. According to the scenario, at 0600 (6 AM) on Wednesday, June 28, 2006 a freighter is holed in a collision 5 nautical miles (nm) west of Point Loma, near San Diego. Over the next hour the vessel releases 70,000 gallons (273,000 liters (L)) of IFO 180 fuel oil. The oil spreads, forming surface slicks that begin moving to the southeast toward the US/Mexico Boundary.

- **Weather:** The weather forecast predicts that winds on Wednesday June 28 will be 12 to 15 knots from the WNW and W, continuing into the evening. At 0300 (3 AM) on June 29 the winds are forecast to decrease to 10 knots from the W and WNW, continuing until 2100 (7 PM) when they will reverse to 5 knots from the ENE.
- **Sea Conditions:** Waves in the path of the spill are expected to be breaking at 2 to 4 feet (1 meter (m)). Sea surface temperature is 17º Centigrade (C), the upper mixed layer depth 10 m and salinity 32.5 parts per thousand.
- **Fate:** Less than 20% of the oil is predicted to evaporate before reaching shore, but there is also a chance that the oil will emulsify, increasing in volume by a factor of 4 to 5.
- **Trajectory and Impact:** With no response, the oil slicks are predicted to travel ESE over water depths ranging from 60-70 m and shoaling to 0 m (beach). The oil is expected to contact 5 to 10 nm of shoreline north and south of the entrance to the Tijuana Slough National Wildlife Refuge (US) beginning at 2300 (11 PM) on June 28. In the absence of protection booming, some oil is expected to enter the estuary on evening flood tides. Much of the oil is expected to remain stranded on the shoreline through Thursday June 29. However, the Thursday night onshore wind will cause refloating oil to move offshore and south across the US/Mexico Boundary impacting sandy beach and rocky headland shorelines at least as far south as Rosarito, Baja California.

With these factors in mind, at 0800 on June 28, the Incident Command (IC) orders open water mechanical response and preparation for shoreline clean up. In addition, the IC is also considering dispersant use. The IC is prepared to order dispersant operations to begin by 1400 (2 PM) on June 28, 8 hours after the spill. The weather summary for the next five days was:

- **Wednesday June 28, 2006** At 0600 winds are from the WNW (285 degrees) at 12 knots, increasing to 15 knots 9 hours later (1500 h) from WSW (250 degrees) and continuing through the night.

- **Thursday June 29, 2006** At 0300 winds continue at 15 knots but shift to the W (270 degrees). At 0900 winds drop to 10 knots to the W (270 degrees). At 1500 h winds stay at 10 knots but shift to the NW (315 degrees). At 2100 the NW winds abate and are replaced by regular night-time light onshore winds, 5 knots from the NNE continuing until Friday morning, June 30.
- **Friday, June 30 to Monday July 3, 2006** At 0900 winds increase to 10 knots from the NNW and remain at this situation through Monday, July 3, 5 days into the spill.

The significant parameters related to oil spill modeling and the fate of the oil are summarized in Table 3.1.

Table 3.1 Key Parameters for the Mexico – United States Pacific Coastal Border Region Scenario.

Time/Date	**0600 on 28 June 2006**
Location	**5 nautical miles west of Point Loma, CA**
Volume	**70,000 gallons (273,000 L or 1,667 barrels)**
Oil Type	**Intermediate Fuel Oil (IFO 180)**
Specific Gravity	**API 14.7**
Pour Point	**-10° C**
Wind Speed	**10 to 15 knots (from the WNW)**
Wave Height	**2 to 4 feet (1 meter), breaking**
Upper Mixed Layer	**10 m**
Water Temperature	**17° C**

3.2 Geographic Area of Concern

The general area of concern (see Figure 3.3) was the Pacific coast of the US from Point Loma, CA to the general vicinity of Ensenada, Mexico, a distance of approximately 30 miles, and the shoreline of the Coronado Islands. Offshore, the ocean area of concern extends out approximately 12.5 miles out from the coast.

3.3 Resources of Concern

Participants reviewed and agreed to use the resource table developed by the Steering Committee prior to the meeting and provided in the participants' notebooks with only minor modifications to the list of representative species, and no changes to the proposed habitats and subhabitats. The final table is presented in Appendix B.

3.4 Conceptual Model

During discussions about the general analytical process, the participants agreed that developing a detailed model was not necessary for their purposes. They were presented the list of seven hazards developed initially in a detailed conceptual model prepared for the San Francisco Bay workshop (Pond et al., 2000) that have been used in all subsequent workshops. They agreed that these should be considered for each of the proposed response options (these hazards are air pollution, aqueous exposure, physical trauma, oiling/smothering, thermal, waste and indirect). The response options to be considered would be natural recovery (no response), on-water mechanical recovery, dispersant application (with two effectiveness levels), on-shore mechanical recovery and, if time was available, on-shore in-situ burning.[5]

3.5 Modeling Results

The NOAA HazMat Modeling Group used the basic information in the scenario to develop a surface trajectory and a dispersed oil trajectory analysis using GNOME for the detailed risk assessment portion of the workshop. Basic weathering information was calculated using the ADIOS II oil weathering model. Mass balance estimates for no response and both dispersant effectiveness levels are presented in Table 3.2. IFO 180 emulsifies to some degree, but is dispersible early in the spill. The estimated water content of the emulsion is approximately 5% after 3 hours, 20% after 6 hours, and stabilizes at 65% after 12 hours. This means that the volumes on the shoreline would be 65% greater than the values given in the table. Figure 3.1 shows the accumulation of oil on shoreline segments between Rosarito and Imperial Beach for the natural recovery option. Segment lengths are not all equal in length, as summarized in Table 3.3 for the segments with the highest concentrations of oil. The maximum accumulation of oil with no response was an average of approximately 5.2 gallons per linear foot, in segment 196.

Selected snapshots from the surface oil trajectory modeling results are shown in Figure 3.2. The average concentration in the dispersed oil plume produced without the use of dispersants remains below 0.5 parts per million (ppm) except for a few instances where the model predicted 0.5 to 1 ppm, and the area affected rarely exceeded 1 square kilometer (Km^2). Based on the values in Table 4.1, these levels are unlikely to represent even a low risk to anything other than highly sensitive species, and those only in a very limited area in the top 2 m. The key impact when the oil remains untreated is the shoreline oiling.

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[5]On-shore in-situ burning was not pursued in detail because participants felt it had limited utility in an urban area and time for further discussion was limited; however, it was noted that marsh burning is a management option at the Tijuana Slough National Wildlife Refuge.

Table 3.2 Oil Budget (in Gallons) for Undispersed and Dispersed Oil (25 and 75% Effectiveness) as Predicted in the Mexico – US Pacific Coastal Border Region Scenario, Initial Spill Volume 70,000 Gallons.

Oil in the Environment, 3 Hours Post-spill				
Response	Floating	Beached	Dispersed	Evaporated
No Dispersal	69,650	0	0	350
Disperse 25%	69,650	0	0	350
Disperse 75%	69,650	0	0	350
Oil in the Environment, 6 Hours Post-spill				
Response	Floating	Beached	Dispersed	Evaporated
No Dispersal	67,466	0	574	1,960
Disperse 25%	67,466	0	574	1,960
Disperse 75%	67,466	0	574	1,960
Oil in the Environment, 12 Hours Post-spill				
Response	Floating	Beached	Dispersed	Evaporated
No Dispersal	62,538	0	602	6,810
Disperse 25%	46,788	0	17,024	6,188
Disperse 75%	15,484	0	49,840	4,676
Oil in the Environment, 24 Hours Post-spill				
Response	Floating	Beached	Dispersed	Evaporated
No Dispersal	2,912	56,184	602	10,304
Disperse 25%	1,904	42,170	17,024	8,904
Disperse 75%	748	13,960	49,840	5,474
Oil in the Environment, 48 Hours Post-spill				
Response	Floating	Beached	Dispersed	Evaporated
No Dispersal	2,660	56,184	602	10,556
Disperse 25%	2,380	41,470	17,024	9,128
Disperse 75%	700	13,972	49,840	5,530
Oil in the Environment, 72 Hours Post-spill				
Response	Floating	Beached	Dispersed	Evaporated
No Dispersal	1,288	57,150	602	10,962
Disperse 25%	1,120	42,268	17,024	9,590
Disperse 75%	280	14,170	49,840	5,712

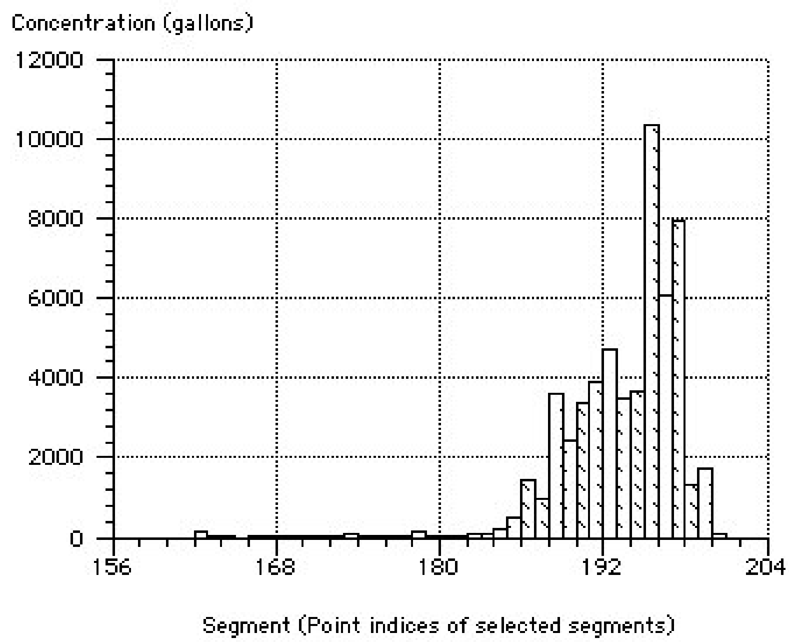


Figure 3.1 *The predicted concentration of oil on selected shoreline segments when no response options are used. Rosarito is at segment 156 and Imperial Beach is at Segment 204. The Mexico – US border is at segment 192.*

While the predicted movement of surface oil is almost directly onshore, moving rapidly to the southeast, in the model the dispersed oil plume moves to the south, ultimately arriving at the Coronado Islands approximately 40 hours after application. By this time, even at the 75% effectiveness level, predicted concentrations are quite low (average of less than 1 ppm, maximum of 1 to 2 ppm). For the 25% effectiveness modeling run even the maximum concentrations are below 1 ppm. The model shows the plume moving around the islands after approximately 11 to 12 hours.

Table 3.4 shows the estimated extent of the dispersed oil plume when dispersants are used at 75% effectiveness. Snapshots from the dispersed oil modeling results are shown in Figure 3.3 and 3.4 for 75% effectiveness and in Figure 3.5 for 25% effectiveness. Figure 3.4 shows an expanded version of the dispersed oil plume trajectory in the vicinity of the Coronado Islands, in order to estimate the risk to the kelp beds and tuna aquaculture facilities in that area (see Figure 3.6).

The use of dispersants does reduce the accumulation of oil on the shore (see Table 3.2) and the reduction is significant in the case of the 75% effectiveness model estimate. For example, after 24 hours approximately 56,000 gallons of oil have beached with no response, while with dispersant at 75% effectiveness this number is reduced to approximately 14,000 gallons. On-water mechanical recovery, assuming an effectiveness of 15%, would lead to a reduction less than that estimated in Table 3.2 for dispersants at 25% effectiveness.

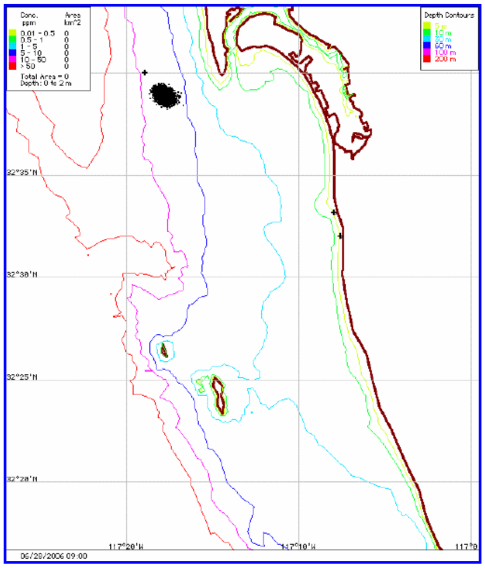
Table 3.3 Shoreline Segment Lengths (in Miles) and Extent of Oil Contamination With No Response.

Segment	Gallons of Oil	Segment Length	Gallons/Mile	Gallons/Foot
202	14	0.406	34.5	0.007
201	182	0.335	544.1	0.103
200	1,946	0.334	5,831.4	1.104
199	2,212	0.471	4,698.9	0.890
198	10,206	0.471	21,655.4	4.101
197	7,490	0.396	18,926.8	3.585
196	10,766	0.396	27,190.5	5.150
195	4,845	0.250	19,375.2	3.670
194	4,676	0.252	18,560.5	3.515
193	5,516	0.502	10,993.6	2.082
192	4,396	0.413	10,631.3	2.014
191	2,549	0.414	6,155.0	1.166
190	1,400	0.451	3,101.7	0.587
189	2,226	0.451	4,932.6	0.934
188	168	0.452	371.9	0.070
187	322	0.453	711.4	0.135

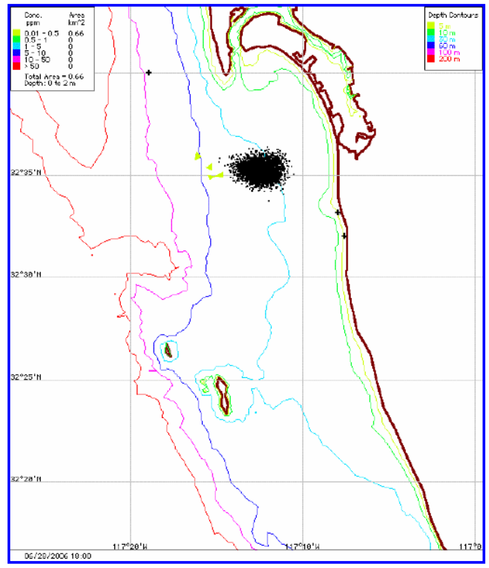
Table 3.4 Estimated Dispersed Oil Plume Extent and Concentrations, Over Time, When Dispersants are Used at 75% Effectiveness. *

Hours Into Spill	Area (Km^2) @> 0.01 ppm	Average Concentration (ppm)	Maximum Concentration (ppm)
0	0.00	0.000	0.000
3	0.00	0.000	0.000
6	1.70	0.232	0.401
8 (Spill Dispersed)	13.87	1.545	4.472
12	13.36	1.502	4.241
24	17.40	1.160	3.345
48	29.59	0.733	1.830
72	77.07	0.271	0.787

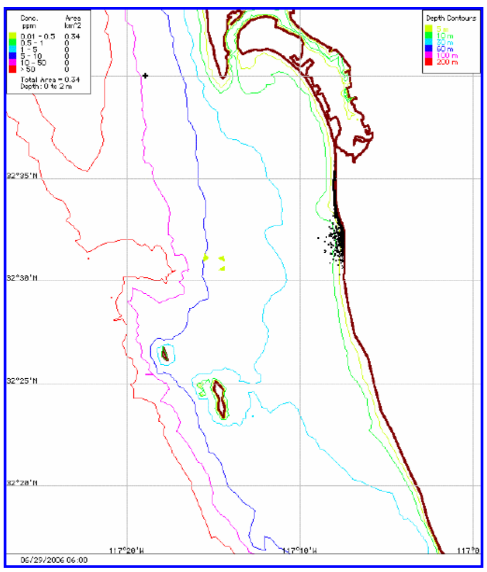
*Note: Plume is modeled to remain mainly in upper mixed layer (upper 10 m) with highest concentrations in upper 2 m.



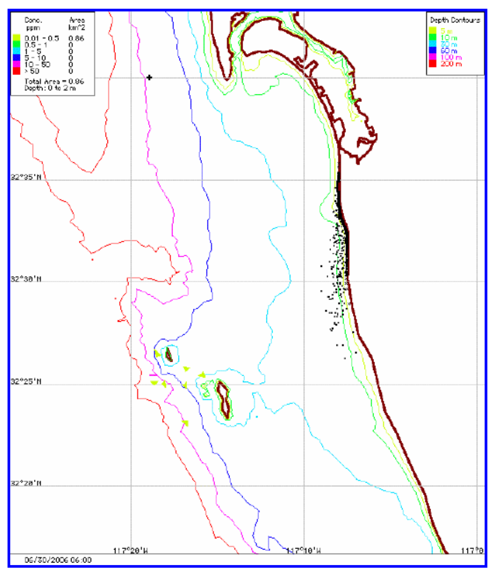
A: 3 Hours



B: 12 Hours



C: 24 Hours



D: 48 Hours

Key:

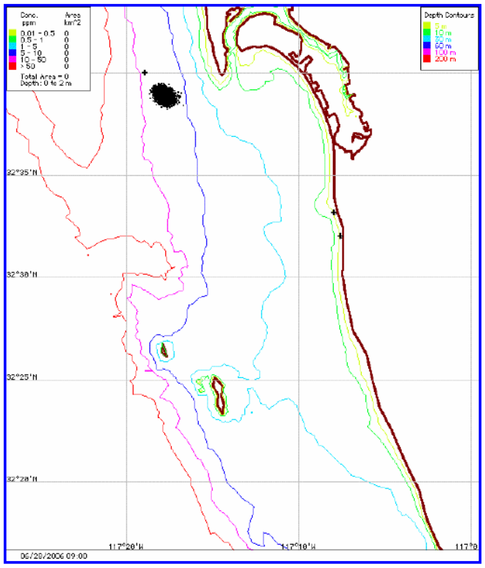
Light green	<0.5 ppm
Medium green	0.5 - 1 ppm
Light blue	1 - 5 ppm
Dark blue	5 - 10 ppm
Pink	10 - 50 ppm
Red	>50 ppm

Figure 3.2 *Results from the NOAA GNOME modeling for the Mexico – United States Pacific Coastal Boarder Region scenario surface oil slick trajectory.*

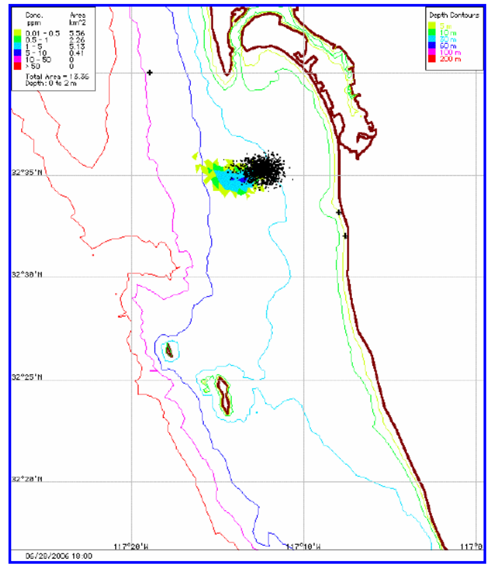
This reduction in shoreline impact comes at the expense of increased exposure to organisms in the water column. With no dispersant use there is some natural dispersion, but the model predicts that it will be less than 1% of the original volume and water column concentrations do not exceed 1 ppm, and then are only briefly present in the immediate vicinity of the slick. Figure 3.7 shows the maximum and average water column concentrations in the top 2 meters when dispersants are used at 75% effectiveness in comparison to conservative toxicity thresholds for sensitive life history stages (planktonic larvae, fish eggs, etc.). Maximum concentrations initially peak at approximately 9 ppm, and rapidly decline over time as dilution occurs (approximately 3 ppm by 24 hours, 2 ppm by 36 hours, and less than 2 ppm by 48 hours).

With respect to the toxicity levels of concern when dispersants are used at 75% effectiveness, only the low level of concern threshold is exceeded for the average concentrations, but the medium level of concern threshold is exceeded up until the 48-hour mark for the maximum concentrations, and the high level of concern threshold is exceeded between 24 and 48 hours. This suggests an overall low level of concern for sensitive life history stages present in the dispersed oil plume, with a higher risk to those in the areas of high concentration. Figure 3.8 compares these concentrations to the level of concern thresholds for adult crustaceans. Figure 3.9 compares the average and maximum exposure profile to the toxicity thresholds for adult fish. The data suggest that adult fish would be at low risk during this spill scenario and adult crustaceans would be at low to moderate risk within the most concentrated portions of the plume.

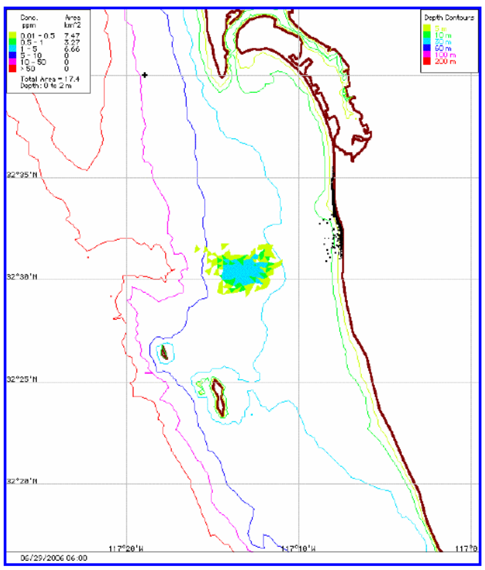
Finally, Figures 3.10 through 3.12 show the maximum and average concentrations of dispersed oil when dispersants are used at 25% effectiveness. Figure 3.10 compares these values to the thresholds for sensitive life history stages. This is the only comparison where either the average or maximum predicted values at 25% effectiveness approached any threshold other than the low level of concern. In this case, the low level of concern threshold falls between the average and maximum concentration curves and the maximum concentration curve essentially parallels the medium and high level of concern threshold in the 24 to 48-hour range, suggesting that animals in the portions of the plume with higher than average concentrations could be at risk.



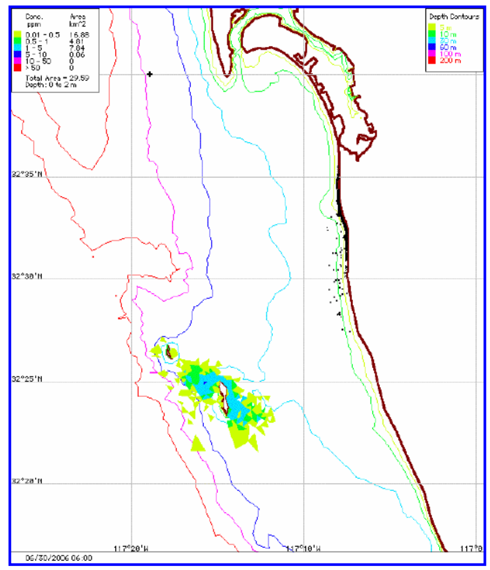
A: 3 Hours



B: 12 Hours (D + 4 Hours)



C: 24 Hours (D + 16 hours)

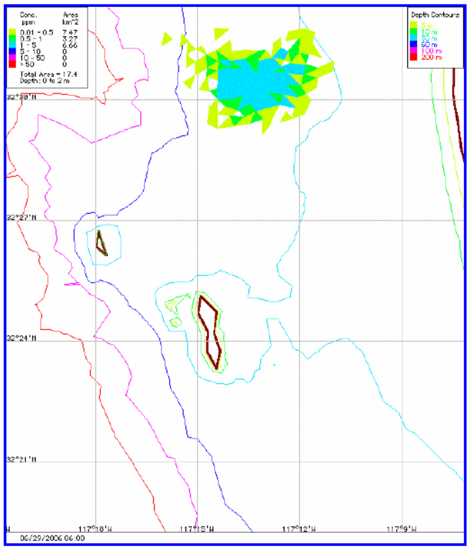


D: 48 Hours (D + 40 hours)

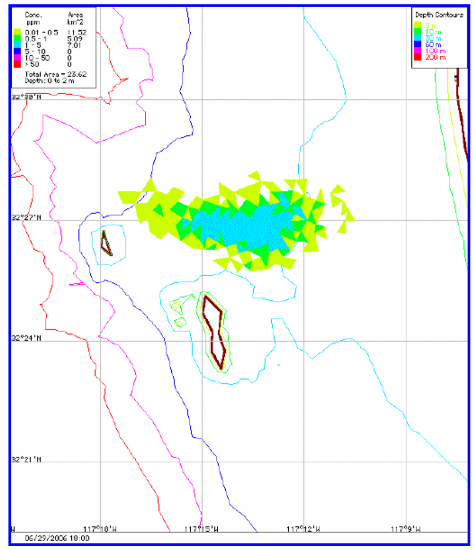
Key:

Light green	<0.5 ppm
Medium green	0.5 - 1 ppm
Light blue	1 - 5 ppm
Dark blue	5 - 10 ppm
Pink	10 - 50 ppm
Red	>50 ppm

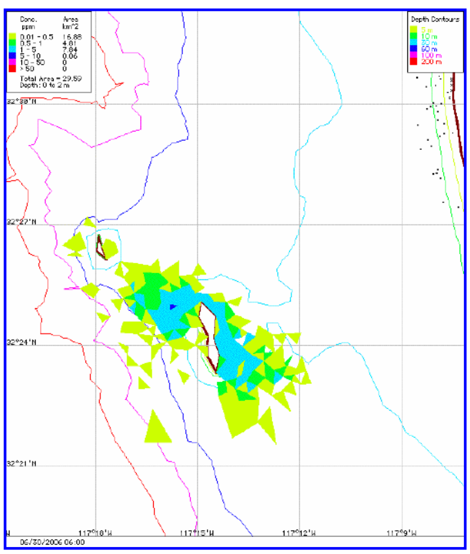
Figure 3.3 *Results from the NOAA GNOME modeling for the Mexico – US Pacific Coastal Border Region scenario for dispersant use at 75% effectiveness showing average dispersed oil concentrations (in ppm) from 0 to 2 meters (surface oil shown).*



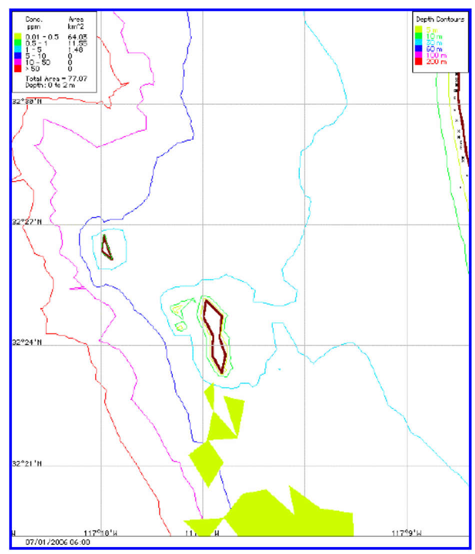
A: 24 Hours (D + 16 Hours)



B: 36 Hours (D + 28 Hours)



C: 48 Hours (D + 40 Hours)

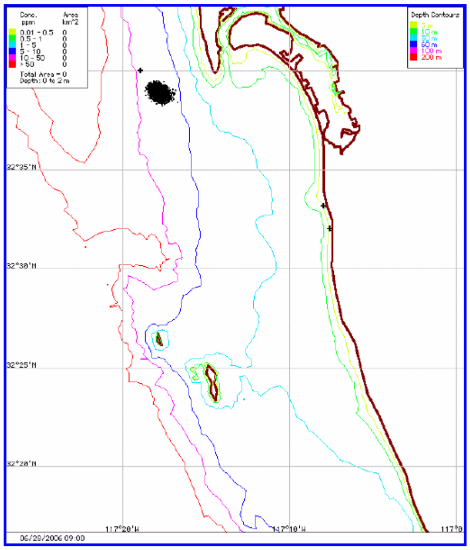


D: 72 Hours (D + 66 Hours)

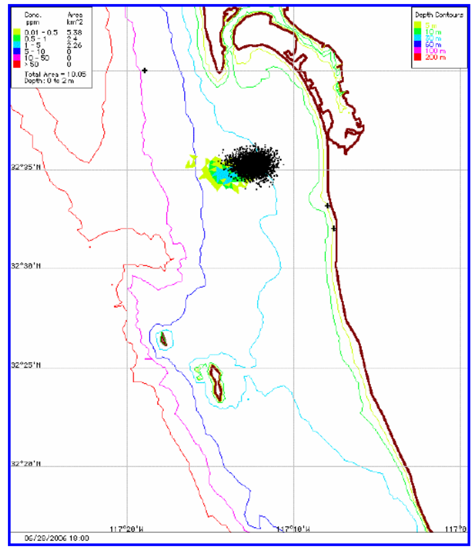
Key:

Light green	<0.5 ppm
Medium green	0.5 - 1 ppm
Light blue	1 - 5 ppm
Dark blue	5 - 10 ppm
Pink	10 - 50 ppm
Red	>50 ppm

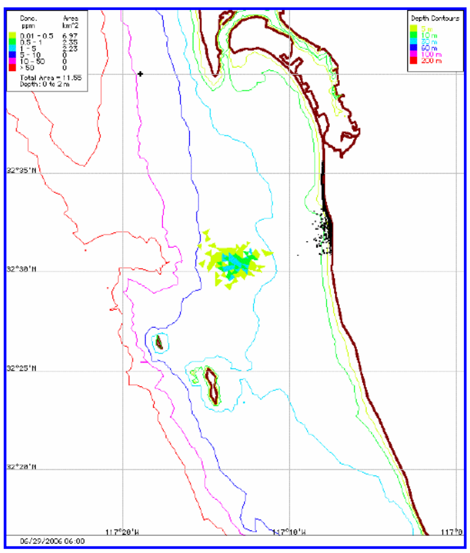
Figure 3.4 *Expanded view of results from the NOAA GNOME modeling for the Mexico – US Pacific Coastal Border Region scenario for dispersant use at 75% effectiveness showing average dispersed oil concentrations (in ppm) from 0 to 2 meters in the vicinity of the Coronado Islands (surface oil shown).*



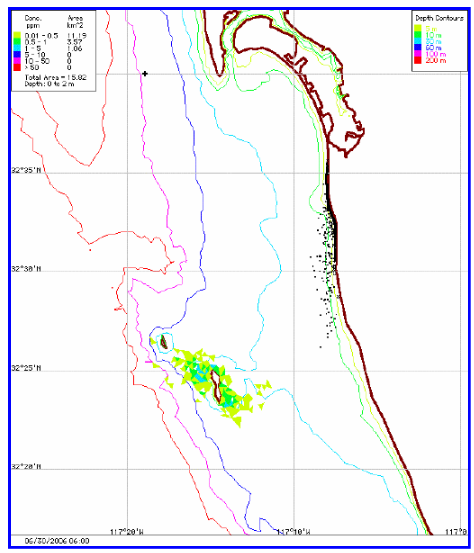
A: 3 Hours



B: 12 Hours (D + 4 Hours)



C: 24 Hours (D + 16 Hours)



D: 48 Hours (D + 40 Hours)

Key:

Light green	<0.5 ppm
Medium green	0.5 - 1 ppm
Light blue	1 - 5 ppm
Dark blue	5 - 10 ppm
Pink	10 - 50 ppm
Red	>50 ppm

Figure 3.5 *Results from the NOAA GNOME modeling for the Mexico – US Pacific Coastal Border Region scenario for dispersant use at 25% effectiveness showing average dispersed oil concentrations (in ppm) from 0 to 2 meters (surface oil shown).*

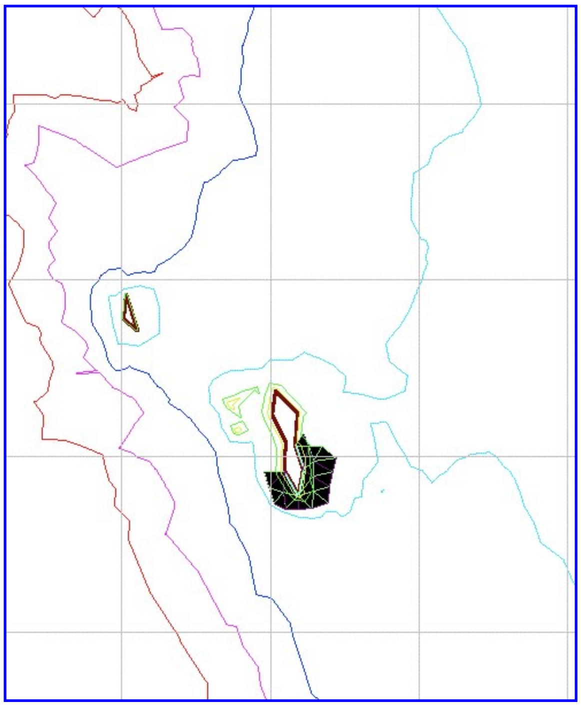


Figure 3.6 *Location of kelp beds and/or tuna aquaculture facilities in the vicinity of the Coronado Islands (both areas designated by solid black squares).*

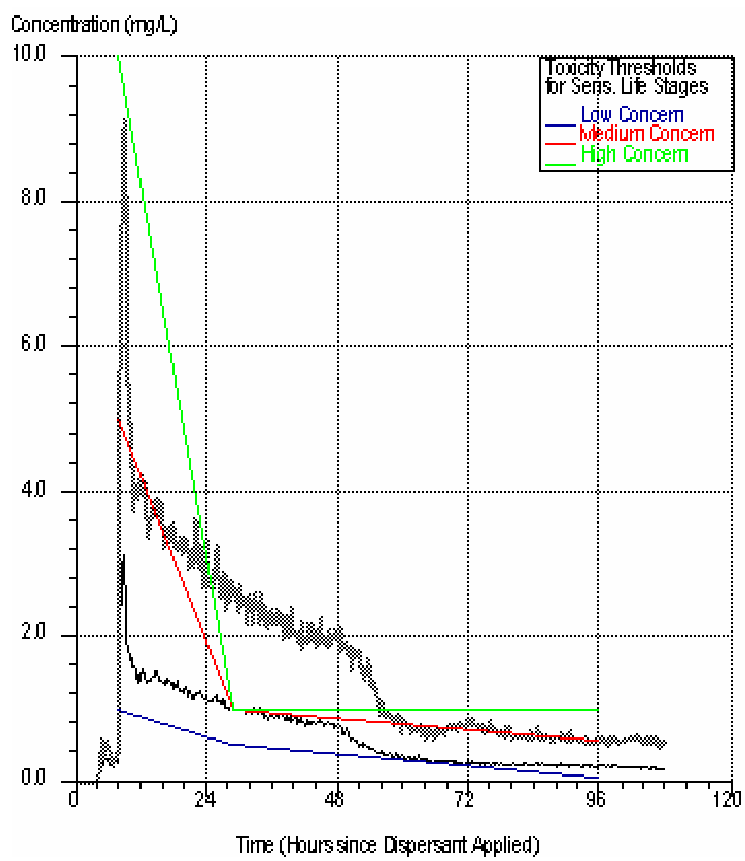


Figure 3.7 *Conservative toxicity thresholds for dispersed oil for sensitive life history stages compared to maximum and average dispersed oil concentrations from 0 to 2 meters with 75% effectiveness (based on the values presented in Table 4.1).*

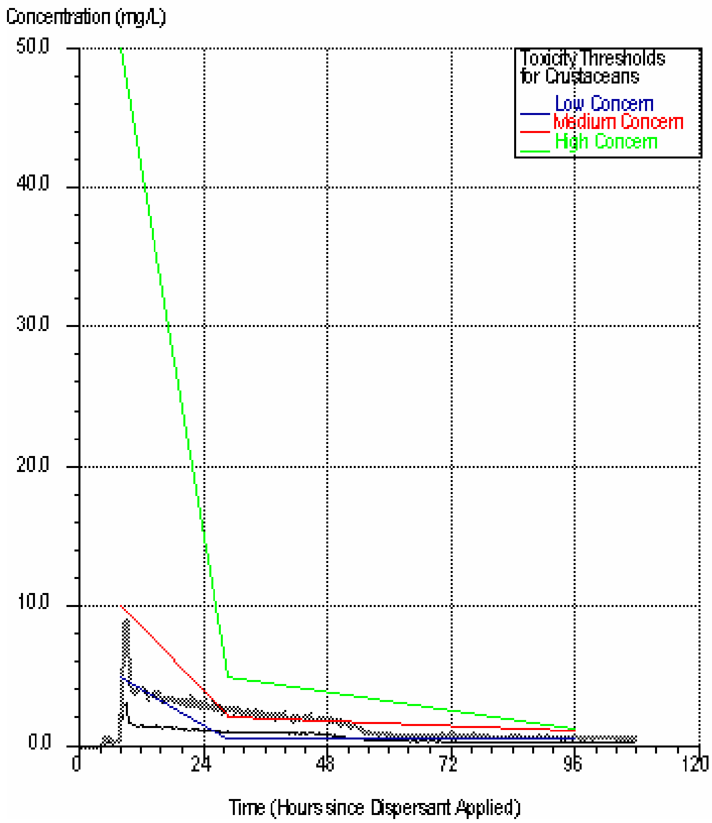


Figure 3.8 *Conservative toxicity thresholds for dispersed oil for adult crustaceans compared to maximum and average concentrations from 0 to 2 meters with 75% effectiveness (based on the values presented in Table 4.1).*

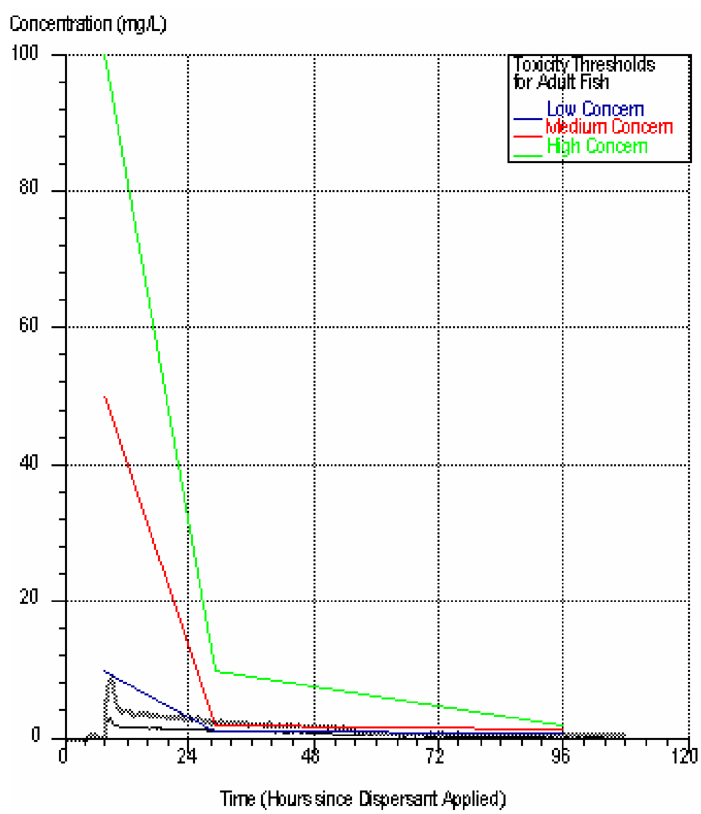


Figure 3.9 *Conservative toxicity thresholds for dispersed oil for adult fish compared to maximum and average concentrations from 0 to 2 meters with 75% effectiveness (based on the values presented in Table 4.1).*

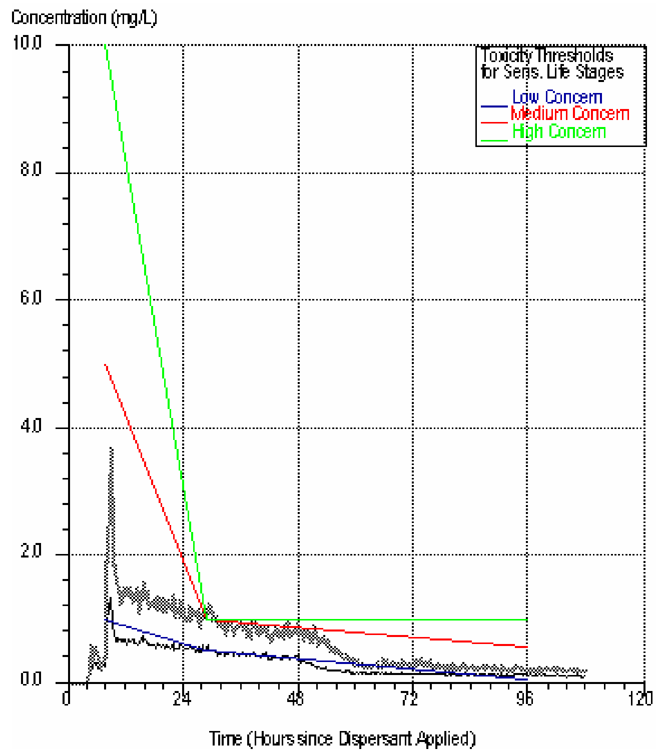


Figure 3.10 *Conservative toxicity thresholds for dispersed oil for sensitive life history stages compared to maximum and average concentrations from 0 to 2 meters with 25% effectiveness (based on the values presented in Table 4.1).*

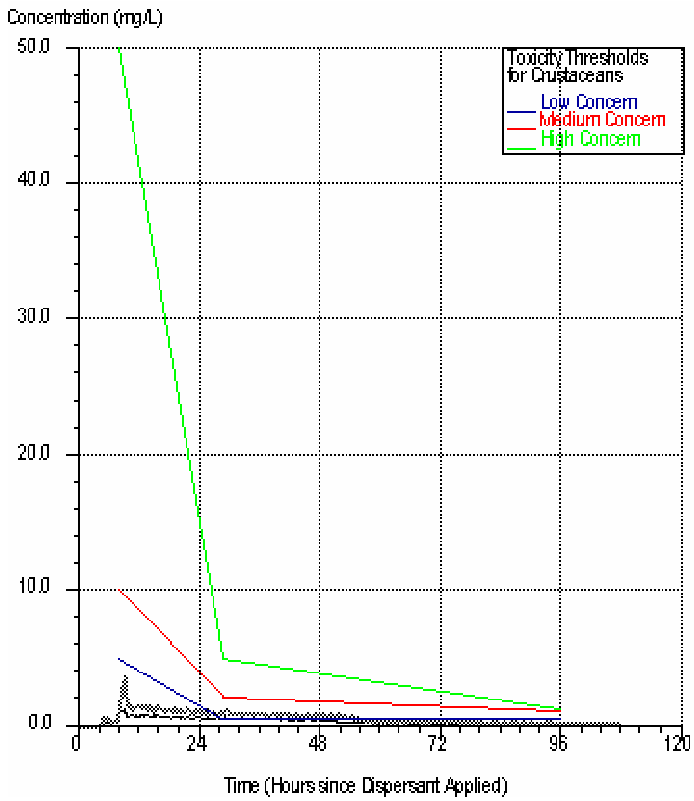
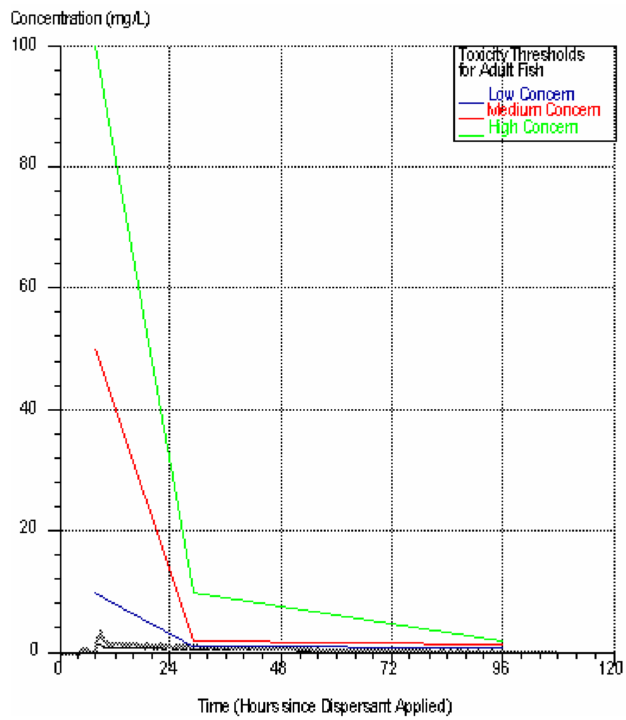


Figure 3.11 *Conservative toxicity thresholds for dispersed oil for adult crustaceans compared to maximum and average concentrations from 0 to 2 meters with 25% effectiveness (based on the values presented in Table 4.1).*

Figure 3. 12 *Conservative toxicity thresholds for dispersed oil for adult fish compared to maximum and average concentrations from 0 to 2 meters with 25% effectiveness (based on the values presented in Table 4.1).*



4.0 The Results of the Risk Analysis Process

Focus groups used the risk matrix presented in Figure 4.1 (see Section 2.0). Each focus group was tasked with reviewing the scenario, the modeling results, information on exposure and sensitivity to oil and dispersed oil, and basic life histories and distributions in order to develop a group estimate of the percent of each resource affected and the recovery time. In the evaluation, the groups used the alphanumeric codes developed early in the workshop to rate the level of concern. Subsequently, color coding also developed in plenary session was used to develop summary levels of concern.

		RECOVERY			
		> 10 years (SLOW) (1)	5 to 10 years (2)	1 to 4 years (3)	< 1 year (RAPID) (4)
% of RESOURCE AFFECTED	> 50% (LARGE) (A)	1A	2A	3A	4A
	35 to 50% (B)	1B	2B	3B	4B
	20 to 35% (C)	1C	2C	3C	4C
	5 to 20% (D)	1D	2D	3D	4D
	0 to 5% (SMALL) (E)	1E	2E	3E	4E

Legend: Red cells represent a "high" level of concern, yellow cells represent a "moderate" level of concern, and green cells represent a "limited" level of concern.

Figure 4.1 *Definition of levels of concern for the Mexico – US Pacific Coastal Border Region risk assessment.*

Using the risk ranking matrix requires that the participants develop estimates of the proportion of the resource affected, and how long it will take the resource to recover. A key factor in determining whether or not a resource is affected is to apply thresholds at which impacts, either acute or chronic, would be expected to occur for the various resource groups under consideration. This is perhaps the most difficult part of the consensus process, and has been discussed in detail at all of the workshops. In this case, as in other workshops, very conservative assumptions were presented by the facilitator and accepted as guidelines by the participants.

The only thresholds which can be generally quantified are those related to aquatic toxicity. Table 4.1, reproduced from the Guidebook, presents a series of concentration thresholds which were made available to the participants. These values are based on a summary of published toxicity information initially developed during the early workshops. This table was reviewed by the National Academy of Sciences panel which recently considered issues related to dispersant use, and is included in their report (National Research Council (NRC), 2005).

Impacts to birds, mammals and turtles on the water surface were assumed if there was a high probability of any contact with the surface oil slick. The nature of these impacts was developed during the focus group discussions. For shoreline resources and habitats, damage was assumed if there was 10 to 100 grams of oil per square meter. Table 4.2 presents estimates of shoreline exposure, based on varying loading rates. It was used for general guidance only and is based on average concentrations; actual shoreline accumulations of oil are generally irregularly distributed, especially at low concentrations.

It is important to keep in mind that the participants used the information available to them to develop <u>levels of concern</u> about the risk, and the risk scores do not represent a prediction of actual impacts. Instead they represent a consensus on the part of the participants that such consequences were likely to occur under the scenario under consideration.

The detailed results for all three focus groups for natural recovery (i.e. no response) are shown in Figure 4.2. There were very high levels of concern in this scenario for organisms on the water surface, upland/supratidal, sandy beaches in open coastal areas and upland, water surface, salt marsh, mud flats and sandy beaches in the estuary. One group (3)

Table 4.1 Consensus Exposure Thresholds of Concern (in ppm) for Dispersed Oil in the Water Column.

Continuous Exposure	Level of Concern	Protective of Sensitive Life Stages	More Protective Criteria	Protective of Adult Fish	More Protective Criteria	Adult Crustacea/ Invertebrates	More Protective Criteria
3 hours	Low	<5	<1-5	<10	<10	<5	<5
	Medium	5-10	5-10	10-100	10-100	5-50	5-50
	High	>10	>10	>100	>100	>50	>50
24 hours	Low	<1	<0.5	<2	<0.5	<2	<0.5
	Medium	1-5	.5-5	2-10	.5-10	2-5	.5-5
	High	>5	>5	>10	>10	>5	>5
96 hours	Low	<1	<0.5	<1	<0.5	<1	<0.5
	Medium			1-5	.0-5	1-5	.5-1
	High	>1	>0.5	>5	>5	>5	>1

Table 4.2 Estimates of Shoreline Exposure per Square Meter of Surface.

Width of Oiled Zone	Loading Rate											
	0.1 g/m			1 g/m			10 g/m			100 g/m		
	Volume per square meter (g/m^2)	Average Thickness[1] (µm)	Concentration in Top 1 square cm[2] (ppm dry wt)	Volume per square meter (g/m^2)	Average Thickness[1] (µm)	Concentration in Top 1 square cm[2] (ppm dry wt)	Volume per square meter (g/m^2)	Average Thickness[1] (µm)	Concentration in Top 1 square cm[2] (ppm dry wt)	Volume per square meter (g/m^2)	Average Thickness[1] (µm)	Concentration in Top 1 square cm[2] (ppm dry wt)
0.1 m	1	95	14	10	950	143	100	9,500	1,429	1000	95,000	14,286
0.5 m	0.5	47.5	2.86	5	475	28.6	50	4,750	286	500	47,500	2,857
1.0 m	0.1	9.5	1.43	1	95	14.3	10	950	143	100	9,500	1,429
10 m	0.01	0.95	0.143	0.1	9.5	1.43	1	95	14.3	10	950	143
100 m	0.001	0.095	0.0143	0.01	0.95	0.143	0.1	9.5	1.43	1	95	14.3

1. Oil density = 0.95 gms/cc
2. Soil density = 1.4 gms/cc

also felt that shallow subtidal habitat was at high risk, both along the open coast and in the estuary. The other two groups rated it as a moderate or low concern. The issue driving the divergence was the risk to mollusks (specifically the Pismo clam). The concerns within the estuary were focused on the risk to shore birds and water fowl, marsh vegetation, and invertebrates living in mud flats, an important food source of many organisms. Nesting birds (especially the California Least Tern) were also the major concern on the outer coast and on the water surface. There was a consensus that exposure of deeper benthic habitat and water column organisms were not a concern.

On-water mechanical recovery (Figure 4.3) did not significantly reduce the risk to the habitats of most concern, based on the estimate of the effectiveness of the equipment available (15% recovery was used). All groups agreed that placing a berm (a major component of the ACP) would protect salt marshes and other sensitive habitat by preventing oil from entering the Tijuana Slough.

The remaining three response options were analyzed at the second workshop. The results for dispersant use at 75% and 25% effectiveness are presented in Figures 4.4 and 4.5, respectively. There was a consistent conclusion that the use of dispersants, if highly effective, would decrease the impacts seen for the natural recovery and on-water mechanical recovery options, but the groups did not agree as to the magnitude of the benefit. While there was some increase in the level of concern for water column exposure, none of the focus groups felt it rose to beyond a moderate level, and all groups were most concerned about local impacts near the Coronado Islands (especially to aquaculture resources). The benefits of dispersant use were not seen by the focus groups unless the application was highly effective, but at the same time the concern for water column exposure also declined when the efficiency was lower.

The final option, on-shore mechanical recovery (Figure 4.6) had essentially the same impacts as natural recovery and on-water mechanical recovery. While all of the groups felt shoreline cleanup was important, they did not believe it would mitigate their primary concerns. In some cases, concern over the impacts of the cleanup itself was expressed.

Region	Marine																																						
Habitats	Terrestrial					Water Surface				Intertidal																													
Subhabitats	Upland/Supratidal									Coastal Salt Marsh							Sea Walls/Pilings/Rip Rap							Sandy Beach					Coarse Sand/Gravel Beach					Rocky Intertidal					
Group	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Plankton	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates
Group 1	L	L	L/R	L	L	L	L/R	R	L								L		L	L	L	L	L	L	L	R	L	L	L	L	R	L	L	L	L	L	L	L	L
	NA	4E	1A	NA	4E	4D	1A	3E	4E	NA	NA	NA	NA	NA	NA	NA	3A	NA	2E	3D	3D	3B	3B	4E	1A	3E	3A	1B	4E	3E	3E	3A	4E	4E	3E	4E	3B	3B	3B
	1A					1A				NA							3B							1A					3A					3B					
Group 2	L	L	L	L	L	L	L/R	C	C	L	L	R	L	L	L	L	L	R	R	L	L	L		R	L	R	R	L	R	R	R	R		R	R	R	L	L	R
	4E	4E	1A	4E	4E	3D	1A	2E	4E	3E	4E	3E	N/A	4E	3E	3E	4E	3E	3E	3E	3E	3E	4E	3E	1A	3E	3E	1C	3E	4E	NA	4E	N/A	3E	3E	4E	3E	3E	3E
	1A					1A				3E							3E							1A					3E					3E					
Group 3	L	R	L	R	R	C	L	C	R								L	R	R	R	R	R	R	R	L	R	R	L	R	L	R	R	R	R	R	R	R	R	R
	3D	3D	1A	4E	4E	3E	1A	4E	3D	NA	NA	NA	NA	NA	NA	NA	3A	3E	3E	3E	3E	3E	3E	3E	1A	3B	3D	1A	3E	3E	N/A	3D	N/A	3E	3C	3C	3C	3B	3C
	1A					2A				NA							3E							1A					3D					3B					

Region	Marine (continued)																																								
Habitats	Subtidal																																Water Column								
Subhabitats	Shallow (<35 feet)						Deep (>35 feet)					Kelp Forest							Sea Grass Beds							Rock Pinnacles							Shallow (<35 feet)							Aq. Fac.	
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Fish	Mollusks
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	3D	3D	3D	4E	4E	4E	4E	4E	4E	4E	4D	4E	3D	3D	3D	3A	4E	4E	3D	3D	3D	3D	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E
	3D						4E					3D							3D							4E							4E							4E	
Group 2	R	R	R	R	R	R	R	R	R	R	R	R	R	R	L	R	R	R	L	R	R	L	R	R	R								R	L/R	R	R	R	R	R	L	L
	N/A	4E	4E	4E	4E	4E	4E	3E	3E	4E	4E	4E	4E	3E	4E	4E	3E	3E	2A	4E	3E	2D	2E	2E	2E	NA	NA	NA	NA	NA	NA	NA	4E	4E	4E	4E	4E	4E	4E	4E	4E
	4E						3E					3E							2A							NA							4E							4E	
Group 3	R	R	R	R	L	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	C	R	R	R	R	R	R		
	4E	4E	3E	3E	1C	3D	4E	4E	4E	4E	4E	4D	4E	4E	4E	4D	4E	4E	3D	4E	3D	3D	4D	4D	4D	4E	4E	4E	4E	4E	4E	4E	4E	4E	3E	4E	4E	4D	4E	4E	4E
	2C						4E					4D							3D							4E							4D							4E	

Region	Marine (continued)							Estuary																										
Habitats	Water Column (continued)							Terrestrial					Water Surface				Intertidal																	
Subhabitats	Deep (>35 feet)							Upland/Supratidal									Salt Marsh							Mud Flat						Sandy Beach				
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Plankton	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	1A	4E	4E	4E	1A	4E	3D	3A	4E	1C	4E	4D	4D	4D	4E	1C	3B	3D	3D	3D	4E	1B	4E	4E	4E
	4E							1A					1A				1C							1C						1B				
Group 2								L	R	L	L	L		L		L	L		L	L	L		L		L	R	L	R	R	R	R	R	R	R
	NA	NA	NA	NA	NA	NA	NA	2E	4E	3A	3E	4E	N/A	1A	N/A	4C	1B	N/A	1A	3D	3D	N/A	3C	N/A	1A	3D	4D	2D	2D	3E	1A	3E	3E	3E
	NA							3A					1A				1A							1A						1A				
Group 3	R	R	R	R	R	R	R	R	R	R	R	R	R	L	R	L	L	R	L	L	L	L	L	R	L	L	L	L	L	R	L	R	L	L
	4E	4E	4E	4E	4E	4E	4E	3D	3D	1A	4E	4E	4E	1A	4E	1A	1A	4E	1A	3A	3A	3A	4C	4E	1A	3A	3A	3A	3A	3E	1A	3B	3D	1A
	4E							1A					1A				1A							1A						1A				

Region	Estuary (continued)																															
Habitats	Intertidal (continued)							Subtidal											Water Column													
Subhabitats	Sea Walls/Pilings/Rip Rap							Shallow (<20 Feet)							Deep (>20 Feet)				Shallow (<20 Feet)							Deep (>20 Feet)						
Group	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Fish	Aquatic Arthropods	Mollusks	Polychaetes	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	NA	NA	NA	NA	4E	4E	3C	3C	3D	3D	3D	NA	NA	NA	NA	NA	NA	NA
	4E							4E							NA				3C							NA						
Group 2								L		R+	R	R	R	R						R+	R	R	R	L								
	NA	NA	NA	NA	NA	NA	NA	4E	N/A	3E	4E	3E	3E	4E	NA	NA	NA	NA	N/A	1E	3E	4E	3E	4D		NA	NA	NA	NA	NA	NA	NA
	NA							3E							NA				1E							NA						
Group 3	L	R	R	L	L	L	L	R	R	L	L	L	L	L					R	L	L	L	L	L	L							
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4D	3A	3A	2A	3A	NA	NA	NA	NA	4E	3C	3A	3A	4E	3A	4E	NA	NA	NA	NA	NA	NA	NA
	4E							2B							NA				3A							NA						

Reference Area codes: L = local, R = regional, and C = continental (see Section 2 for definitions).

Figure 4.2. *Detailed focus group risk analysis results for natural recovery.*

Region	Marine															
Habitats	Terrestrial					Water Surface				Intertidal						
Subhabitats	Upland/Supratidal									Coastal Salt Marsh						
Group	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Plankton	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates
Group 1	L	L	L/R	L	L	L	L/R	R	L							
	NA	4E	1A	NA	4E	4D	1A	3E	4E	NA	NA	NA	NA	NA	NA	NA
	1A					1A				NA						
Group 2	L	L	L	L	L	L	L/R	C	C	L	L	R	L	L	L	L
	4E	4E	1A	4E	4E	3D	1A	2E	4E	3E	4E	3E	N/A	4E	3E	3E
	1A					1A				3E						
Group 3	L	R	L	R	R	C	L	C	R							
	3D	3D	1A	4E	4E	3E	1A	4E	3D	NA	NA	NA	NA	NA	NA	NA
	1A					2A				NA						

Region	Marine (cont.)																						
Habitats	Intertidal																						
Subhabitats	Sea Walls/Pilings/Rip Rap							Sandy Beach					Coarse Sand/Gravel Beach					Rocky Intertidal					
Group	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates
Group 1	L		L	L	L	L	L	L	L	R	L	L	L	L	R	L	L	L	L	L	L	L	L
	3A	NA	2E	3D	3D	3B	3B	4E	1A	3E	3A	1B	4E	3E	3E	3A	4E	4E	3E	4E	3B	3B	3B
	3B							1A					3A					3B					
Group 2	L	R	R	L	L	L		R	L	R	R	L	R	R	R	R		R	R	R	L	L	R
	4E	3E	3E	3E	3E	3E	4E	3E	1A	3E	3E	1C	3E	4E	NA	4E	NA	3E	3E	4E	3E	3E	3E
	3E							1A					4E					3E					
Group 3	L	R	R	R	R	R	R	R	L	R	R	L	R	L	R	R	R	R	R	R	R	R	R
	3A	3E	3E	3E	3E	3E	3E	3E	1A	3B	3D	1A	3E	3E	NA	3D	NA	3E	3C	3C	3C	3B	3C
	3E							1A					3D					3B					

Region	Marine (continued)																		
Habitats	Subtidal																		
Subhabitats	Shallow (<35 feet)						Deep (>35 feet)					Kelp Forest							
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	3D	3D	3D	4E	4E	4E	4E	4E	4E	4E	4D	4E	3D	3D	3D
	3D						4E					3D						
Group 2	R	R	R	R	R	R	R	R	R	R	R	R	R	R	L	R	R	R
	N/A	4E	4E	4E	4E	4E	4E	3E	3E	4E	4E	4E	4E	3E	4E	4E	3E	3E
	4E						3E					3E						
Group 3	R	R	R	R	L	R	R	R	R	R	R	R	R	R	R	R	R	R
	4E	4E	3E	3E	1C	3D	4E	4E	4E	4E	4E	4D	4E	4E	4E	4D	4E	4E
	2C						4E					4D						

Region	Marine (continued)																						
Habitats	Subtidal														Water Column								
Subhabitats	Sea Grass Beds							Rock Pinnacles							Shallow (<35 feet)							Aq. Fac.	
Group	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Fish	Mollusks
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	3A	4E	4E	3D	3D	3D	3D	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E
	3D							4E							4E							4E	
Group 2	L	R	R	L	R	R	R								R	L/R	R	R	R	R	R	L	L
	2A	4E	3E	2D	2E	2E	2E	NA	NA	NA	NA	NA	NA	NA	4E	4E	4E	4E	4E	4E	4E	4E	4E
	2A							NA							4E							4E	
Group 3	R	R	R	R	R	R	R	R	R	R	R	R	R	R	C	R	R	R	R	R	R		
	3D	4E	3D	3D	4D	4D	4D	4E	4E	4E	4E	4E	4E	4E	4E	4E	3E	4E	4E	4D	4E	4E	4E
	3D							4E							4D							4E	

Region	Marine (continued)							Estuary								
Habitats	Water Column (continued)							Terrestrial					Water Surface			
Subhabitats	Deep (>35 feet)							Upland/Supratidal								
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Plankton
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	1A	4E	4E	4E	1A	4E	3D
	4E							1A					1A			
Group 2								L	R	L	L	L		L		L
	NA	NA	NA	NA	NA	NA	NA	2E	4E	3A	3E	4E	N/A	1A	N/A	4C
	NA							3A					1A			
Group 3	R	R	R	R	R	R	R	R	R	R	R	R	R	L	R	L
	4E	4E	4E	4E	4E	4E	4E	3D	3D	1A	4E	4E	4E	1A	4E	1A
	4E							1A					1A			

Region	Estuary (cont.)																	
Habitats	Intertidal																	
Subhabitats	Salt Marsh							Mud Flat						Sandy Beach				
Group	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	3A	4E	1C	4E	4D	4D	4D	4E	1C	3B	3D	3D	3D	4E	1B	4E	4E	4E
	1C							1C						1B				
Group 2	L		L	L	L		L		L	R	L	R	R	R	R	R	R	R
	1B	N/A	1A	3D	3D	N/A	3C	N/A	1A	3D	4D	2D	2D	3E	1A	3E	3E	3E
	1A							1A						1A				
Group 3	L	R	L	L	L	L	L	R	L	L	L	L	L	R	L	R	L	L
	1A	4E	1A	3A	3A	3A	4C	4E	1A	3A	3A	3A	3A	3E	1A	3B	3D	1A
	1A							1A						1A				

Region	Estuary (continued)																		
Habitats	Intertidal (continued)							Subtidal											
Subhabitats	Sea Walls/Pilings/Rip Rap							Shallow (<20 Feet)							Deep (>20 Feet)				
Group	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Fish	Aquatic Arthropods	Mollusks	Polychaetes
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	NA	NA	NA	NA
	4E							4E							NA			
Group 2								L		R+	R	R	R	R				
	NA	NA	NA	NA	NA	NA	NA	4E	N/A	3E	4E	3E	3E	4E	NA	NA	NA	NA
	NA							3E							NA			
Group 3	L	R	R	L	L	L	L	R	R	L	L	L	L	L				
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4D	3A	3A	2A	3A	NA	NA	NA	NA
	4E							2B							NA			

Region	Estuary (continued)														
Habitats	Water Column														
Subhabitats	Shallow (<20 Feet)							Deep (>20 Feet)							
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	3C	3C	3D	3D	3D	NA	NA	NA	NA	NA	NA	NA
	3C							NA						
Group 2		R+	R	R	R	L								
	N/A	1E	3E	4E	3E	4D		NA	NA	NA	NA	NA	NA	NA
	1E							NA						
Group 3	R	L	L	L	L	L	L							
	4E	3C	3A	3A	4E	3A	4E	NA	NA	NA	NA	NA	NA	NA
	3A							NA						

Reference Area codes: L = local, R = regional, and C = continental (see Section 2 for definitions).

Figure 4.3 *Detailed focus group risk analysis results for on-water mechanical recovery.*

Region	Marine																																						
Habitats	Terrestrial					Water Surface				Intertidal																													
Subhabitats	Upland/Supratidal									Coastal Salt Marsh							Sea Walls/Pilings/Rip Rap							Sandy Beach					Coarse Sand/Gravel Beach					Rocky Intertidal					
Group	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Plankton	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates
Group 1	L	L	L/R	L	L	L	L/R	R	L								L		L	L	L	L	L	L	L	R	L	L	L	L	R	L	L	L	L	L	L	L	L
	NA	4E	3B	NA	4E	4D	3C	4E	4E	NA	NA	NA	NA	NA	NA	NA	3C	NA	3E	4E	4E	4D	3D	4E	3B	4E	4C	4C	4E	4E	4E	4C	4E	4E	4E	4E	4C	4C	4C
	3B					3C				NA							3E							3B					4C					4C					
Group 2	L	L	L	L	L	L	L/R	C	C	L	L	R	L	L	L	L	L	R	R	L	L	L		R	L	R	R	L	R	R	R	R		R	R	R	L	L	R
	4E	4E	1B	4E	4E	3E	1B	2E	4E	4E	4E	4E	NA	4E	4E	4E	4E	3E	4E	4E	4E	4E	4E	3E	1B	4E	4E	1D	4E	4E	NA	4E	NA	4E	4E	4E	4E	4E	4E
	1B					1B				4E							4E							1A					4E					4E					
Group 3	L	R	L	R	R	C	L	C	R								L	R	R	R	R	R	R	R	L	R	R	L	R	L	R	R	R	R	R	R	R	R	R
	3E	3E	1A	4E	4E	3E	1A	4E	3E								3D	3E	3E	3E	3E	3E	3E	4E	1A	3D	3E	2C	3E	3E	NA	3E	NA	4E	3E	4E	4E	4E	4E
	1A					2A				NA							3E							1A					3E					4E					

Region	Marine (continued)																																								
Habitats	Subtidal																																	Water Column								
Subhabitats	Shallow (<35 feet)						Deep (>35 feet)					Kelp Forest							Sea Grass Beds							Rock Pinnacles							Shallow (<35 feet)							Aq. Fac.	
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Fish	Mollusks
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4C	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4D	4D	4E	4E	4E	4C	4E	4E	4E
	4E						4E					4E							4C							4E							4C							4E	
Group 2	R	R	R	R	R	R	R	R	R	R	R	R	R	R	L	R	R	R	L	R	R	L	R	R	R								R	R/L	R	R	R	R	R	L	L
	NA	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4D	4E	3E	3E	3D	4E	3E	3E	3E	3E	3E	4E	4E	4E	4D	4E	3D	3E	4E	3D	4E	NA	4E	4E	4E	4A	4A
	4E						4E					4D							3D							3D							3D							4A	
Group 3	R	R	R	R	L	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	C	R	R	R	R	R	R		
	NA	NA	3E	3E	1E	3E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4C	4D	4C	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	3E	4E	4E	4D	4E	4D	4D
	1E						4E					4C							4E							4E							4D							4D	

Region	Marine (continued)							Estuary																										
Habitats	Water Column (continued)							Terrestrial					Water Surface				Intertidal																		
Subhabitats	Deep (>35 feet)							Upland/Supratidal									Salt Marsh							Mud Flat						Sandy Beach				
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Plankton	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	3B	4E	4E	4E	3B	4E	4E	3D	4E	3B	4E	4E	4E	4E	4E	3B	4C	4D	4D	4D	4E	3B	4E	4E	4E
	4E							3B					3B				3B							3B						3B				
Group 2								L	R	L	L	L		L		L	L		L	L	L		L		L	R	L	R	R	R	R	R	R	R
	NA	NA	NA	NA	NA	NA	NA	2E	4E	3C	3E	4E	NA	1A	NA	4C	1B	NA	1A	3D	3D	NA	3C	NA	1A	3D	4D	2D	2D	3E	1A	3E	3E	3E
	NA							3C					1B				1B							2B						1B				
Group 3	R	R	R	R	R	R	R	R	R	R	R	R	R	L	R	L	L	R	L	L	L	L	L	R	L	L	L	L	L	R	L	R	L	L
	4E	4E	4E	4E	4E	4E	4E	3E	3E	1C	4E	4E	4E	1A	4E	1A	1A	4E	1A	3A	3A	3A	4C	4E	1A	3A	3A	3A	3A	3E	1A	3B	3D	1A
	4E							1C					1A				1A							1A						1A				

Region	Estuary (continued)																																
Habitats	Intertidal (continued)							Subtidal											Water Column														
Subhabitats	Sea Walls/Pilings/Rip Rap							Shallow (<20 Feet)							Deep (>20 Feet)				Shallow (<20 Feet)							Deep (>20 Feet)							
Group	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Fish	Aquatic Arthropods	Mollusks	Polychaetes	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	NA	NA	NA	NA	4E	4E	4E	4E	4E	4E	4E	NA	NA	NA	NA	NA	NA	NA
	4E							4E							NA				4E							NA						
Group 2								L		R+	R	R	R	R						R+	R	R	R	L								
	NA	NA	NA	NA	NA	NA	NA	4E	NA	3E	4E	3E	3E	4E	NA	NA	NA	NA	NA	1E	3E	4E	3E	4E	NA	NA	NA	NA	NA	NA	NA	NA
	NA							3E							NA				1E							NA						
Group 3	L	R	R	L	L	L	L	R	R	L	L	L	L	L					R	L	L	L	L	L	L							
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4D	3A	3A	2A	3A	NA	NA	NA	NA	4E	3C	3A	3A	4E	3A	4E	NA	NA	NA	NA	NA	NA	NA
	4E							3A							NA				3A							NA						

Reference Area codes: L = local, R = regional, and C = continental (see Section 2 for definitions).

Figure 4.4 *Detailed focus group risk analysis results for dispersant application at 75% effectiveness.*

Region	Marine																																						
Habitats	Terrestrial					Water Surface				Intertidal																													
Subhabitats	Upland/Supratidal									Coastal Salt Marsh							Sea Walls/Pilings/Rip Rap							Sandy Beach					Coarse Sand/Gravel Beach					Rocky Intertidal					
Group	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Plankton	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates
Group 1	L	L	L/R	L	L	L	L/R	R	L								L		L	L	L	L	L	L	L	R	L	L	L	L	R	L	L	L	L	L	L	L	L
	NA	4E	1A	NA	4E	4D	2B	3E	4E	NA	NA	NA	NA	NA	NA	NA	3A	NA	2E	3D	3D	3B	3B	4E	1A	3E	3A	1B	4E	3E	3E	3A	4E	4E	3E	4E	3B	3B	3B
	1A					2B				NA							3B							1A					3A					3B					
Group 2	L	L	L	L	L	L	L/R	C	C	L	L	R	L	L	L	L	L	R	R	L	L	L		R	L	R	R	L	R	R	R	R		R	R	R	L	L	R
	4E	4E	1A	4E	4E	3D	1A	2E	4E	3E	4E	3E	N/A	4E	3E	3E	4E	3E	3E	3E	3E	3E	4E	3E	1A	3E	3E	1C	3E	4E	NA	4E	N/A	3E	3E	4E	3E	3E	3E
	1A					1A				3E							3E							1A					4E					3E					
Group 3	L	R	L	R	R	C	L	C	R								L	R	R	R	R	R	R	R	L	R	R	L	R	L	R	R	R	R	R	R	R	R	R
	3D	3D	1A	4E	4E	3E	1A	4E	3D	NA	NA	NA	NA	NA	NA	NA	3A	3E	3E	3E	3E	3E	3E	3E	1A	3B	3D	1A	3E	3E	N/A	3D	N/A	3E	3C	3C	3C	3B	3C
	1A					2A				NA							3E							1A					3D					3B					

Region	Marine (continued)																																								
Habitats	Subtidal																																Water Column								
Subhabitats	Shallow (<35 feet)						Deep (>35 feet)					Kelp Forest							Sea Grass Beds							Rock Pinnacles							Shallow (<35 feet)							Aq. Fac.	
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Fish	Mollusks
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	3D	3D	3D	4E	4E	4E	4E	4E	4E	4E	4D	4E	3D	3E	3D	3A	4E	4E	3D	3D	3D	3D	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4D	4E	4E	4E
	3D						4E					3D							3D							4E							4D							4E	
Group 2	R	R	R	R	R	R	R	R	R	R	R	R	R	R	L	R	R	R	L	R	R	L	R	R	R								R	R/L	R	R	R	R	R	L	L
	N/A	4E	4E	4E	4E	4E	4E	3E	3E	4E	4E	4E	4E	3E	4E	4E	3E	3E	2A	4E	3E	2D	2E	2E	2E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	NA	4E	4E	4E	4A	4A
	4E						3E					3E							2A							4E							4E							4A	
Group 3	R	R	R	R	L	L	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	C	R	R	R	R	R	R		
	4E	4E	3E	3E	1C	3D	4E	4E	4E	4E	4E	4D	4E	4E	4E	4D	4E	4E	3D	4E	3D	3D	4D	4D	4D	4E	4E	4E	4E	4E	4E	4E	4E	4E	3E	4E	4E	4D	4E	4E	4E
	2C						4E					4D							3D							4E							4D							4E	

Region	Marine (continued)							Estuary																										
Habitats	Water Column (continued)							Terrestrial					Water Surface				Intertidal																	
Subhabitats	Deep (>35 feet)							Upland/Supratidal									Salt Marsh							Mud Flat						Sandy Beach				
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Plankton	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	1A	4E	4E	4E	1A	4E	3D	3A	4E	1C	4E	4D	4D	4D	4E	1C	3B	3D	3D	3D	4E	1B	4E	4E	4E
	4E							1A					1A				1C							1C						1B				
Group 2								L	R	L	L	L		L		L	L		L	L	L		L		L	R	L	R	R	R	R	R	R	R
	NA	NA	NA	NA	NA	NA	NA	2E	4E	3A	3E	4E	N/A	1A	N/A	4C	1B	N/A	1A	3D	3D	N/A	3C	N/A	1A	3D	4D	2D	2D	3E	1A	3E	3E	3E
	NA							3A					1A				1A							1A						1A				
Group 3	R	R	R	R	R	R	R	R	R	R	R	R	R	L	R	L	L	R	L	L	L	L	L	R	L	L	L	L	L	R	L	R	L	L
	4E	4E	4E	4E	4E	4E	4E	3D	3D	1A	4E	4E	4E	1A	4E	1A	1A	4E	1A	3A	3A	3A	4C	4E	1A	3A	3A	3A	3A	3E	1A	3B	3D	1A
	4E							1A					1A				1A							1A						1A				

Region	Estuary (continued)																															
Habitats	Intertidal (continued)							Subtidal											Water Column													
Subhabitats	Sea Walls/Pilings/Rip Rap							Shallow (<20 Feet)							Deep (>20 Feet)				Shallow (<20 Feet)							Deep (>20 Feet)						
Group	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Fish	Aquatic Arthropods	Mollusks	Polychaetes	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	NA	NA	NA	NA	4E	4E	3C	3C	3D	3D	3D	NA	NA	NA	NA	NA	NA	NA
	4E							4E							NA				3C							NA						
Group 2								L		R+	R	R	R	R						R+	R	R	R	L								
	NA	NA	NA	NA	NA	NA	NA	4E	N/A	3E	4E	3E	3E	4E	NA	NA	NA	NA	N/A	1E	3E	4E	3E	4D	NA	NA	NA	NA	NA	NA	NA	NA
	NA							3E							NA				1E							NA						
Group 3	L	R	R	L	L	L	L	R	R	L	L	L	L	L					R	L	L	L	L	L	L							
	4E	4E	4E	4E	4E	4E	4E	4E	4E	2B	3A	3A	2A	3A	NA	NA	NA	NA	4E	3C	3A	3A	4E	3A	4E	NA	NA	NA	NA	NA	NA	NA
	4E							2B							NA				3A							NA						

Reference Area codes: L = local, R = regional, and C = continental (see Section 2 for definitions).

Figure 4.5 *Detailed focus group risk analysis results for dispersant application at 25% effectiveness.*

Region	Marine																																						
Habitats	Terrestrial					Water Surface				Intertidal																													
Subhabitats	Upland/Supratidal									Coastal Salt Marsh							Sea Walls/Pilings/Rip Rap							Sandy Beach					Coarse Sand/Gravel Beach					Rocky Intertidal					
Group	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Plankton	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates
Group 1	L	L	L/R	L	L	L	L/R	R	L								L		L	L	L	L	L	L	L	R	L	L	L	L	R	L	L	L	L	L	L	L	L
	4E	4E	2A	NA	4E	4E	4E	4E	4E	NA	NA	NA	NA	NA	NA	NA	3A	NA	4E	3E	3A	3A	3A	4E	2A	4B	3A	4E	4E	4E	4E	4A	4E	4E	4E	4E	3A	3A	3A
	2A					4E				NA							3A							2A					4A					3A					
Group 2	L	L	L	L	L	L	L/R	C	C	L	L	R	L	L	L	L	L	R	R	L	L	L		R	L	R	R	L	R	R	R	R		R	R	R	L	L	R
	4E	4E	1C	4E	4E	3E	1C	2E	4E	3E	4E	3E	NA	4E	3E	3E	3A	4E	4E	3D	4E	3A	4D	3E	1C	4E	4E	1C	4E	4E	NA	4E	NA	3E	3E	4E	4E	3E	4E
	1C					1C				3E							3A							1C					4E					3E					
Group 3	L	R	L	R	R	C	L	C	R								L	R	R	R	R	R	R	R	L	R	R	L	R	L	R	R	R	R	R	R	R	R	R
	3D	3D	1A	4E	4E	3E	1A	4E	3D	NA	NA	NA	NA	NA	NA	NA	3C	3E	3E	3E	3E	3E	3E	3E	1C	4B	4C	2B	3E	3E	NA	3D	NA	3E	3C	3C	3C	3B	3C
	1A					2A				NA							3E							1C					3D					3B					

Region	Marine (continued)																																								
Habitats	Subtidal																																Water Column								
Subhabitats	Shallow (<35 feet)						Deep (>35 feet)					Kelp Forest							Sea Grass Beds							Rock Pinnacles							Shallow (<35 feet)							Aq. Fac.	
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Fish	Mollusks
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E
	4E						4E					4E							4E							4E							4E							4E	
Group 2	R	R	R	R	R	R	R	R	R	R	R	R	R	R	L	R	R	R	L	R	R	L	R	R	R								R	R/L	R	R	R	R	R	L	L
	NA	4E	4E	4E	4E	4E	4E	3E	3E	4E	4E	4E	4E	3E	4E	4E	3E	3E	2C	4E	3E	2E	3E	3E	3E	NA	NA	NA	NA	NA	NA	NA	4E	4E	4E	4E	4E	4E	4E	4E	4E
	4E						3E					3E							2C							NA							4E							4E	
Group 3	R	R	R	R	L	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	C	R	R	R	R	R	R		
	4E	4E	3E	3E	2D	3E	4E	4E	4E	4E	4E	4D	4E	4E	4E	4D	4E	4E	3D	4E	3D	3D	4D	4D	4D	4E	4E	4E	4E	4E	4E	4E	4E	4E	3E	4E	4E	4D	4E	4E	4E
	2D						4E					4D							3D							4E							4D							4E	

Region	Marine (continued)							Estuary																										
Habitats	Water Column (continued)							Terrestrial					Water Surface				Intertidal																		
Subhabitats	Deep (>35 feet)							Upland/Supratidal									Salt Marsh							Mud Flat						Sandy Beach				
Group	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Plankton	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	2B	4E	4E	4E	2B	4E	4E	3A	4E	3C	4E	4D	4D	4D	4E	3C	3B	3D	4D	3D	4E	2C	4E	4E	4E
	4E							2B					2B				3A							3B						2C				
Group 2								L	R	L	L	L		L		L	L		L	L	L		L		L	R	L	R	R	R	R	R	R	R
	NA	NA	NA	NA	NA	NA	NA	2E	4E	3A	3E	4E	N/A	1A	N/A	4C	1B	N/A	1A	3D	3D	N/A	3C	N/A	1A	3D	4D	2D	2D	3E	1B	3E	3E	3E
	NA							3A					1A				1A							1A						1B				
Group 3	R	R	R	R	R	R	R	R	R	R	R	R	R	L	R	L	L	R	L	L	L	L	L	R	L	L	L	L	L	R	L	R	L	L
	4E	4E	4E	4E	4E	4E	4E	3D	3D	1A	4E	4E	4E	1A	4E	1A	1A	4E	1A	3A	3A	3A	4C	4E	1A	3A	3A	3A	3A	3E	1A	3B	3D	1A
	4E							1A					1A				1A							1A						1A				

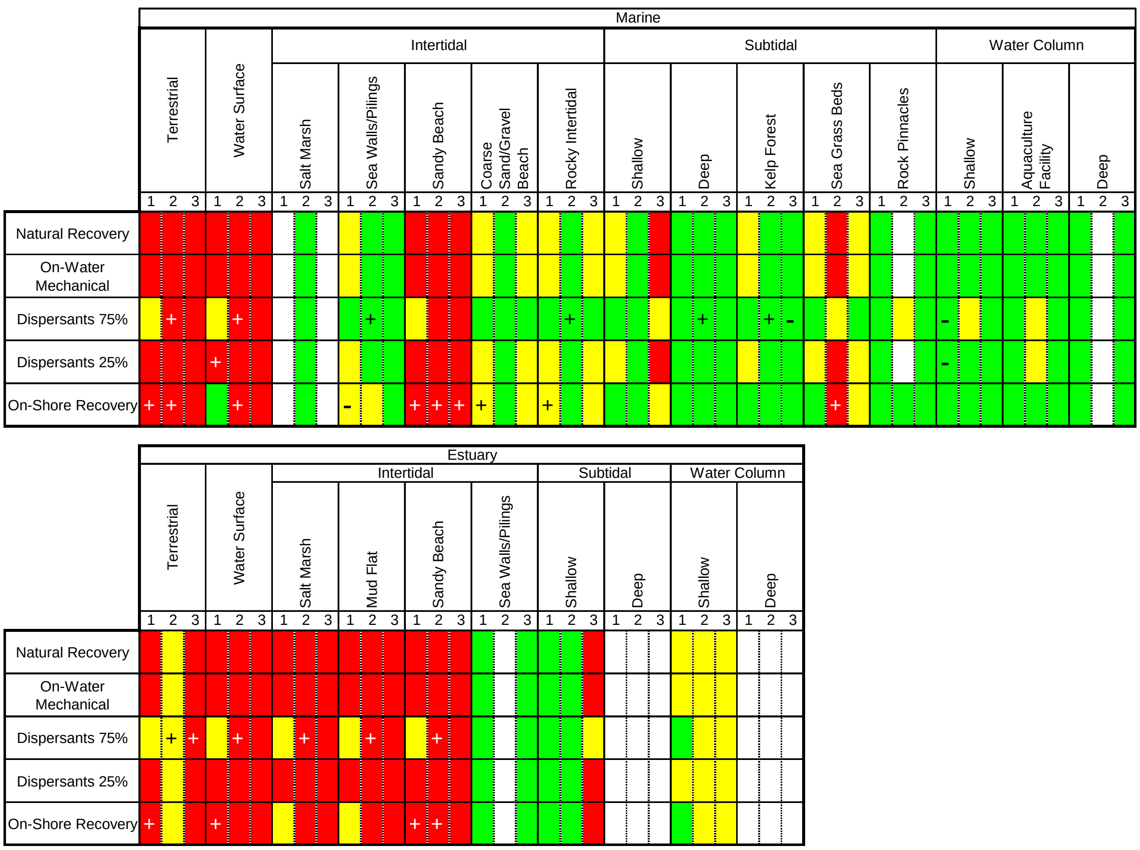
Region	Estuary (continued)																														
Habitats	Intertidal (continued)							Subtidal											Water Column													
Subhabitats	Sea Walls/Pilings/Rip Rap							Shallow (<20 Feet)							Deep (>20 Feet)				Shallow (<20 Feet)							Deep (>20 Feet)						
Group	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Vegetation	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Other Invertebrates	Fish	Aquatic Arthropods	Mollusks	Polychaetes	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians	Mammals	Birds	Fish	Aquatic Arthropods	Mollusks	Plankton	Reptiles/Amphibians
Group 1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	4E	NA	NA	NA	NA	4E	4E	4C	4C	4C	4C	4C	NA	NA	NA	NA	NA	NA	NA
	4E							4E							NA				4C							NA						
Group 2								L		R+	R	R	R	R						R+	R	R	R	L								
	NA	NA	NA	NA	NA	NA	NA	4E	N/A	3E	4E	3E	3E	4E	NA	NA	NA	NA	N/A	1E	3E	4E	3E	4D	NA	NA	NA	NA	NA	NA	NA	NA
	NA							3E							NA				1E							NA						
Group 3	L	R	R	L	L	L	L	R	R	L	L	L	L	L					R	L	L	L	L	L	L							
	4E	4E	4E	4E	4E	4E	4E	4E	4E	4D	3A	3A	2A	3A	NA	NA	NA	NA	4E	3C	3A	3A	4E	3A	4E	NA	NA	NA	NA	NA	NA	NA
	4E							2B							NA				3A							NA						

Reference Area codes: L = local, R = regional, and C = continental (see Section 2 for definitions).

Figure 4.6 *Detailed focus group risk analysis results for on-shore mechanical recovery.*

5.0 Summary Risk Analysis Results and Lessons Learned

Table 5.1 presents the summary results for this workshop. Four response options were analyzed along with natural recovery: on-water mechanical recovery, dispersant application at 75% effectiveness, dispersant application at 25% effectiveness and on-shore mechanical recovery. This table is based on the detailed data in Section 4 and allows an easy comparison across response options. In summary, participants felt that the most potential benefit to the environment resulted from the use of dispersants, provided they were relatively highly effective. The benefit was not large, however, since participants still felt that the oil on the shoreline was sufficient to be a concern. The groups were divided in their opinion of the potential benefits. There was a consensus that on-water mechanical recovery was not likely to provide much benefit to shoreline habitats. The increased risk to the water column with



Legend: Red cells represent a "high" level of concern, yellow cells represent a "moderate" level of concern, and green cells represent a "limited" level of concern. There are two group scores per sub-habitat type (columns). A + indicates reduced concern within the broad risk category, while a – indicates an increased concern within the category.

Figure 5.1 *Final relative risk matrix for the Mexico – US Pacific Coastal Border Region risk assessment.*

dispersant use was a concern, but not as high as the risk to the shoreline and water surface areas which might be protected. The major concern with dispersant use was the potential risk to aquaculture facilities and habitats around the Coronado Islands; however the groups concluded that this was not as great a concern as originally expected. No attempt was made to resolve differences between focus group scores, but they were discussed.

5.1 Consensus Recommendations

On the last day of the workshop, the participants developed the following list of consensus comments for consideration in future oil spill response planning efforts. They suggested these be presented to the Area Committee for consideration.

- Interaction with US and Mexican representatives was extremely valuable and it will be valuable during an actual spill event (will reduce time for joint response decisions).

    - US/Mexico exercises are important and need to continue in the future.
    - Knowing specific names or titles of US and Mexican counterparts is very important.
    - Federal and state level interactions between US and Mexico have occurred, but there has been little involvement of local state responders prior to this workshop.

- Mexican counterparts would like to have more resource experts available during this process.
- Mexican counterparts should get more involved in dispersant use issues.
- Any cleanup decisions on or near Imperial Beach or the Tijuana Slough will be driven by threatened and endangered wildlife, and the Captain of the Port and other responders would need to know this.
- Biological/human health concerns will need to be considered when responding in the Tijuana Slough.
- Pre-planning is extremely important (CERA process and ACP). Pre-planning aids preparedness in addressing spill issues, especially between US and Mexico.
- There are specific issues that require further coordination between US (Federal and state of California) and Mexico through the Joint Response Team. This team can input changes to the MEXUS PAC Area Plan, which can be revised based on these exercises. Specific issues are:

    - Applied response technologies (dispersant)
    - Wildlife response operations
    - Communications (phones, fax machines, etc.) during an actual spill
    - Logistics of moving equipment and personnel across the border
    - USCG District 11 should be integrating all MEXUS PAC Area exercises and workshop “lessons learned” decisions (past and present) into documents used by Joint Response Team

- Joint Response Team needs to identify how information will be disseminated.
- ACP committee should consider the value of marsh burning, in conjunction with USFWS burn plans.
- Continue training for decision-makers and responders, in order to address public pressures and expectations.
- There needs to be continued involvement of border patrol in future planning and exercises.
- The Mexican Navy has compiled an atlas of sensitive resources for Mexico. The maps are on a regional scale, but more effort is needed to provide local detail.
- It would be useful to have border area resource maps available in both English and Spanish.

The participants also developed three recommendations specifically related to the response options evaluated in this exercise:

- In the estuary, shoreline protection (as defined in the ACP) is critical because of the potential limited effectiveness of other available response options.
- If dispersants are used, we need to activate dispersant application assets and apply dispersants as soon as practical, in accordance with the California Dispersant Use Plan.
- When state and/or federal regulations are in place, drilling will be necessary to demonstrate the capability of the C-130 to arrive on site within the prescribed window.

6.0 References

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Appendix A

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Appendix B

Resource Table

Region	Habitat	Subhabitat	Resource Category	Example Organisms
Marine	Terrestrial	Upland and Supratidal	Vegetation	Dune grass, trees, shrubs, lichens
			Mammals	Racoon, fox, domestic animals
			Birds	Raptors, gulls, Fed. listed plover and terns
			Reptiles/Amphibians	
			Insects	
	Water Surface incl. Microlayer		Mammals	Seals, dolphins, whales
			Birds	Alcids and pelagic birds, diving birds, gulls, terns (Fed. listed CA Least & Gull billed terns)
			Reptiles/Amphibians	Green sea turtle
			Plankton	Fish eggs and larvae
	Intertidal	Coastal Salt Marsh	Vegetation	Perennial marsh grasses, diatoms, algae
			Mammals	Racoon, fox, domestic animals
			Birds	Shorebirds, wading birds, waterfowl
			Fish	Killifish, anchovy, Silversides
			Aquatic Arthropods	Crabs, amphipods, shrimp
			Mollusks	Snails, clams, mussels
			Other Invertebrates	Fat innkeepers, Nereis
		Sea Walls/ Pilings/RipRap	Vegetation	Sea lettuce, leafy reds, corralines, sea palms, brown algae
			Mammals	Harbor seals, sea lions
			Birds	Gulls, Fed. listed CA Least & Gull billed terns
			Fish	Sculpins, surf perch, rockfish, herring (and eggs)
			Aquatic Arthropods	Crabs
			Mollusks	Mussels, snails, abalone
			Other Invertebrates	Pile worms, feather dusters, tubeworms, sea urchins, starfish, anemones
		Sandy Beach	Mammals	Racoon, fox, domestic animals
			Birds	Gulls, shore birds, raptors, loons, grebes, wading birds, waterfowl, Fed. Listed W. Snowy plover, CA Least & Gull billed terns
			Fish	Surf perch, surf smelt, striped bass
			Aquatic Arthropods	Sand crabs, crabs, amphipods
			Mollusks	clams
		Coarse Sand and/or Gravel Beach	Mammals	Racoon, fox, domestic animals
			Birds	Gulls, shore birds, raptors, loons, grebes, wading birds, waterfowl, Fed. Listed W. Snowy plover, CA Least & Gull billed terns
			Fish	
			Aquatic Arthropods	Crabs, amphipods
			Mollusks	Clams
		Rocky Intertidal/Cliffs/Tide pools	Mammals	Racoon, fox, domestic animals
			Birds	Gulls, raptors, Fed. Listed W. Snowy plover, CA Least & Gull billed terns
			Fish	Sculpins
			Aquatic Arthropods	Hermit crabs, snails
			Mollusks	Mussels, snails, abalone
			Other Invertebrates	Sea urchins, starfish, anemones, tube worms

Region	Habitat	Subhabitat	Resource Category	Example Organisms
Marine (cont.)	Subtidal	Shallow (<35 feet)	Mammals	Grey whales, seals
			Birds	Alcids and pelagic birds, diving birds
			Fish	Demersal fish, sharks
			Aquatic Arthropods	Crabs, shrimp
			Mollusks	Clams, snails
			Other Invertebrates	Polychates, sea cucs, sea stars, brittle stars
		Deep (>35 feet)	Mammals	Grey whales, seals, dolphins
			Fish	Demersal fish, sharks
			Aquatic Arthropods	Crabs, shrimp
			Mollusks	Clams, snails
			Other Invertebrates	Polychates, sea cucumbers, sea stars, brittle stars
		Kelp Forest	Vegetation	Giant kelp
			Mammals	Seals
			Birds	Alcids and pelagic birds, diving birds, gulls, terns (foraging for CA Least & Gull billed terns)
			Fish	Wrasses, sea horse, rockfish, snapper
			Aquatic Arthropods	Crabs, isopods, amphipods, barnacles, lobster
			Mollusks	sea snails, mussels, abalone, octopus
			Other Invertebrates	Sea urchins, starfish, anemones, polychaetes, sponges
		Sea Grass Beds	Vegetation	Sea grass
			Mammals	
			Birds	Alcids and pelagic birds, diving birds, gulls, terns (foraging for CA Least & Gull billed terns)
			Fish	Wrasses, sea horse, rockfish, snapper
			Aquatic Arthropods	Crabs, isopods, amphipods, barnacles, lobster
			Mollusks	sea snails, mussels, abalone, octopus
			Other Invertebrates	Sea urchins, starfish, anemones, polychaetes, sponges
		Rock Pinnacle	Vegetation	Benthic algae
			Mammals	Seals
			Birds	Alcids and pelagic birds, diving birds, gulls, terns (foraging for CA Least & Gull billed terns)
			Fish	Wrasses, sea horse, rockfish, snapper
			Aquatic Arthropods	Crabs, isopods, amphipods, barnacles, lobster
			Mollusks	sea snails, mussels, abalone, octopus
			Other Invertebrates	Sea urchins, starfish, anemones, polychaetes, sponges
	Water Column	Shallow Water (<35 feet)	Mammals	Seals, dolphins, whales
			Birds	Diving birds, (foraging for CA terns)
			Fish	Demersal fish, sharks
			Aquatic Arthropods	Shrimp
			Mollusks	Squid
			Plankton	Copepods, fish eggs and larvae, invertebrate larvae, phytoplankton, jellyfish
			Reptiles/Amphibians	Green sea turtle
		Aquaculture Facilities	Fish	Tuna
			Mollusks	Abalone

Region	Habitat	Subhabitat	Resource Category	Example Organisms
Marine (cont.)	Water Column (cont.)	Deep Water (>35 feet)	Mammals	Seals, dolphins, whales
			Birds	Diving birds
			Fish	Demersal fish, sharks
			Aquatic Arthropods	Shrimp
			Mollusks	Squid
			Plankton	Copepods, fish eggs and larvae, invertebrate larvae, phytoplankton, jellyfish
			Reptiles/Amphibians	Green sea turtle
Estuary	Terrestrial	Upland and Supratidal	Vegetation	Dune grass, trees, shrubs, lichens
			Mammals	Racoon, fox, domestic animals
			Birds	Raptors, gulls, Fed. listed plover and terns
			Reptiles/Amphibians	
			Insects	
	Water Surface incl. Microlayer		Mammals	Seals, dolphins
			Birds	Alcids and pelagic birds, diving birds, gulls, Federally listed plover and terns
			Reptiles/Amphibians	Green sea turtle
			Plankton	Fish eggs and larvae
	Intertidal	Salt Marsh	Vegetation	Perennial marsh grasses, diatoms, algae
			Mammals	Racoon, fox, domestic animals
			Birds	Shorebirds, wading birds, waterfowl, Federally listed lite footed clapper rail
			Fish	Killifish, anchovy, Silversides
			Aquatic Arthropods	Crabs, amphipods, shrimp
			Mollusks	Snails, clams, mussels
			Other Invertebrates	Fat innkeepers, Nereis
		Mud Flats	Mammals	Racoon, fox, domestic animals
			Birds	Gulls, wading birds, shorebirds, waterfowl, Federally listed W. snowy plover & terns
			Fish	Sculpins, flatfish
			Aquatic Arthropods	Crabs, fiddler crabs, amphipods
			Mollusks	Clams, snails
			Other Invertebrates	Sea cucumbers, polychaetes
		Sandy Beach	Mammals	Racoon, fox, domestic animals
			Birds	Gulls, shore birds, raptors, loons, grebes, wading birds, waterfowl
			Fish	Surf perch, surf smelt, striped bass
			Aquatic Arthropods	Sand crabs, crabs, amphipods
			Mollusks	Clams
		Sea Walls/ Pilings/RipRap	Vegetation	Sea lettuce, leafy reds, corralines, sea palms, brown algae
			Mammals	Harbor seals
			Birds	Gulls, CA Least & Gull billed terns
			Fish	Sculpins, surf perch, rockfish, herring (and eggs)
			Aquatic Arthropods	Crabs
			Mollusks	Mussels, snails, abalone
			Other Invertebrates	Pile worms, feather dusters, tubeworms, sea urchins, starfish, anemones

Region	Habitat	Subhabitat	Resource Category	Example Organisms
Estuary (cont.)	Subtidal	Shallow (<20 feet)	Vegetation	Algae
			Mammals	Seals
			Birds	Alcids and pelagic birds, diving birds, gulls, Fed listed CA Least & Gull billed terns
			Fish	Demersal fish, sharks
			Aquatic Arthropods	Crabs, shrimp
			Mollusks	Clams, snails
			Other Invertebrates	Polychates, sea cuc's, sea stars, brittle stars
		Deep (>20 feet)	Fish	Demersal fish, sharks
			Aquatic Arthropods	Crabs, shrimp
			Mollusks	Clams, snails
			Polychaetes	Polychaetes, sea cuc's, sea stars, brittle stars
	Water Column	Shallow Water (<20 feet)	Mammals	Seals, dolphins
			Birds	Diving birds, Fed listed CA terns
			Fish	Demersal fish, sharks
			Aquatic Arthropods	Shrimp
			Mollusks	Squid
			Plankton	Copepods, fish eggs and larvae, invertebrate larvae, phytoplankton, jellyfish
			Reptiles/Amphibians	Green sea turtle
		Deep Water (>20 feet)	Mammals	Seals, dolphins
			Birds	Diving birds, Fed listed CA terns
			Fish	Demersal fish, sharks
			Aquatic Arthropods	Shrimp
			Mollusks	Squid
			Plankton	Copepods, fish eggs and larvae, invertebrate larvae, phytoplankton, jellyfish
			Reptiles/Amphibians	Green sea turtle