Ecological Risk Assessment: Consensus Workshop

Environmental Tradeoffs Associated With Oil Spill Response Technologies

Mexico – United States Gulf of Mexico Coastal Border Region

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A Report to the US Coast Guard, Sector Corpus Christi

Don Aurand (Compiler)
Ecosystem Management & Associates, Inc.

Ecosystem Management & Associates, Inc.
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LIST OF ABBREVIATIONS, SYMBOLS, AND ACRONYMS

ADIOS	Automated Data Inquiry for Oil Spills
cc	Cubic centimeter
CD	Compact Disk
CERA	Consensus Ecological Risk Assessment
CROSERF	Chemical Response to Oil Spills: Ecological Effects Research Forum
EM&A	Ecosystem Management & Associates, Inc.
EPA	Environmental Protection Agency
ERA	Ecological Risk Assessment
ERD	Emergency Response Division (NOAA)
ESI	Environmental Sensitivity Index
g(gms)	Gram(s)
GNOME	General NOAA Oil Modeling Environment
hrs	Hours
ISB	In Situ Burning
L	Liter
µm	Micrometer (1 X 10^{-6} meter)
m	Meter
MEXUS	Mexico – United States
NGO	Non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
NPS	United States National Park Service
NRC	National Research Council
OSRL	Oil Spill Response Limited
PPE	Personal Protective Equipment
ppm	Parts per million
RRT	Regional Response Team
SCAT	Shoreline Cleanup Assessment Team
SSC	Scientific Support Coordinator
TAMU SERF	Texas A&M University Shoreline Environmental Research Facility
TGLO	Texas General Land Office
TPWD	Texas Park and Wildlife Department
US	United States
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service

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Executive Summary

In October/November 2007, the United States Coast Guard (USCG) Sector Corpus Christi hosted a workshop to provide training in dispersant use in oil spills and to evaluate the relative risk to natural resources from various oil spill response options including no response (natural recovery), on-water mechanical recovery, dispersant application and on-shore mechanical recovery. The workshop involved participants from both the United States (US) and Mexico, and was designed to emphasize cooperative decision-making when a spill threatens shoreline resources in both countries. The workshop consisted of two three-day workshops separated by approximately two weeks.

The spill scenario was designed to present participants a situation with similar threats and decisions on both sides of the US-Mexico border. In the scenario, oil spilled approximately 3 miles offshore and the potential response actions were evaluated to determine their influence on the impact of the spill on sensitive coastal and estuarine resources. According to the scenario, after an explosion in the engine room, a tanker carrying 1.2 million gallons of Angola Soyo Crude Oil had two releases of oil. The first spill of 60,000 gallons was expected to come ashore primarily in the US, and, approximately 42 hours later, a second spill released an additional 80,000 gallons of oil expected to come ashore in Mexico.

Participants were divided into four focus groups to evaluate the relative risks and benefits of the response options. Two groups, comprised of US participants, focused on the first spill (which affected the US) and two groups, comprised primarily of Mexican Navy personnel, examined the second spill (which affected the coastline in Mexico). After evaluating the options within the parameters presented for this scenario, the groups concluded that because of the size of the spill, there were potential serious risks to both shoreline and shallow water habitats. On-water mechanical recovery was viewed as being of limited utility in this scenario. Dispersant use raised serious concerns but did provide some benefit to shoreline and intertidal habitats. Likewise, on-shore mechanical recovery was beneficial to some habitats, but raised serious concerns in mangrove areas. The size of the spill made it unlikely that any alternative response would be effective in preventing serious impacts. The highest concern was for estuarine habitats. At the end of the workshop participants developed a list of lessons learned and recommendations for future oil spill response planning in the area.

1.0 Objectives of the Mexico – US Gulf of Mexico 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 CG-533) 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* (Aurand *et al*., 2000), is available from CG-533. It can also be downloaded from the contractor's web site at www.ecosystem-management.net.

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 U.S. Environmental Protection Agency's (EPA) Ecological Risk Assessment (ERA) guidelines (U.S. 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 and training 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 (NGO). 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, results may not be accepted by all stakeholders involved in an actual spill event.

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 (prior to the first meeting), **problem formulation**, participants (usually a small subgroup serving as a Steering Committee) 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**, all the participants evaluate 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 risks and benefits of each response option to overall environmental protection as compared with natural recovery (i.e., baseline).

1.2 Sponsor's Objectives

The Mexico – US Gulf of Mexico Coastal Border Region workshop was sponsored by the USCG Sector Corpus Christi on behalf of the Mexico – US (MEXUS) 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 Gulf of Mexico coastal border region. 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 will be better able to engage in effective risk assessment and tradeoff identification in future pre-spill and spill specific consultations. This would result in a better understanding of resource trustee and response agency concerns, more timely and effective response decisions, and hopefully greater resource protection and recovery.

1.3 Participants

A total of 48 individuals from 15 organizations attended the workshop. Of these, 14 were from Mexico and 34 were from the US. At the first workshop, the participants were divided into four focus groups. The days attended by each participant, and the focus groups they participated in are 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.

2.0 Overview of Workshop Events

This training exercise consisted of two 3-day workshops. The first workshop was held 16 to 18 October, and the second on 6 to 8 November, 2007.

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, EM&A (see CERA Overview or CERA Overview Spanish Version files on the workshop CD). After this presentation, there was 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 Steering Committee recommendations and materials were reviewed for the participants by Mr. Charlie Henry, NOAA SSC for USCG District 8, who noted that the objective was to develop a scenario that would reasonably threaten shoreline resources in both Mexico and the US and would allow consideration of dispersant use. 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, and on-shore mechanical recovery.

Mr. Henry presented the details of the scenario (see the Oil Spill Scenario on the workshop CD) and the results of the 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 Surface Oil Trajectory – Spill (long and beach) and Spill 2 (long and beach) files on the workshop CD).

Mr. Henry's talk was followed by two presentations on regional and local ecological resources. The first was by Mr. Alex Nunez from Texas Parks and Wildlife Department (TPWD) (see Natural Resources of the Lower Laguna Madre file on the workshop CD). This presentation included the major Lower Laguna Madre habitats, geography, species at risk, and applicable oil spill response plans. Mr. Ernesto Reyes, US Fish and Wildlife Service (USFWS), followed Mr. Nunez and provided additional information on resources at risk. These presentations were followed by an open discussion about the habitats and how they related to the proposed resources at risk table (presented to the group by Dr. Aurand). The participants were asked to review the resources at risk table at their convenience during the day and to discuss any modifications that needed to be made early on day two.

Dr. Aurand then reviewed a draft risk ranking matrix with the participants. The draft matrix is a standard five by four matrix presented to all workshops as a starting point for discussions. It is presented as Figure 8.2 in the Guidebook (Aurand *et al*., 2000), without any cell aggregation boundaries for high, medium, or low levels of concern. The final matrix for this workshop, presented as Figure 4.1, includes minor changes from the draft risk matrix in both the time to recovery scale (overall scale lengthened from seven to ten years) and the percentage of resources affected scale (shortened from five rows to four). As part of the discussion on risk ranking, the participants examined the issue of defining a 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 are:

- Local (L) – defined as spill footprint;
- Area (A) – defined as lower Texas, upper Mexico and adjacent water or lagoon systems; and
- Regional (R) – Gulf-wide or greater.

Dr. Aurand then asked the participants to make updates and corrections to the Resources at Risk Table in their notebook, based on suggestions from the Steering Committee. Additional changes (limited to the lists of representative species) were suggested by the participants. The final Resources at Risk Table is presented in Appendix C.

In preparation for the evaluation of the scenario, Dr. Aurand gave an overview presentation on oil spills (see Oil Spill Basics on the workshop CD). When this presentation was completed, Dr. Aurand and Mr. Henry (acting as co-facilitators) reviewed the procedures for evaluating the baseline response option (natural recovery/no intervention) and the participants were divided into four focus groups (see Appendix A).[1] The remainder of day one was spent evaluating the natural recovery option.

Day two began with LT Otilia Gonzalez Nakagawa (Secretaria de Marina) and Ing. Alfredo Jonas Entenza Tapia (Instituto Tecnologico de Altamira) who gave an overview of areas of concern, resources at risk and climate information for the upper Tamaulipas, Mexico area (see Sistema Laguna Madre Tamaulipas, México on the workshop CD). The remainder of the day was spent completing the evaluation of natural recovery and a discussion analyzing the results.

Day three began with an on-water mechanical recovery presentation by Mr. Juan Salgado Texas General Land Office (TGLO) to prepare for discussion of that alternative (see TGLO ERA Presentation 1 2007 on the workshop CD). Dr. Aurand and Mr. Henry then led a discussion on encounter rates and other limitations associated with on-water mechanical recovery, and opened the floor for a discussion of what the overall efficiency of on-water recovery was likely to be in this scenario. Ultimately, participants agreed on an on-water offshore mechanical recovery efficiency of 5% or less for Spill One, and 10-15% for Spill Two. Participants then broke into their four focus groups to rank the "On-Water Mechanical Recovery" response. They completed the analysis by mid-day and the facilitators moved into the evaluation of dispersants.

The dispersant discussion began with an introductory movie entitled "An Introduction of Dispersants and Their Application" prepared by Oil Spill Response Limited (OSRL) of Southampton, United Kingdom. Mr. Henry then reviewed the NOAA modeling results for both spills, including the QuickTime movies of the trajectories of remaining surface oil and dispersed oil (see Dispersed Oil Trajectory – Spill 1 (long) and Spill 2 (long and beach) on the workshop CD). Dr. Aurand reviewed how to use the toxicity information provided in the workshop notebooks, including the results of a cooperative dispersant effects research program (see Section 7 from CROSERF and Section 8 from CROSERF on the workshop

[1] Focus groups 1 and 2 were comprised primarily of participants from Mexico, and analyzed the second spill, which affected the Mexican coast, while focus Groups 3 and 4 were made up of participants from the US and focused on the first spill, which affected primarily the lower Texas coast.

CD).[2] Finally, the participants discussed these presentations and developed a list of issues that they felt needed to be addressed at the beginning of the next workshop:

1. Better summary of toxicity data
2. Sea grass – impacts of oil and dispersed oil to leaves versus rhizomes, exposure and recovery
3. Diversion Booming strategies – how to estimate effectiveness?
4. Toxicity effects of floating oil in very shallow water
5. Sea turtles – toxicity of feeding on contaminated algae and seaweed
6. Toxicity of dispersants
7. Effects of oil on algal mats – recovery times, effects on weathering of oil
8. Persistence of oil on coarse and fine sand beaches – outer and sheltered
9. Better resource maps
10. What are the key species for analysis of ecological effects?

The second workshop (6-8 November 2007) began with a review of accomplishments to date and discussion of questions identified at the conclusion of the first workshop, as summarized below for each numbered question:

1. In order to assist participants interpret the toxicity data, Dr. Aurand reviewed the material provided in the workshop notebook, particularly the optional thresholds table (provided as Table 4.1), noting that it is also included in the recent National Academy of Sciences review of dispersant issues (Table 2-3 in NRC, 2005), which also includes a detailed review of the toxicological effects of dispersants and dispersed oil (Chapter 5). He then reviewed selected slides from an EM&A training presentation on dispersants (see Dispersant Training on the workshop CD). Finally, he reminded participants that there were a number of tables available in the CROSERF report excerpts in their notebooks that could be used along with Table 4.1.
2. Dr. Aurand reviewed the findings of two studies done along the coast of Saudi Arabia after the Gulf War-related oil spills of 1991 (Kenworthy *et al*., 1993 and Durako *et al*., 1993). There are not many studies that look at this issue, and the habitats are somewhat similar. These studies found essentially no impact to submerged sea grass beds from floating oil after one year.
3. Discussion of this topic was deferred until the analysis of on-shore mechanical recovery.
4. Dr. Aurand reviewed the general findings of two field studies, one done in New England (Gilfillan *et al*., 1986) and one done in Panama (Ballou *et al.*, 1989), which examined the consequences to shoreline and nearshore habitats of the release of either floating or dispersed oil. In the New England study, the primary focus was on subtidal benthic habitats. If oil was dispersed, effects were short-term and temporary, and if oil was allowed to strand, redisposition of oil from the

[2] 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. The final report is available from the American Petroleum Institute, Washington, DC and from the EM&A website, www.ecosystem-management.net.

shoreline into the subtidal area caused longer term effects. In the study in Panama, dispersed oil caused impacts to coral reef and sea grass communities (primarily to invertebrates), but these habitats recovered in one to several years while protecting the mangrove forest. Floating oil, on the other hand, had less impact on subtidal habitats, but had serious and long-term effects on the mangrove forests. This study site has been visited several times in the recent past, and impacts are still apparent in the mangrove forest, after nearly 20 years (Baca *et al*., 2005).

5. Dr. Aurand reviewed the contents of the NOAA publication "Oil and Sea Turtles" and indicated that it could be obtained from NOAA on the internet at http://response.restoration.noaa.gov/book_shelf/35_turtle_complete.pdf.
6. The recent NRC report on dispersants contains a summary of the available information on the toxicity of dispersants, summarized in Table 5-2 (pages 212-214) of NRC (2005). In summary, modern dispersants are less toxic than the oil that they are used to treat, and since they are applied at very low concentrations, it is unlikely to exceed thresholds of concern in open waters. There is a low risk to marine mammals and birds if they are accidentally sprayed, and so there are always protocols in place to prevent accidental contact.
7. The effects of oil on algal mats has not been well studied, but blue-green mats were an important community along the Saudi Arabian coast, just as they are in the Laguna Madre, and they were heavily impacted during the Gulf War oil spill in 1991. Two fairly recent studies (Barth, 2003 and 2007) examined the impacts and subsequent recovery of these communities in Saudi Arabia. Impacts can be severe and long-term.
8. A study was done in the Texas A & M University (TAMU) Shoreline Environmental Research Facility (SERF) in the late 1990s that examined oil and dispersed oil retention on sand beaches (using local sand) in tests tanks with low energy regimes (Fuller *et al*., 1999). Dispersed oil was less likely to be retained, and therefore those sediments were less toxic in a standard aquatic toxicity test.
9. No additional resource maps were identified, and the group felt that this would probably become a recommendation.
10. Identification of "driver species" was discussed and the participants were told that this was a topic that they needed to resolve in their focus groups.

When this discussion ended, Dr. Aurand and Mr. Henry reviewed the work accomplished to date and answered general questions about the use of dispersants. Afterwards, participants broke into their focus groups to analyze the dispersant option. During the afternoon, it was pointed out that there was one additional question from the first meeting, which concerned information on oil spill impacts to mangroves. Dr. Aurand indicated that the best source of summary information is probably the NOAA report, "Oil Spills in Mangroves: Planning and Response Considerations," which is available on the Internet at http://response.restoration.noaa.gov/book_shelf/34_mangrove_complete.pdf.

On day two, Mr. Charlie Henry clarified the location of the scenario oil spill and gave a brief description of an actual oil spill he was working on, which had delayed his arrival the previous day. Next, Mr. Juan Salgado (TGLO) gave an overview of on-shore mechanical recovery (see On-Shore Mechanical Recovery Resources on the workshop CD). Finally, Dr. Aurand gave a presentation to review basic techniques and concerns related to on-shore activities (see Shoreline Cleanup on the workshop CD). Participants then scored shoreline recovery, completing that activity by mid-afternoon, which ended the analytical portion of the exercise.

At this point, the four focus groups were asked to separately discuss the following five questions to evaluate effects of seasonality, location and volume on results:

- What are your critical concerns about the possible consequences of the spill? (Review your scores for Natural Recovery for information)
- What would your group's recommendations be concerning possible response tactics for this spill, and what are the key issues related to the response options proposed? (How would you recommend responding and why? Use the conclusions for the response options on your sheet to explain.)
- How would your conclusions change if the spill were five times as large (300,000 gallons/450,000 gallons)?
- How would your conclusions change if it were a different season?
- List the key assumptions in your discussions and any issues/concerns you had about the information that would be available. (What do you need to do a better job?)

After this was done, the focus group conclusions were reviewed in plenary session (see Section 5.1).

On the morning of the last day, the participants met to review the results of the workshop, and to develop recommendations for future planning efforts. The review was lead by Mr. Henry, who asked that recommendations address the following questions:

- In the event that this type of threat was real, where would you start?
- What could be done to improve on-water mechanical recovery?
- What other offshore response options would we consider?
- What are your conclusions about shoreline protection and cleanup on the outer coast?
- What are your conclusions about shoreline protection and cleanup on the inner coast?

The results for the recommendations for future consideration can be found in Section 5.2. After the recommendations were finalized, the meeting was adjourned.

3.0 Exercise Scenario and Basic Analytical Information

3.1 Exercise Scenario

The scenario was developed by Mr. Henry and reviewed by the workshop Steering Committee prior to the workshop. The scenario was designed to create similar threats and decisions on both sides of the US – Mexico border, with the goals of enhancing future contingency planning, exercising elements of the MEXUS Plan, and evaluating the Regional Response Team (RRT 6) Nearshore Expedited Dispersant Approval Process. The scenario allows for dispersant use off the waters of Texas and Tamaulipas, Mexico as an oil spill mitigation response technique. Key parameters for the spill are summarized in Table 3.1 and the scenario is summarized in Appendix B ("HOPE ESPERANZA Incident") and the PowerPoint presentation "Oil Spill Scenario" on the workshop CD.

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

Time/Date	**0005 October 9 and 1800 October 11, 2007**
Initial Release Location	**26º 5.0´ N, 97º 0.0´ W**
Second Release Location	**25º 30.25´ N, 96º 43.41´ W**
Volume	**60,000 and 80,000 Gallons**
Oil Type	**Soyo Crude Oil (Angolan)**
API Gravity	**37.3**
Wind Direction/Speed	**East, 5 – 10 Knots**
Air/Water Temperature	**78º F**

The NOAA ERD Modeling Group used the basic information in the scenario to develop a surface trajectory and a dispersed oil trajectory analysis for the workshop. Basic weathering information was calculated using the ADIOS II program for the oil under consideration. Trajectory calculations were made using the GNOME model. QuickTime movies and time-series snapshots were produced for both the surface slicks and the dispersed oil plumes.

Response options modeled included: No Response, where the released oil was allowed to weather (evaporation, natural dispersion) and strand on shore with no intervention; and the use of dispersants (at an overall effectiveness of 80%). For dispersant application, both spills were subject to dispersant application and dispersion. In the model, intentional dispersion only occurred during daylight hours. Sufficient dispersant resources are available, and application of the required volume of dispersant could be completed in less than one day.

3.2 Geographic Area of Concern

The general areas of concern were the coastal waters offshore southern Texas and northern Mexico, the outer coast in this area, and the associated embayments of the Laguna Madre.

3.3 Resources of Concern

During the planning for the workshop, Dr. Aurand suggested to the Steering Committee that a good starting point for defining the habitats and associated resources of concern would be the Resources at Risk Table used in the Galveston Bay CERA, held in 1999 (Pond *et al*., 2000). Mr. Henry agreed to review that table and send Dr. Aurand suggested modifications, based on local conditions. With that information, Dr. Aurand prepared a draft table, which was distributed to selected members of the Steering Committee for review. The draft table was provided to the participants in their workshop notebooks, and on the first day they were given corrections to the draft Resources at Risk Table based on suggestions from the Steering Committee. Additional changes (limited to the lists of representative species) were suggested by the participants. The final Resources at Risk Table is presented in Appendix C.

TGLO supplied workshop participants with a CD titled Texas Coastal Oil Spill Planning and Response Toolkit 2006 that contains:

- Area Contingency Plans
- Maps/Charts (including Texas ESI maps)
- Regional Response Team
- Incident Command System, and
- Additional Documents & Links.

3.4 Conceptual Model

During discussions about the general analytical process, the facilitators suggested and the participants agreed that developing a detailed conceptual model was not necessary for their purposes. As an alternative, they accepted 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 participants also agreed that they would consider the response options recommended by the Steering Committee. These were natural recovery (no response), on-water mechanical recovery, dispersant application, and on-shore mechanical recovery.

3.5 Modeling Results

The NOAA ERD 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 program. These calculations were made separately for Spill 1 (impacting US territorial waters) and Spill 2 (impacting Mexican territorial waters) and are discussed below.

3.5.1 Spill 1

Mass balance estimates for Spill 1are presented in Table 3.2 for untreated oil, and for oil treated with dispersant at 80% effectiveness. Figure 3.1 presents a graphical representation of the fate of the untreated oil over time, and Table 3.3 shows the volume of oil present on four shoreline segments for the same two conditions. Mr. Henry noted that this oil can emulsify (absorb water) creating a floating “mousse” product that may be up to five times the volume of the oil. However, this oil does not emulsify rapidly and dispersant operations could occur for up to two days if conditions allowed.

Table 3.2 Oil Budget (in Gallons) for Spill 1 for Undispersed and Dispersed Oil (80% Effectiveness) as Predicted in the Mexico – United States Gulf of Mexico Coastal Border Region Scenario, Spill Volume 60,000 Gallons.

60,000 Gallons No Chemical Dispersion (Natural)

Hours	Released	Floating	Evaporated	Dispersed	Beached	Off Map
0	0	0	0	0	0	0
6	25002	16134	8706	162	0	0
12	55002	41778	12648	576	0	0
18	60000	45582	13776	642	0	0
24	60000	44670	14688	642	0	0
36	60000	43446	15912	642	0	0
48	60000	39570	16488	642	3300	0
72	60000	738	17010	642	41610	0
96	60000	156	17118	642	42084	0
120	60000	198	17286	642	41874	0
144	60000	102	17412	642	41844	0
168	60000	90	17526	642	41742	0
192	60000	30	17526	642	41802	0
216	60000	24	17550	642	41784	0
240	60000	12	17556	264	41790	378

60,000 Gallons 80% Chemical Dispersion

Hours	Released	Floating	Evaporated	Dispersed	Beached	Off Map
0	0	0	0	0	0	0
6	25002	16134	8706	162	0	0
12	55002	41778	12648	576	0	0
18	60000	45582	13776	642	0	0
24	60000	44670	14688	642	0	0
36	60000	8850	15192	35958	0	0
48	60000	8124	15270	35958	648	0
72	60000	132	15402	35958	8508	0
96	60000	42	15426	35958	8574	0
120	60000	36	15468	35958	8538	0
144	60000	18	15492	35958	8532	0
168	60000	36	15510	35958	8496	0
192	60000	6	15510	33606	8526	2352
216	60000	0	15516	2706	8526	33252
240	60000	0	15516	2004	8526	33954

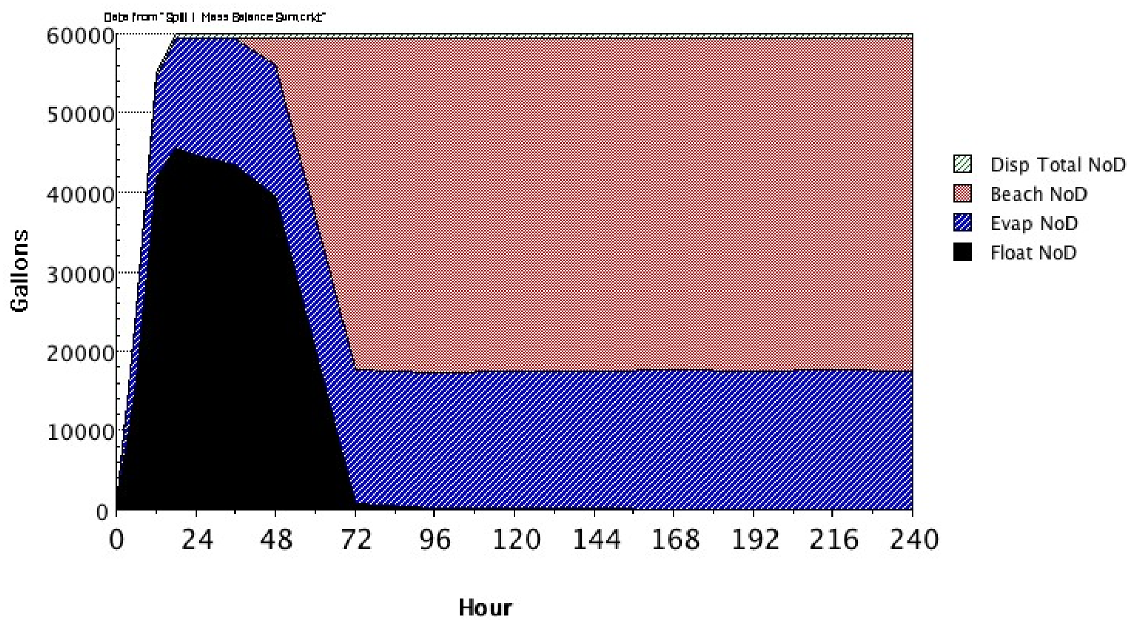


Figure 3.1 *The ADIOS predictions for the fate of the floating oil in Spill 1 of the Mexico – US Gulf of Mexico Coastal Border Region scenario without the use of dispersants.*

Table 3.3 The Estimated Gallons of Oil on Four Shoreline Areas for Spill 1 in the Mexico – United States Gulf of Mexico Coastal Border Region Scenario With and Without the Use of Dispersants.

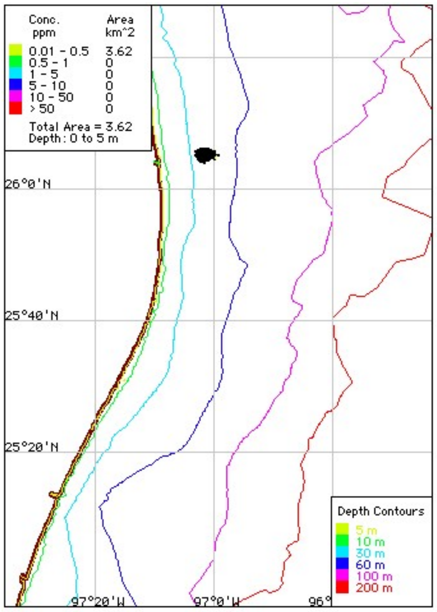
General Segment Description	Natural Recovery		Dispersant (80%)	
	Gallons	Shoreline Length In Miles	Gallons	Shoreline Length In Miles
North of Entrance (So. Padre Is, US)	15,234	2.752	3,078	2.752
Entrance to Laguna Madre (So. Padre Is, US)	5,238	N/A	1,032	N/A
South of Entrance to Rio Grande (US and Mexico)	17,700	5.732	3,702	5.732
South of Rio Grande (Mexico)	3,720	16.432	696	16.432
Totals	41,892	24.916	8,508	24.916

Selected snapshots from the surface oil trajectory modeling results for Spill 1 are shown in Figure 3.2. The average and maximum concentrations from 0 to 5 meters in the dispersed oil plume produced without the use of dispersants are shown in Figure 3.3 and are compared to toxicity threshold values sensitive life history stages in Figure 3.4 (see Table 4.1 and the associated discussion in Section 4.1 for information on development and interpretation of thresholds).

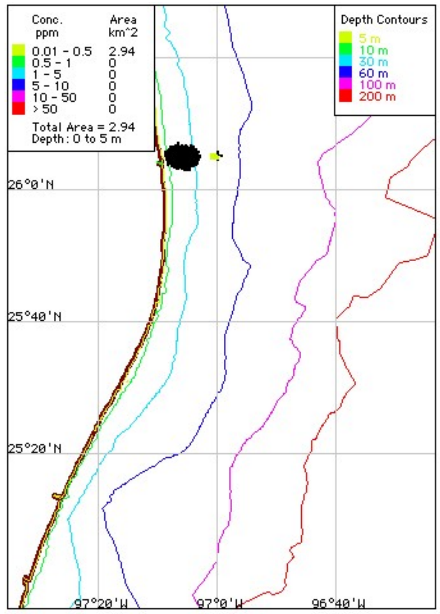
Under the modeled wind conditions, the floating oil from Spill 1 moves directly to the west and impacts the outer coast between 36 and 48 hours after the release in the vicinity of the Brazos Santiago Pass into the Laguna Madre. While the modeling results are imprecise, approximately 25% of the 41,892 gallons listed as "beached" in Table 3.2 was in the vicinity of the inlet and could reasonably be expected to enter the Laguna Madre. The remaining 75% was distributed along the outer shore both north and south of the inlet.

A very small amount of oil naturally disperses, and moves southward with the modeled long shore current. Maximum concentrations in the surface 0 to 5 meters of the water column with no response (Figure 3.3) do not exceed any thresholds of concern, even for sensitive life history stages.

Snapshots from the dispersed oil modeling results (80% effectiveness) are shown in Figure 3.5. Figure 3.6 shows the ADIOS predictions for the fate of the oil when dispersant is applied. Applying dispersant at approximately 24 hours dramatically reduces, but does not eliminate, oil reaching the shoreline. With respect to the water column, when comparing Figure 3.2 to Figure 3.5, the differences in the extent and concentration of the dispersed oil plume are not easily seen, largely because of the scale and the fact that the area affected by the dispersed plume is small in comparison to the area modeled. Differences are more obvious in the QuickTime trajectory movies on the workshop CD, and by comparing Figure 3.3 to Figure 3.7, which shows the average and maximum water column concentrations. When dispersants are used, predicted maximum concentrations are approximately 10 times higher, but still do not exceed 2 ppm. No toxicity thresholds of concern for adult fish (Figure 3.8) are predicted to be exceeded, for adult crustaceans the threshold for a low level of concern may be exceeded in areas of maximum concentrations (Figure 3.9), and for sensitive life history stages the low level of concern threshold is predicted to be exceeded for a longer period of time, but only in areas of continuous high concentration (Figure 3.10).



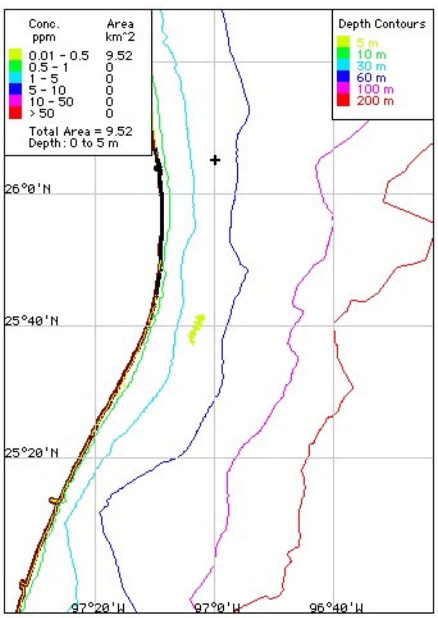
A: 0 Hours



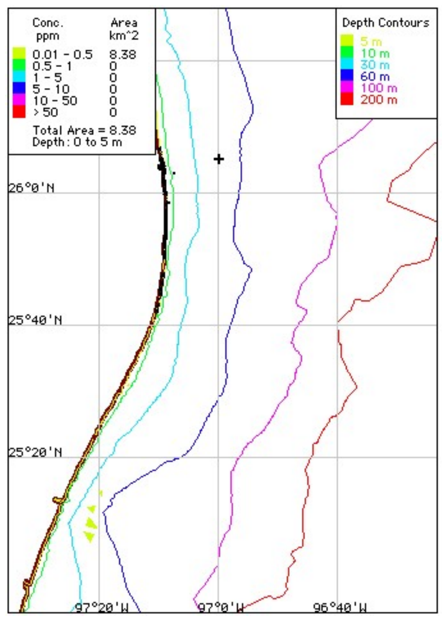
B: 12 Hours

Key to Dissolved Oil Concentration:

Light Green	<0.5 ppm
Med. Green	0.5 – 1 ppm
Light blue	1 – 5 ppm
Dark blue	5 – 10 ppm
Pink	10 – 50 ppm
Red	>50 ppm



C: 48 Hours



D: 72 Hours

Figure 3.2 *Results from the NOAA GNOME modeling for Spill 1 in the Mexico – United States Gulf of Mexico Coastal Border Region Scenario without the use of dispersants showing surface oil and average dispersed oil concentrations from 0 to 5 meters.*

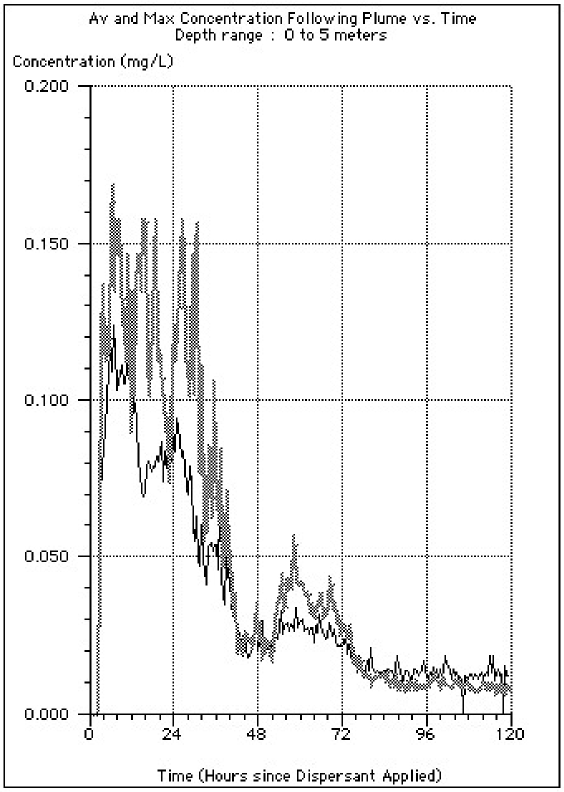
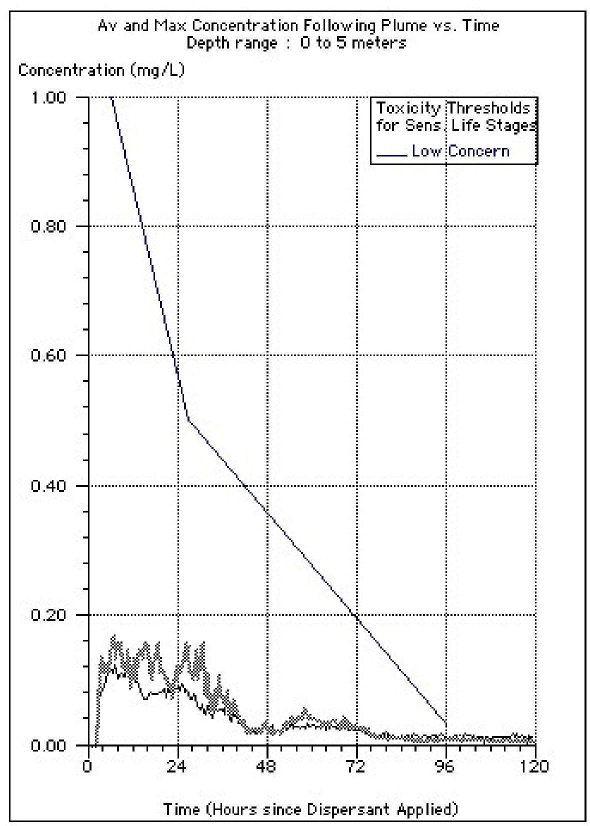
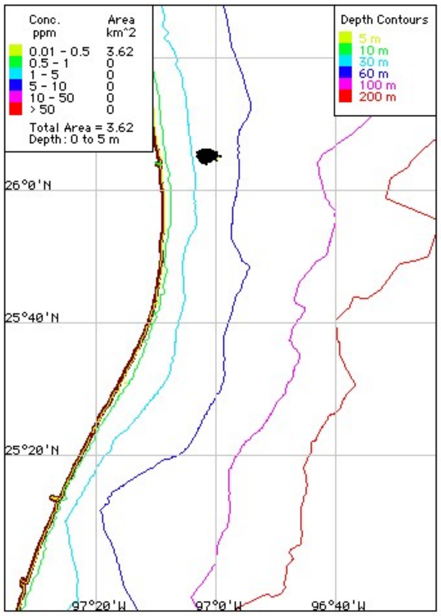


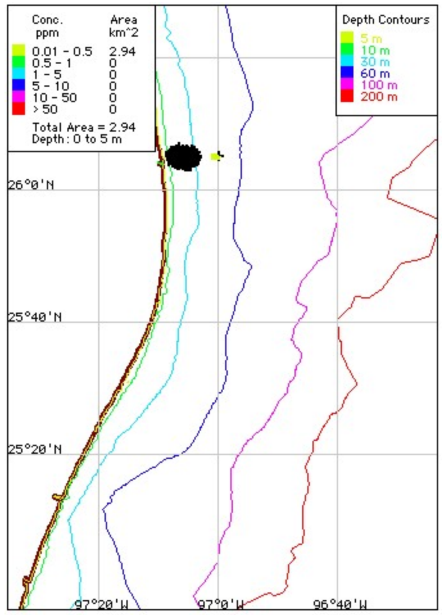
Figure 3.3 *Maximum and average oil concentration from 0 to 5 meters in the plume versus time without the use of dispersant for Spill 1.*

Figure 3.4 *Conservative toxicity thresholds for dispersed oil for sensitive life history stages compared to maximum and average dispersed oil concentrations at 0 to 5 meters without the use of dispersants for Spill 1 (based on the values presented in Table 4.1).*





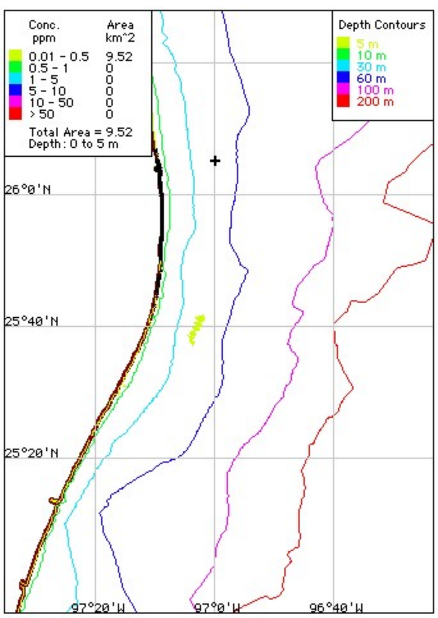
A: 0 Hours



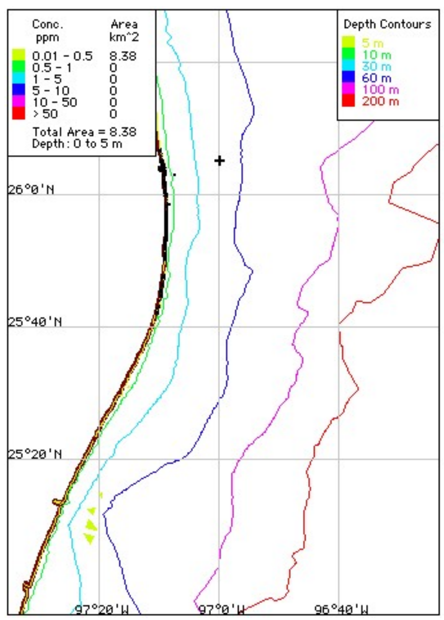
B: 12 Hours

Key to Dissolved Oil Concentration:

Light Green	<0.5 ppm
Med. Green	0.5 – 1 ppm
Light blue	1 – 5 ppm
Dark blue	5 – 10 ppm
Pink	10 – 50 ppm
Red	>50 ppm



C: 48 Hours



D: 72 Hours

Figure 3.5 *Results from the NOAA GNOME modeling for the Mexico – United States Gulf of Mexico Coastal Border Region Scenario for Spill 1 with the use of dispersants at 80% effectiveness showing average dispersed oil concentrations (in ppm) from 0 to 5 meters and remaining surface oil.*

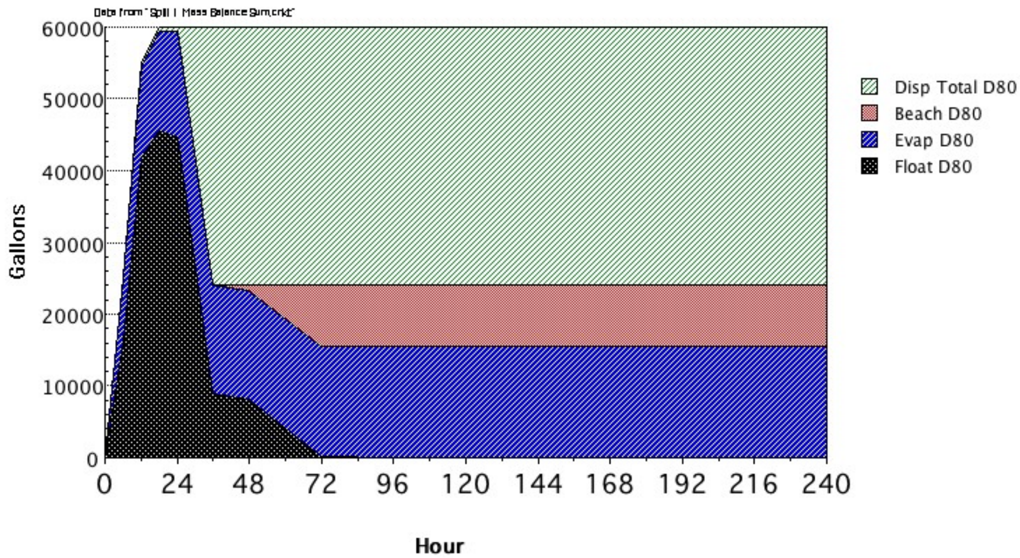


Figure 3.6 *The ADIOS predictions for the fate of the floating oil in Spill 1 of the Mexico – US Gulf of Mexico Coastal Border Region scenario with the use of dispersants at 80% effectiveness.*

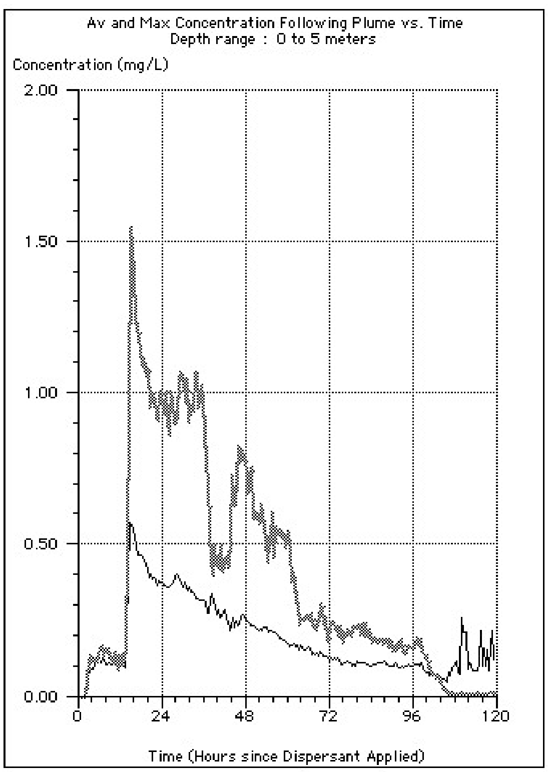


Figure 3.7 *Maximum and average oil concentration from 0 to 5 meters in the plume versus time with the use of dispersants at 80% effectiveness for Spill 1.*

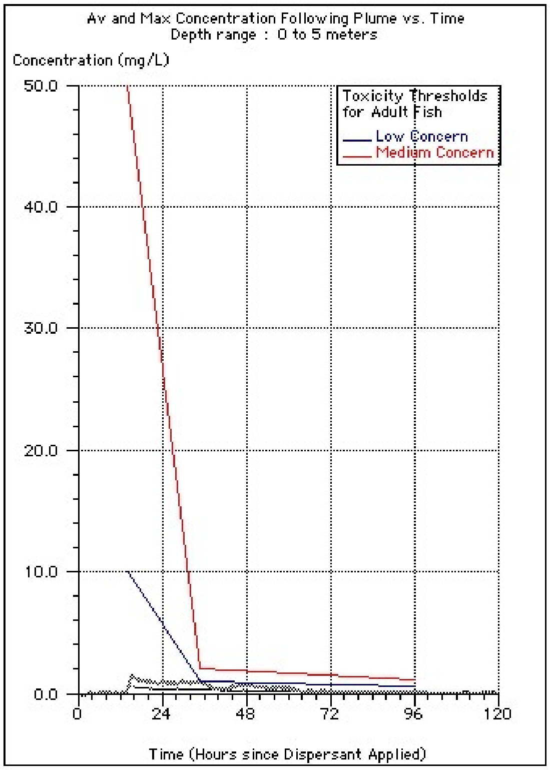


Figure 3.8 *Toxicity thresholds for dispersed oil for adult fish compared to maximum and average dispersed oil concentrations at 0 to 5 meters with the use of dispersants at 80% effectiveness for Spill 1 (based on the values presented in Table 4.1).*

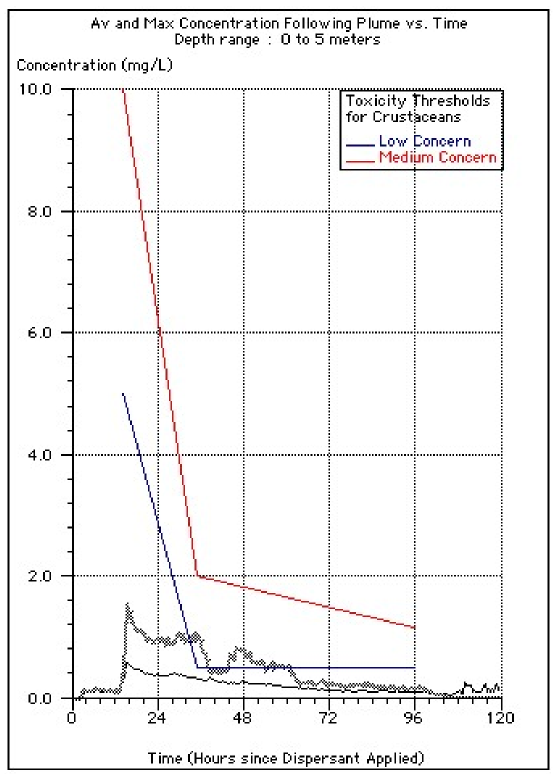


Figure 3.9 *Toxicity thresholds for dispersed oil for adult crustaceans compared to maximum and average dispersed oil concentrations at 0 to 5 meters with the use of dispersants at 80% effectiveness for Spill 1 (based on the values presented in Table 4.1).*

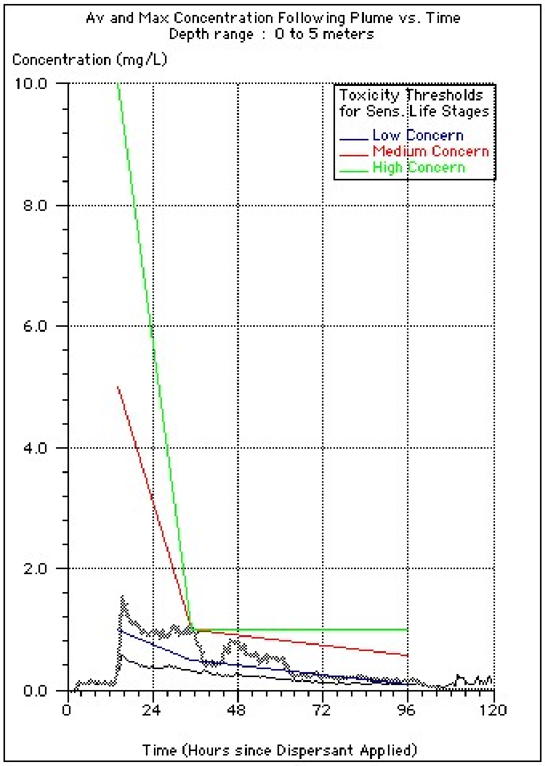


Figure 3.10 *Toxicity thresholds for dispersed oil for sensitive life history stages compared to maximum and average dispersed oil concentrations at 0 to 5 meters with the use of dispersants at 80% effectiveness for Spill 1 (based on the values presented in Table 4.1).*

3.5.2 Spill 2

Mass balance estimates for Spill 2 are presented in Table 3.4 for untreated oil, and for oil treated with dispersant at 80% effectiveness. In comparison to Spill 1, the predicted shoreline contact takes longer (60 to 72 hours versus 48 hours) and although the volume impacting the shoreline is very similar in both spills (around 42,000 gallons) in Spill 2 this represents a smaller percentage of the total spill. Figure 3.11 shows selected snapshots from the surface oil trajectory modeling for Spill 2.[3] In this case, the predicted oil plume moves to the southwest, and a small amount of dispersed oil can be seen following the same general trajectory, but not as rapidly. Once again, the area affected by the plume is relatively small compared to the area modeled. Figure 3.12 shows the predicted average and maximum concentration of naturally dispersed oil without dispersants for Spill 2, and these values are compared to thresholds of concern for sensitive life history stages in Figure 3.13. The concentrations predicted for Spill 2 are somewhat lower than for Spill 1, and even the low threshold of concern for sensitive life history stages is not predicted to be exceeded.

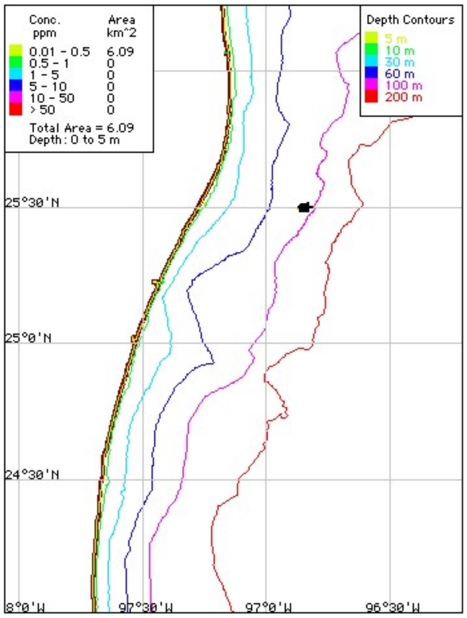
Finally, Figure 3.14 shows the results of the GNOME modeling for Spill 2, with the use of dispersants. In the case of Spill 2, the differences with and without the use of

[3] As discussed in Mr. Henry's presentation on the scenario (see "Oil Spill Scenario" on the workshop CD), the mapping data available to the GNOME modeling group for the Mexican coastline was less detailed and not as recent as that available for the US. Consequently, estimates of oiling by shoreline segment, and an estimate of the amount of oil entering estuarine areas could not be made.

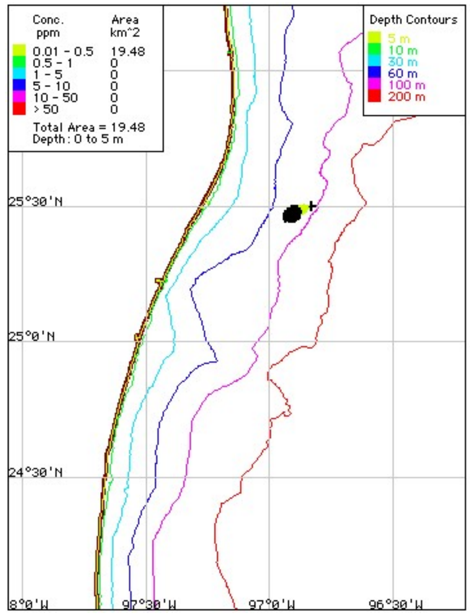
dispersants are more obvious, and the dispersed oil plume moving to the south parallel to the shoreline is obvious. Even so, concentrations remain below 1 ppm, even early in the dispersant event. Figure 3.15 shows the average and maximum predicted concentrations of dispersed oil when Spill 2 is treated, which leads to an approximate doubling in maximum concentration. As seen if Figure 3.16, thresholds of concern are not exceeded, even for sensitive life history stages.

Table 3.4 Oil Budget (in Gallons) for Spill 2 for Undispersed and Dispersed Oil (80% Effectiveness) as Predicted in the Mexico – United States Gulf of Mexico Coastal Border Region Scenario, Spill Volume 80,000 Gallons.

80,000 Gallons No Chemical Dispersion (Natural)						
Hours	**Released**	**Floating**	**Evaporated**	**Dispersed**	**Beached**	**Off Map**
0	0	0	0	0	0	0
3	80000	61544	17704	752	0	0
6	80000	54208	23504	2288	0	0
9	80000	49736	26304	3960	0	0
12	80000	47704	28336	3960	0	0
18	80000	46016	30024	3960	0	0
24	80000	44416	30856	4728	0	0
30	80000	44136	30992	4872	0	0
36	80000	43536	31592	4872	0	0
42	80000	43384	31744	4872	0	0
48	80000	42680	32448	4872	0	0
54	80000	42552	32576	4872	0	0
60	80000	41800	33304	4872	24	0
66	80000	40608	33440	4872	1080	0
72	80000	33928	33440	4872	7760	0
78	80000	23048	33440	4872	18640	0
84	80000	11160	33656	4872	30312	0
90	80000	5328	33704	4872	36096	0
96	80000	1384	33704	4872	40040	0
102	80000	232	33712	4872	41184	0
108	80000	64	33720	4872	41344	0
114	80000	176	33720	4872	41232	0
120	80000	96	33728	4872	41304	0
126	80000	24	33728	4872	41376	0
132	80000	16	33728	4872	41384	0
138	80000	80	33728	4872	41320	0
144	80000	64	33728	4872	41336	0
150	80000	32	33728	4872	41368	0
156	80000	32	33728	4872	41368	0
162	80000	56	33728	4872	41344	0
168	80000	32	33728	4872	41368	0
80,000 Gallons 80% Chemical Dispersion						
Hours	**Released**	**Floating**	**Evaporated**	**Dispersed**	**Beached**	**Off Map**
0	0	0	0	0	0	0
3	80000	61544	17704	752	0	0
6	80000	54208	23504	2288	0	0
9	80000	49736	26304	3960	0	0
12	80000	47704	28336	3960	0	0
18	80000	46016	30024	3960	0	0
24	80000	44416	30856	4728	0	0
30	80000	44136	30992	4872	0	0
36	80000	43536	31592	4872	0	0
42	80000	43384	31744	4872	0	0
48	80000	8856	31976	39168	0	0
54	80000	8808	32024	39168	0	0
60	80000	8656	32160	39168	16	0
66	80000	8336	32176	39168	320	0
72	80000	7032	32176	39168	1624	0
78	80000	4840	32176	39168	3816	0
84	80000	2312	32208	39168	6312	0
90	80000	1280	32224	39168	7328	0
96	80000	336	32224	39168	8272	0
102	80000	48	32224	39168	8560	0
108	80000	32	32224	39168	8576	0
114	80000	40	32224	39168	8568	0
120	80000	24	32224	39168	8584	0
126	80000	0	32224	39168	8608	0
132	80000	0	32224	39168	8608	0
138	80000	24	32224	39168	8584	0
144	80000	16	32224	39168	8592	0
150	80000	16	32224	39168	8592	0
156	80000	16	32224	39168	8592	0
162	80000	16	32224	39168	8592	0
168	80000	0	32224	39168	8608	0



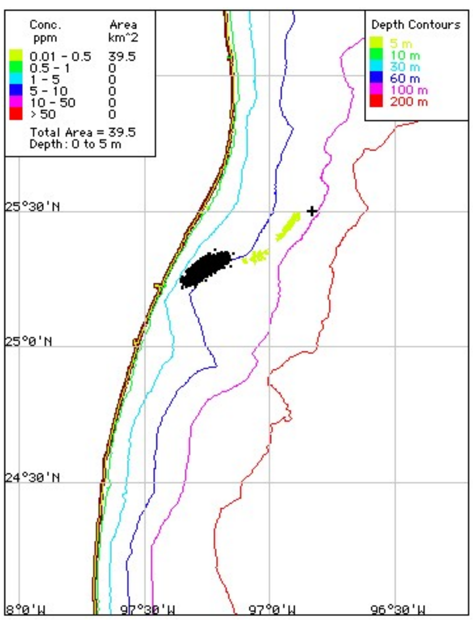
A: 0 Hours



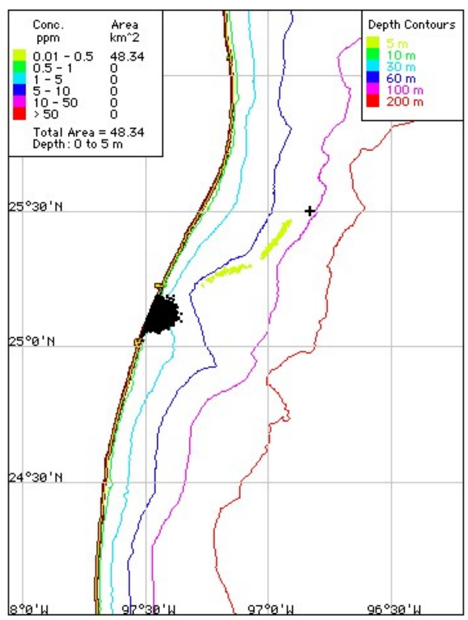
B: 12 Hours

Key to Dissolved Oil Concentration:

Light Green	<0.5 ppm
Med. Green	0.5 – 1 ppm
Light blue	1 – 5 ppm
Dark blue	5 – 10 ppm
Pink	10 – 50 ppm
Red	>50 ppm



C: 48 Hours



D: 72 Hours

Figure 3.11 *Results from the NOAA GNOME modeling for Spill 2 in the Mexico – United States Gulf of Mexico Coastal Border Region Scenario without the use of dispersants showing surface oil and average dispersed oil concentrations from 0 to 5 meters.*

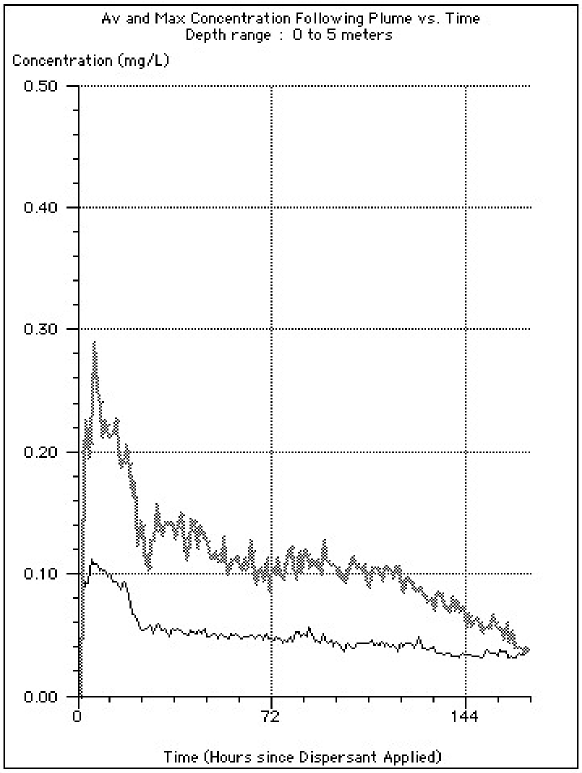


Figure 3.12 *Maximum and average oil concentration from 0 to 5 meters in the plume versus time without the use of dispersant for Spill 2.*

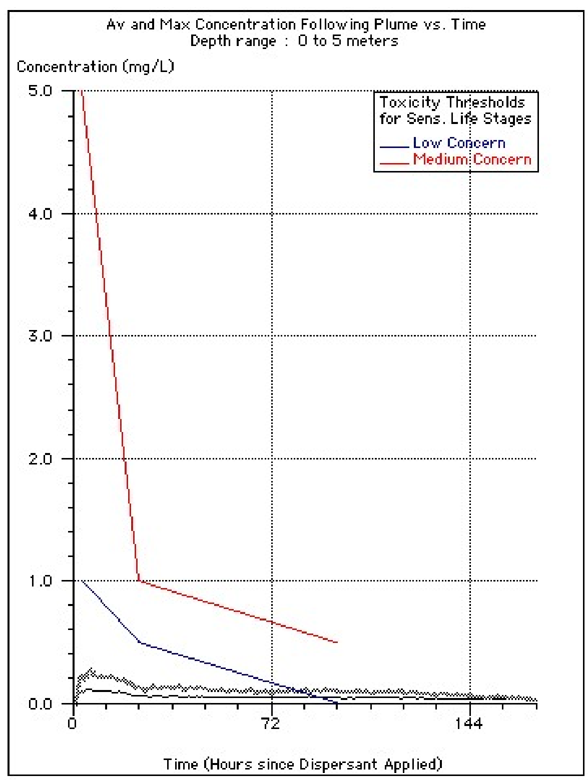
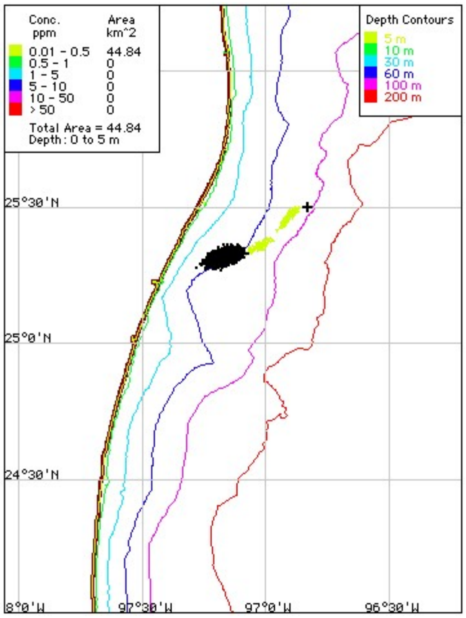
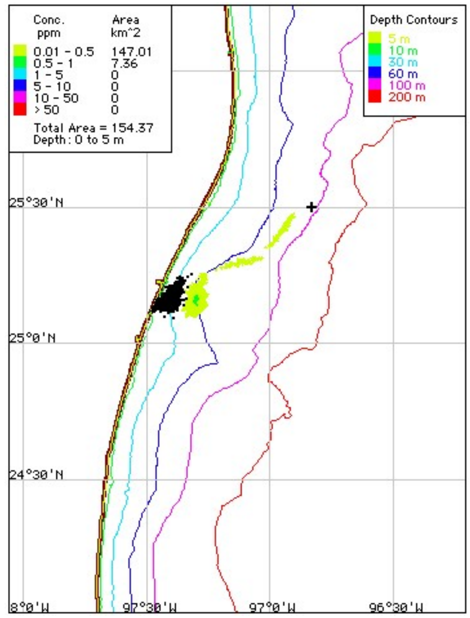


Figure 3.13 *Conservative toxicity thresholds for dispersed oil for sensitive life history stages compared to maximum and average dispersed oil concentrations at 0 to 5 meters without the use of dispersants for Spill 2 (based on the values presented in Table 4.1).*



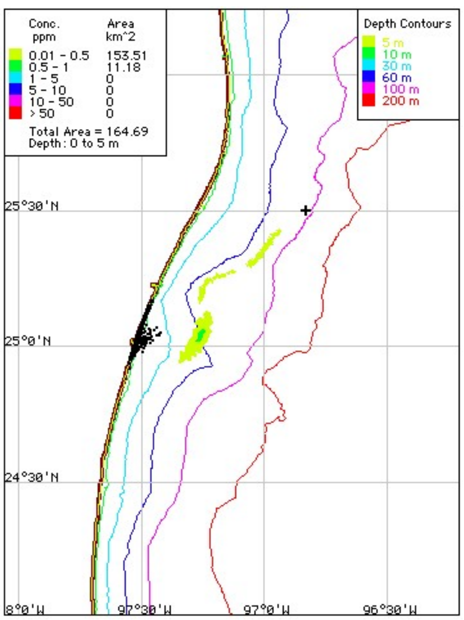
A: Approximately 48 Hours



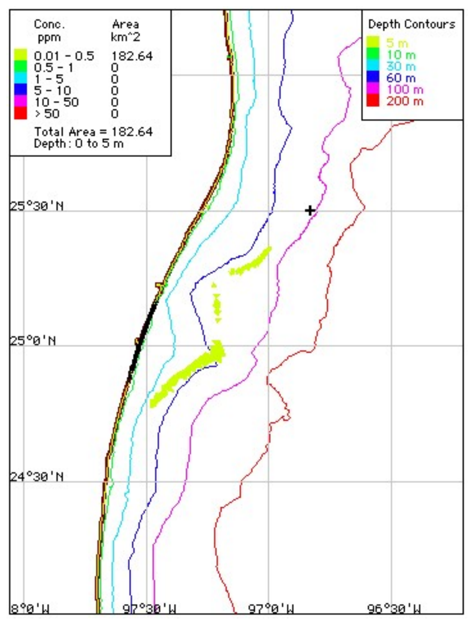
B: 72 Hours

Key to Dissolved Oil Concentration:

Light Green	<0.5 ppm
Med. Green	0.5 – 1 ppm
Light blue	1 – 5 ppm
Dark blue	5 – 10 ppm
Pink	10 – 50 ppm
Red	>50 ppm



C: 96 Hours



D: 120 Hours

Figure 3.14 *Results from the NOAA GNOME modeling for Spill 2 in the Mexico – United States Gulf of Mexico Coastal Border Region Scenario with the use of dispersants at 80% effectiveness average dispersed oil concentrations from 0 to 5 meters and remaining surface oil.*

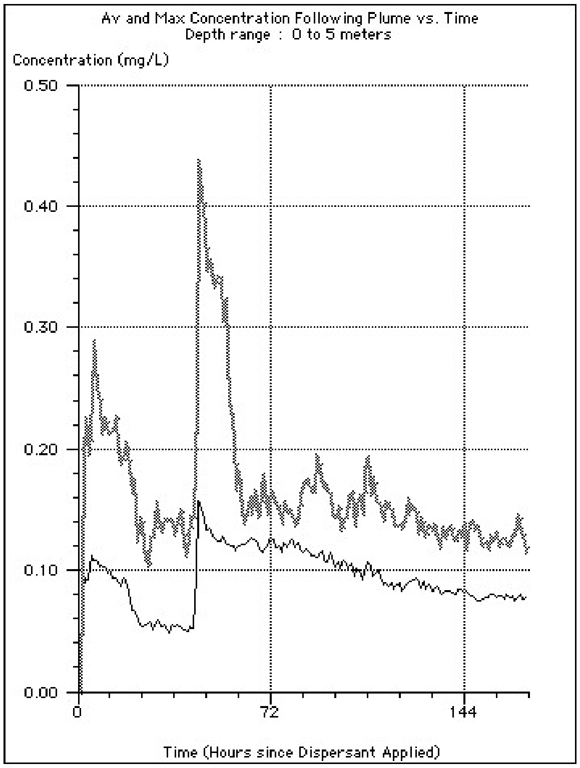


__Figure 3.15__ Maximum and average oil concentration from 0 to 5 meters in the plume versus time with the use of dispersants at 80% effectiveness for Spill 2.

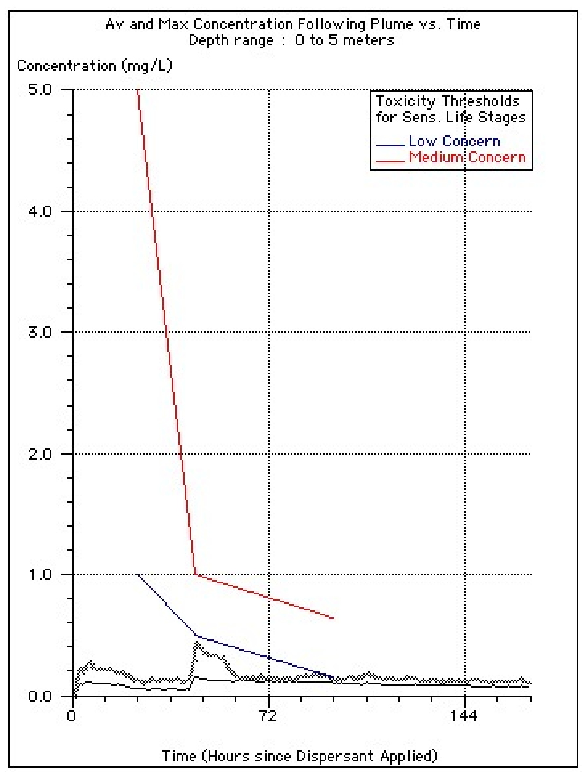


__Figure 3.16__ Toxicity thresholds for dispersed oil for sensitive life history stages compared to maximum and average dispersed oil concentrations at 0 to 5 meters with the use of dispersants at 80% effectiveness for Spill 2 (based on the values presented in Table 4.1).

4.0 The Results of the Risk Analysis Process

Focus groups developed and then 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 initial evaluation, the groups used alphanumeric codes to rate the level of concern. After the scaling was developed in plenary session, color coding was used to indicate summary levels of concern.

		RECOVERY			
		> 10 years (SLOW) (1)	**4 to 10 years (2)**	**1 to 3 years (3)**	**< 1 year (RAPID) (4)**
% of RESOURCE AFFECTED	**> 50% (LARGE) (A)**	**1A**	**2A**	**3A**	**4A**
	26 to 50% (B)	**1B**	**2B**	**3B**	**4B**
	10 to 25% (C)	**1C**	**2C**	**3C**	**4C**
	<10% (SMALL) (D)	**1D**	**2D**	**3D**	**4D**

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 Gulf of Mexico Coastal Border Region assessment.*

4.1 Thresholds

Using the 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 (NRC, 2005). The values in Table 4.1 are the basis for the level of concern thresholds shown in the Figures in Section 3. Those graphical representations were created by plotting the 3, 24, and 96-hour values in the table and then connecting the points. The 'protective,' not 'more protective,' thresholds were used in the graphs.

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

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 oil contacted the habitat. 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.

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

4.2 Summary Results

It is important to keep in mind that the participants used the information available to them to develop levels of concern 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. Also, in this workshop the two spills were designed to impact different areas and were analyzed separately, each by two focus groups. Spill 1, which impacted the south Texas shoreline, was analyzed by Focus Groups 3 and 4 (US participants) and Spill 2, which impacted the coast of northern Mexico, was analyzed by Focus Groups 1 and 2 (primarily Mexican participants). A summary of the groups' conclusions is presented below.

The detailed results for all focus groups for natural recovery (i.e. no response) and on-water mechanical recovery are shown in Figure 4.2. The figure shows the results for coastal bays (Part A) and the outer coast (Part B). These two response options are shown together because, in plenary session, all of the participants agreed that the use of on-water mechanical recovery equipment, in this scenario, was unlikely to have a major effect on the risk scores. This was not a conclusion that such activities should not be undertaken, but given the anticipated recovery amounts, their impact was likely to be minimal.

In general, the levels of concern expressed for Spill 2 are lower than those for Spill 1. For both spills, however, the highest levels tended to be for habitats in the Laguna Madre. While it was clear that oil would be entering the US portion of the Laguna Madre, there was less certainty that similar amounts of oil would impact estuaries in Mexico, and some of the habitats viewed as of the most concern (riprap and oyster reefs) were not present in the areas in Mexico affected by the spill. Riprap areas around inlets were a concern because they are an important habitat and food source for seabirds and sea turtles. The potential effects of Spill 1 in the Laguna Madre were ranked as a high or moderate level of concern by both focus groups for almost all of the habitats evaluated.

There was generally less concern for offshore shoreline and water column habitats, partly because of the season (fall). Riprap remained a high to moderate concern. Since it was fall, sea turtle habitat on the beaches was much less of a concern than it would have been in other times of the year, but the risk was still judged to be moderate by three of the four groups because of potential risk to other beach fauna. Water column and benthic impacts were generally low to moderate. The perceived risk to sea turtles on the sea surface was a difficult discussion in all of the focus groups, and the range of scores for the water surface reflects this uncertainty.

Figure 4.3 shows the results, by focus group, for the use of dispersants at 80% effectiveness. In this case, the levels of concern for Spill 1 in the coastal bays is reduced for most habitats, but enough oil was still entering the Laguna Madre that concern remained high for black mangrove forest and oyster reefs, two habitats in short supply in the area considered to be of high ecological value. Both focus groups analyzing Spill 1 had reduced, but still moderate, levels of concern for salt flats and riprap. When dispersant use was analyzed for Spill 2, the conclusion was that levels of concern were uniformly low. This was based on the greatly reduced level of oil expected to impact the coast and the estuarine habitats of concern. None of the focus groups ranked levels of concern for offshore benthic habitats or water column habitats as more than low when dispersant was used.

On-shore mechanical recovery (including protective booming) (Figure 4.4) for Spill 1 was judged both focus groups as mitigating the worst of the impacts to habitats within the Laguna Madre. Protective and deflection booming is an integral part of the planned response strategy in this area and participants felt it would be effective in protecting the limited areas of highest value habitat. The combination of clean-up and protection was rated as particularly valuable for vegetated marshes and to a lesser degree for black mangrove forests and salt flats. Protective booming was the preferred option for riprap areas in inlets and, if effective, would greatly reduce impacts. Removal of oil in such areas was viewed as generally problematic. For Spill 2, potential impacts in both coastal bays and the outer coast were viewed as having a low level of concern. While not as detailed as plans in the US, similar techniques would be used in Mexico, and given the generally lower level of concern with natural recovery, participants felt they would be sufficient to largely mitigate the effects of the spill.

Habitats	Terrestrial					Intertidal Shoreline				
Subhabitats						Sand Beaches				
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Arthropods	Birds	Mammals	Arthropods	Molluscs	Infauna
Group 1	L	R	L	L	L	R	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4B	3B	4D
	4D					4C				
Group 2	L	R	L	L	L	R	L	L	L	L
	4C	4C	4D	4D	4D	4D	4D	4C	4D	4C
	4D					4D				
Group 3	L	L	L	L	L	L	L	L	L	L
	4D	4D	3D	4D	4D	3B	3D	4A	4A	4A
	4D					3C				
Group 4	L	R	A	L	L	R	A	L	L	L
	4D	4D	4D	4D	4D	3C	4D	2B	3A	3C
	4D					3B				

Habitats	Intertidal Shoreline								
Subhabitats	Vegetated Marshes								
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Mollusks	Epifauna	Infauna
Group 1	L	R	L	L	L	L	L	L	L
	2B	3C	4D	4D	3B	2B	2D	2D	2D
	2C								
Group 2	L	R	L	L	L	L	L	L	L
	4D	4C	4D	4D	4C	4D	4D	4D	4C
	4D								
Group 3	L	A	L	L	L	L	L	L	L
	4A	3C	3D	4A	4A	4A	4A	4A	4A
	3C								
Group 4	L	A	A	L	A	L	L	L	L
	1A	2B	4D	4D	2B	3A	2A	2A	2A
	2B								

Habitats	Intertidal Shoreline								
Subhabitats	Black Mangrove Forest								
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Mollusks	Epifauna	Infauna
Group 1									
	2C	3C	4D	4C	4C	4B	3C	4C	4C
	3D								
Group 2	L	R	L	L	L	L	L	L	L
	4C	4C	4D	4D	4C	4C	4D	4D	4C
	4D								
Group 3	L	L	L	L	L	L	L	L	L
	2A	3C	3D	4A	4B	4A	4A	4A	4A
	2A								
Group 4	L	A	A	L	A	L	L	L	L
	1A	2B	4D	4D	2B	3A	2A	2A	2A
	2A								

Habitats	Intertidal Shoreline						
Subhabitats	Salt Flats						
Response Option	Vegetation	Birds	Mammals	Fish	Arthropods	Molluscs	Infauna
Group 1							
	4D	4D	4D	4D	4D	4D	4D
	4D						
Group 2	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D
	4D						
Group 3	L	L	L	L	L	L	L
	2A	3B	4D	4C	3A	3A	3A
	2A						
Group 4	L	A	A	A	L	L	L
	3A	2B	4D	3C	4A	2A	4A
	3B						

Habitats	Intertidal Shoreline (cont.)								Benthic (subtidal)						
Subhabitats	Riprap/man-made								Soft Bottom						
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Molluscs	Epifauna	Vegetation	Birds	Reptiles/amphibians	Fish	Arthropods	Molluscs	Infauna
Group 1									L	L	L	L	L	L	L
									4C	4C	4C	4C	4C	4C	4C
	N/A								4C						
Group 2	L	R	L	L	L	L	L	L	L	R	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D								4D						
Group 3	L	L	L	L	L	L	L	L	L	A	L	L	L	L	L
	4A	2B	4D	1B	3A	4A	4A	4A	4D	3C	4D	4C	4C	4C	4C
	2B								4C						
Group 4	L	L	L	A	L	L	L	L	L	R	A	A	L	L	L
	3A	3B	4D	4D	3A	3A	2A	3A	4D	4B	4D	4D	3B	3C	4C
	3B								3C						

Habitats	Special Habitats											
Subhabitats	Oyster Reefs					Sea Grass Beds						
Response Option	Birds	Fish	Arthropods	Molluscs	Epifauna	Vegetation	Birds	Fish	Arthropods	Molluscs	Epifauna	Infauna
Group 1						L	L	L	L	L	L	L
						3B	3C	3C	3C	3C	3C	3C
	N/A					3C						
Group 2	R	L	L	L	L	L	R	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D					4D						
Group 3	L	L	L	L	L	L	L	L	L	L	L	L
	3B	3C	4A	3B	4A	2C	3B	3A	4D	3B	4D	4D
	3B					2C						
Group 4	A	L	L	L	L	L	A	A	L	L	L	L
	4D	3A	3A	1A	4A	2A	2B	3B	2A	2A	2A	2A
	2B					2A						

Habitats	Water Column									
Subhabitats	Surface				Remaining					
Response Option	Plankton	Mammals	Birds	Fish	Plankton	Mammals	Birds	Fish	Arthropods	Coelenterates
Group 1	L	L	R	L	L	L	R	L	L	L
	4A	4D	4C	4D	4C	4C	4C	4C	4C	4C
	4C				4C					
Group 2	L	L	R	L	L	L	R	L	L	L
	4B	4D	4D	4D	4D	4D	4D	4D	4B	4D
	4D				4D					
Group 3	L	L	L	L	L	L	L	L	L	L
	4A	3D	3C	4D	4D	3D	3D	4D	4D	4D
	3C				4D					
Group 4	L	A	R	A	L	A	R	A	L	
	4A	3D	3B	3B	4B	4D	4D	3C	3C	4A
	3C				4C					

A. Coastal Bays

Habitats	Terrestrial					Intertidal													
Subhabitats						Sand Beaches						Riprap/man-made							
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Arthropods	Birds	Mammals	Reptiles/amphibians	Arthropods	Molluscs	Infauna	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Molluscs	Epifauna
Group 1	L	A	L	L	L	A	L	R	L	L	L	L	A	A	L	L	L	L	L
	4D	3C	4D	4D	4D	3C	4D	1D	4B	3B	4B	3B	3D	4D	4D	4D	4D	4C	4C
	4D					3B						3D							
Group 2	L	R	L	L	L	R	L	L	L	L	L	L	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	4A	4D	3D	4B	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D					4C						4D							
Group 3	L	L	L	L	L	A	A	A	L	L	L	L	L	L	A	L	L	L	L
	4D	4D	4D	4D	4D	3C	4D	4D	4A	4A	4A	4A	2B	4D	1B	3A	4A	4A	4A
	4D					3C						2B							
Group 4	L	R	A	L	L	R	A	L	L	L	L	L	A	L	A	L	L	L	L
	4D	4D	4D	4D	4D	3D	4D	4D	3B	4A	4A	3A	4D	4D	3D	3B	3B	3B	3B
	4D					3B						3B							

Habitats	Benthic (Subtidal)											
Subhabitats	Shallow (<5 meters)							Deep (>5 meters)				
Response Option	Vegetation	Birds	Reptiles/amphibians	Fish	Arthropods	Molluscs	Infauna	Reptiles/amphibians	Fish	Arthropods	Molluscs	Infauna
Group 1	L	A	A	A	L	L	L	A	A	L	L	L
	4D	3B	2B	4C	4D	4D	4D	4D	4D	3D	3D	4D
	3B							4D				
Group 2	L	L	L	L	L	L	L	R	A	L	L	L
	4C	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D				
Group 3	L	L	L	L	L	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D				
Group 4	L	L	A	L	L	L	L	A	A	A	L	L
	4D	4D	4D	4C	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D				

Habitats	Water Column												
Subhabitats	Water Surface					Upper 5 meters							
Response Option	Plankton	Mammals	Birds	Reptiles/amphibians	Fish	Plankton	Mammals	Birds	Reptiles/amphibians	Fish	Arthropods	Molluscs	Coelenterates
Group 1	A	A	A	A	A	L	A	A	A	A	A	L	L
	4A	3A	2A	2A	4D	4A	3D	4D	2A	4D	4C	4D	4C
	3A					3C							
Group 2	R		R	L	A	A		A	A	A	R	L	L
	4D		4C	4D	4C	4D		4C	4C	4D	4B	4D	4D
	4C					4D							
Group 3	L	A	A	A	A	L	L	L	L	L	L	L	L
	4A	4D	2C	3C	4D	4D	4D	4D	4D	4D	4D	4D	4D
	2C					4D							
Group 4	L	A	A	A	A	L		A	A	A	L	L	L
	4A	3D	3C	2C	3D	4A		3C	4D	4C	4B	4C	4A
	3C					4C							

Habitats	Water Column													
Subhabitats	Middle Water Column							Bottom 5 meters						
Response Option	Plankton	Mammals	Reptiles/amphibians	Fish	Arthropods	Molluscs	Coelenterates	Plankton	Mammals	Reptiles/amphibians	Fish	Arthropods	Molluscs	Coelenterates
Group 1	L	A	A	L	A	L	L	L	A	A	A	A	L	L
	4D	3D	2B	4B	4C	4D	4C	4D	4D	2C	4C	4C	3D	4D
	3C							3D						
Group 2	A		A	A	A	A	A	L		L	L	L	L	L
	4D		4D	4D	4C	4D	4D	4D		4D	4D	4C	4D	4D
	4D							4D						
Group 3	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D						
Group 4	L		A	A	L	L	L	L		A	A	L	L	L
	4B		4D	4D	4D	4D	4D	4B		3C	4D	4D	4D	4D
	4D							4D						

B. Outer Coast

Reference Area codes: L = local, A = lower Texas and upper Mexico and adjacent waters, and R = Gulf-wide or greater (see Section 2 for definitions).

Figure 4.2 *Detailed focus group risk analysis results for Spill 1(Groups 3 and 4) and Spill 2 (Groups 1 and 2) for natural recovery and on-water mechanical recovery.*

Habitats						Intertidal Shoreline																													
Subhabitats	Terrestrial					Sand Beaches					Vegetated Marshes									Black Mangrove Forest									Salt Flats						
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Arthropods	Birds	Mammals	Arthropods	Molluscs	Infauna	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Mollusks	Epifauna	Infauna	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Mollusks	Epifauna	Infauna	Vegetation	Birds	Mammals	Fish	Arthropods	Molluscs	Infauna
Group 1	L	R	L	L	L	R	L	L	L	L	L	R	L	L	L	L	L	L	L	L	R	L	L	L	L	L	L	L	L	R	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	3D	4D	4D	3D	3D	4D	4D	4D	3D	3D	3D	4D	3D	4D	4D	4D	4D	3D	4C	3D	3D	4D	4D	4D	4D	4D	4D	4D
	4D					4D					3D									4D									4D						
Group 2	L	R	L	L	L	R	L	L	L	L	L	R	L	L	L	L	L	L	L	L	R	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4C	4D	4C	4D	4C	4D	4D	4C	4D	4D	4D	4C	4C	4C	4D	4D	4C	4C	4D	4D	4C	4D	4D	4D	4D	4D	4D	4D
	4D					4D					4D									4D									4D						
Group 3	L	L	L	L	L	L	L	L	L	L	L	A	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4D	4D	3D	4D	4D	3B	3D	4B	4B	4B	4C	3D	3D	4C	4D	4C	4C	4C	4C	2B	3D	3D	4C	4D	3C	4C	4C	4C	3C	3D	4D	4D	3D	4C	4C
	4D					4B					4C									2B									3C						
Group 4	L	R	A	L	L	R	A	L	L	L	L	A	A	L	A	L	L	L	L	L	A	A	L	A	L	L	L	L	L	A	A	A	L	L	L
	4D	4D	4D	4D	4D	3D	4D	2C	3B	3C	1B	2C	4D	4D	2C	3B	2B	2B	2B	1B	2C	4D	4D	2C	3B	2B	2B	2B	3B	2B	4D	3D	4B	2B	4B
	4D					3C					2C									2B									3C						

Habitats	Intertidal Shoreline (cont.)								Benthic (subtidal)							Special Habitats												Water Column									
Subhabitats	Riprap/man-made								Soft Bottom							Oyster Reefs					Sea Grass Beds							Surface				Remaining					
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Molluscs	Epifauna	Vegetation	Birds	Reptiles/amphibians	Fish	Arthropods	Molluscs	Infauna	Birds	Fish	Arthropods	Molluscs	Epifauna	Vegetation	Birds	Fish	Arthropods	Molluscs	Epifauna	Infauna	Plankton	Mammals	Birds	Fish	Plankton	Mammals	Birds	Fish	Arthropods	Coelenterates
Group 1	L	R	L	L	L	L	L	L	L	L	L	L	L	L	L	R	L	L	L	L	L	L	L	L	L	L	L	L	L	R	L	L	L	R	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	3D	3D	4D	4D	4D	4D	4D	4D	4D	3D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D								4D							4D					4D							4D				4D					
Group 2	L	R	L	L	L	L	L	L	L	R	L	L	L	L	L	R	L	L	L	L	L	R	L	L	L	L	L	L	L	R	L	L	L	R	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4B	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4B	4D
	4D								4D							4D					4D							4D				4D					
Group 3	L	L	L	L	L	L	L	L	L	A	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
	4C	2C	4D	1D	3C	4C	4C	4C	4D	3D	4D	4D	4D	4D	4D	3C	3B	4B	3C	4B	3D	3D	3D	4D	3D	4D	4D	4B	3D	3D	4D	4D	3D	3D	4D	4D	4D
	2C								4D							3C					3D							3D				4D					
Group 4	L	L	L	A	L	L	L	L	L	R	A	A	L	L	L	A	L	L	L	L	L	A	A	L	L	L	L	L	A	R	A	L	A	R	A	L	
	3B	3C	4D	4D	3B	3B	2B	3B	4D	4C	4D	4D	3C	3D	4D	4D	3A	3A	1A	4A	2C	2D	3C	2C	2C	2C	2C	4C	4D	3C	3C	4C	4D	4D	4D	4D	4D
	3C								3D							2B					2C							3D				4D					

A. Coastal Bays

Habitats						Intertidal														Benthic (Subtidal)											
Subhabitats	Terrestrial					Sand Beaches						Riprap/man-made								Shallow (<5 meters)							Deep (>5 meters)				
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Arthropods	Birds	Mammals	Reptiles/amphibians	Arthropods	Molluscs	Infauna	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Molluscs	Infauna	Vegetation	Birds	Reptiles/amphibians	Fish	Arthropods	Molluscs	Infauna	Reptiles/amphibians	Fish	Arthropods	Molluscs	Infauna
Group 1	L	A	L	L	L	A	L	R	L	L	L	L	A	A	L	L	L	L	L	L	A	A	A	L	L	L	A	A	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D					4D						4D								4D							4D				
Group 2	L	R	L	L	L	R	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	R	A	L	L	L
	4D	4D	4D	4D	4D	4D	4D	3D	4B	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4C	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4C					4D						4D								4D							4D				
Group 3	L	L	L	L	L	A	A	A	L	L	L	L	L	L	A	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	3D	4D	4D	4B	4B	4B	4A	2B	4D	1B	3A	4A	4A	4A	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D					3D						2B								4D							4D				
Group 4	L	R	A	L	L	R	A	L	L	L	L	L	A	L	A	L	L	L	L	L	L	A	L	L	L	L	A	A	A	L	L
	4D	4D	4D	4D	4D	3D	4D	4D	3C	4B	4B	3B	4D	4D	3D	3B	3B	3B	3B	4C	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D					3C						3B								4D							4D				

Habitats	Water Column																										
Subhabitats	Water Surface					Upper 5 meters								Middle Water Column							Bottom 5 meters						
Response Option	Plankton	Mammals	Birds	Reptiles/amphibians	Fish	Plankton	Mammals	Birds	Reptiles/amphibians	Fish	Arthoropods	Molluscs	Coelenterates	Plankton	Mammals	Reptiles/amphibians	Fish	Arthoropods	Molluscs	Coelenterates	Plankton	Mammals	Reptiles/amphibians	Fish	Arthoropods	Molluscs	Coelenterates
Group 1	A	A	A	A	A	L	A	A	A	A	A	L	L	L	A	A	L	A	L	L	L	A	A	A	A	L	L
	4A	3B	2C	2C	4D	4A	3D	4D	3D	4D	4C	4D	4C	4D	4D	3D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	3D					4C								4D							4D						
Group 2	R		R	L	A	A		A	A	A	R	L	L	A		A	A	A	A	A	L		L	L	L	L	L
	4D		4C	4D	4C	4D		4C	4C	4D	4B	4D	4D	4D		4D	4D	4C	4D	4D	4D		4D	4D	4C	4D	4D
	4C					4D								4D							4D						
Group 3	L	A	A	A	A	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4B	4D	2D	3D	4D	4B	4D	4D	4D	4C	4C	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	2D					4C								4D							4D						
Group 4	L	A	A	A	A	L	A	A	A	A	L	L	L	L	A	A	A	L	L	L	L	A	A	A	L	L	L
	3A	3C	3C	2C	3C	4A	4D	3C	4C	4A	4A	4B	4A	4A	4D	4C	4C	4C	4C	4C	4B	4D	3C	4D	4D	4D	4D
	3B					4B								4C							4D						

B. Outer Coast

Reference Area codes: L = local, A = lower Texas and upper Mexico and adjacent waters, and R = Gulf-wide or greater (see Section 2 for definitions).

Figure 4.3 *Detailed focus group risk analysis results for Spill 1(Groups 3 and 4) and Spill 2 (Groups 1 and 2) for dispersant application at 80% effectiveness.*

Habitats						Intertidal Shoreline													
Subhabitats	Terrestrial					Sand Beaches					Vegetated Marshes								
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Arthropods	Birds	Mammals	Arthropods	Molluscs	Infauna	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Mollusks	Epifauna	Infauna
Group 1	L	R	L	L	L	R	L	L	L	L	L	R	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	2C	3D	4D	4D	4D	4C	4D	4D	4D
	4D					4D					3D								
Group 2	L	R	L	L	L	R	L	L	L	L	L	R	L	L	L	L	L	L	L
	4B	4C	4D	4D	4D	4D	4D	4C	4C	4C	4C	4C	4D	4D	4B	4C	4C	4C	4C
	4C					4C					4C								
Group 3	L	L	L	L	L	L	L	L	L	L	L	A	L	L	L	L	L	L	L
	4D	4D	3D	4D	4D	3C	3D	4A	4A	4A	4B	3D	3D	4C	4C	4B	4B	4B	4B
	4D					4A					4B								
Group 4	L	R	A	L	L	R	A	L	L	L	L	A	A	L	A	L	L	L	L
	3D	4D	4D	4D	4D	3C	4D	2B	3A	3C	3C	3D	4D	4D	2D	3C	2C	2C	2C
	4D					3B					3C								

Habitats	Intertidal Shoreline															
Subhabitats	Black Mangrove Forest									Salt Flats						
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Mollusks	Epifauna	Infauna	Vegetation	Birds	Mammals	Fish	Arthropods	Molluscs	Infauna
Group 1	L	R	L	L	L	L	L	L	L	L	R	L	L	L	L	L
	2D	3D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	3D									4D						
Group 2	L	R	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4C	4C	4D	4D	4C	4C	4D	4D	4C	4D	4D	4D	4D	4D	4D	4D
	4D									4D						
Group 3	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	2C	3D	3D	4C	4C	4C	4C	4C	4C	3C	3D	4D	4D	3D	4C	4C
	2C									3C						
Group 4	L	A	A	L	A	L	L	L	L	L	A	A	A	L	L	L
	1C	2D	4D	4D	2D	3C	2C	2C	2C	3D	2D	4D	4D	4C	2D	4C
	2C									3C						

Habitats	Intertidal Shoreline (cont.)								Benthic (subtidal)						
Subhabitats	Riprap/man-made								Soft Bottom						
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Fish	Arthropods	Molluscs	Epifauna	Vegetation	Birds	Reptiles/amphibians	Fish	Arthropods	Molluscs	Infauna
Group 1	L	R	L	L	L	L	L	L	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D								4D						
Group 2	L	R	L	L	L	L	L	L	L	R	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D								4D						
Group 3	L	L	L	L	L	L	L	L	L	A	L	L	L	L	L
	4A	3C	4D	3C	3A	4A	4A	4A	4D	3C	4D	4C	4C	4C	4C
	4A								4C						
Group 4	L	L	L	A	L	L	L	L	L	R	A	A	L	L	L
	3B	3C	4D	4D	3B	3B	2B	3B	4D	4B	4D	4D	3B	3C	4C
	3C								3C						

Habitats	Special Habitats												Water Column									
Subhabitats	Oyster Reefs					Sea Grass Beds							Surface				Remaining					
Response Option	Birds	Fish	Arthropods	Molluscs	Epifauna	Vegetation	Birds	Fish	Arthropods	Molluscs	Epifauna	Infauna	Plankton	Mammals	Birds	Fish	Plankton	Mammals	Birds	Fish	Arthropods	Coelenterates
Group 1	R	L	L	L	L	L	L	L	L	L	L	L	L	L	R	L	L	L	R	L	L	L
	4D	4D	4D	4D	4D	4D	3D	4D	4D	4D	4D	4D	4C	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D					4D							4D				4D					
Group 2	R	L	L	L	L	L	R	L	L	L	L	L	L	L	R	L	L	L	R	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D					4D							4D				4D					
Group 3	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	3C	3D	4C	3C	4B	3D	3D	3C	4D	3D	4D	4D	4A	3D	3C	4D	4D	3D	3D	4D	4D	4D
	3C					3D							3C				4D					
Group 4	A	L	L	L	L	L	A	A	L	L	L	L	L	A	R	A	L	A	R	A	L	
	4D	4C	4C	1D	4C	2C	2C	3C	2C	2C	2C	2C	4C	4D	3D	3D	4D	4D	4D	4D	4D	4D
	3C					2C							3D				4D					

A. Coastal Bays

Habitats						Intertidal													
Subhabitats	Terrestrial					Sand Beaches						Riprap/man-made							
Response Option	Vegetation	Birds	Mammals	Reptiles/amphibians	Arthropods	Birds	Mammals	Reptiles/amphipians	Arthropods	Molluscs	Infauna	Vegetation	Birds	Mammals	Reptiles/amphipians	Fish	Arthropods	Molluscs	Infauna
Group 1	L	A	L	L	L	A	L	R	L	L	L	L	A	A	L	L	L	L	L
	4D	4D	4D	4D	4D	3D	4D	3D	4D	3D	4D	4C	3D	4D	4D	4D	4D	4C	4C
	4D					4C						4D							
Group 2	L	R	L	L	L	R	L	L	L	L	L	L	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D					4D						4D							
Group 3	L	L	L	L	L	A	A	A	L	L	L	L	L	L	A	L	L	L	L
	4D	4D	4D	4D	4D	3D	4D	4D	4A	4A	4A	4A	3C	4D	3C	3A	4A	4A	4A
	4D					4A						4A							
Group 4	L	R	A	L	L	R	A	L	L	L	L	L	A	L	A	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4B	4B	4B	3B	4D	4D	3D	4B	4B	4B	4B
	4D					4C						4B							

Habitats	Benthic (Subtidal)											
Subhabitats	Shallow (<5 meters)							Deep (>5 meters)				
Response Option	Vegetation	Birds	Reptiles/amphibians	Fish	Arthropods	Molluscs	Infauna	Reptiles/amphipians	Fish	Arthropods	Molluscs	Infauna
Group 1	L	A	A	A	L	L	L	A	A	L	L	L
	4D	3D	3D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D				
Group 2	L	L	L	L	L	L	L	R	A	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D				
Group 3	L	L	L	L	L	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D				
Group 4	L	L	A	L	L	L	L	A	A	A	L	L
	4C	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D				

Habitats	Water Column												
Subhabitats	Water Surface					Upper 5 meters							
Response Option	Plankton	Mammals	Birds	Reptiles/amphibians	Fish	Plankton	Mammals	Birds	Reptiles/amphibians	Fish	Arthoropods	Molluscs	Coelenterates
Group 1	A	A	A	A	A	L	A	A	A	A	A	L	L
	4C	4D	2C	3C	4D	4C	4D	4D	3D	4D	4D	4D	4D
	3C					3D							
Group 2	R		R	L	A	A		A	A	A	R	L	L
	4D	4D	4C	4D	4C	4D	4D	4C	4C	4D	4B	4D	4D
	4D					4D							
Group 3	L	A	A	A	A	L	L	L	L	L	L	L	L
	4A	4D	2C	3C	4D	4D	4D	4D	4D	4D	4D	4D	4D
	2C					4D							
Group 4	L	A	A	A	A	L	A	A	A	A	L	L	L
	4A	3C	3C	2C	3D	4A	4D	3C	4D	4C	4B	4C	4A
	3D					4C							

Habitats	Water Column													
Subhabitats	Middle Water Column							Bottom 5 meters						
Response Option	Plankton	Mammals	Reptiles/amphibians	Fish	Arthoropods	Molluscs	Coelenterates	Plankton	Mammals	Reptiles/amphibians	Fish	Arthoropods	Molluscs	Coelenterates
Group 1	L	A	A	L	A	L	L	L	A	A	A	A	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D						
Group 2	A		A	A	A	A	A	L		L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D						
Group 3	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D	4D
	4D							4D						
Group 4	L	A	A	A	L	L	L	L	A	A	A	L	L	L
	4B	4D	4D	4D	4D	4D	4D	4B	4D	3C	4D	4D	4D	4D
	4D							4D						

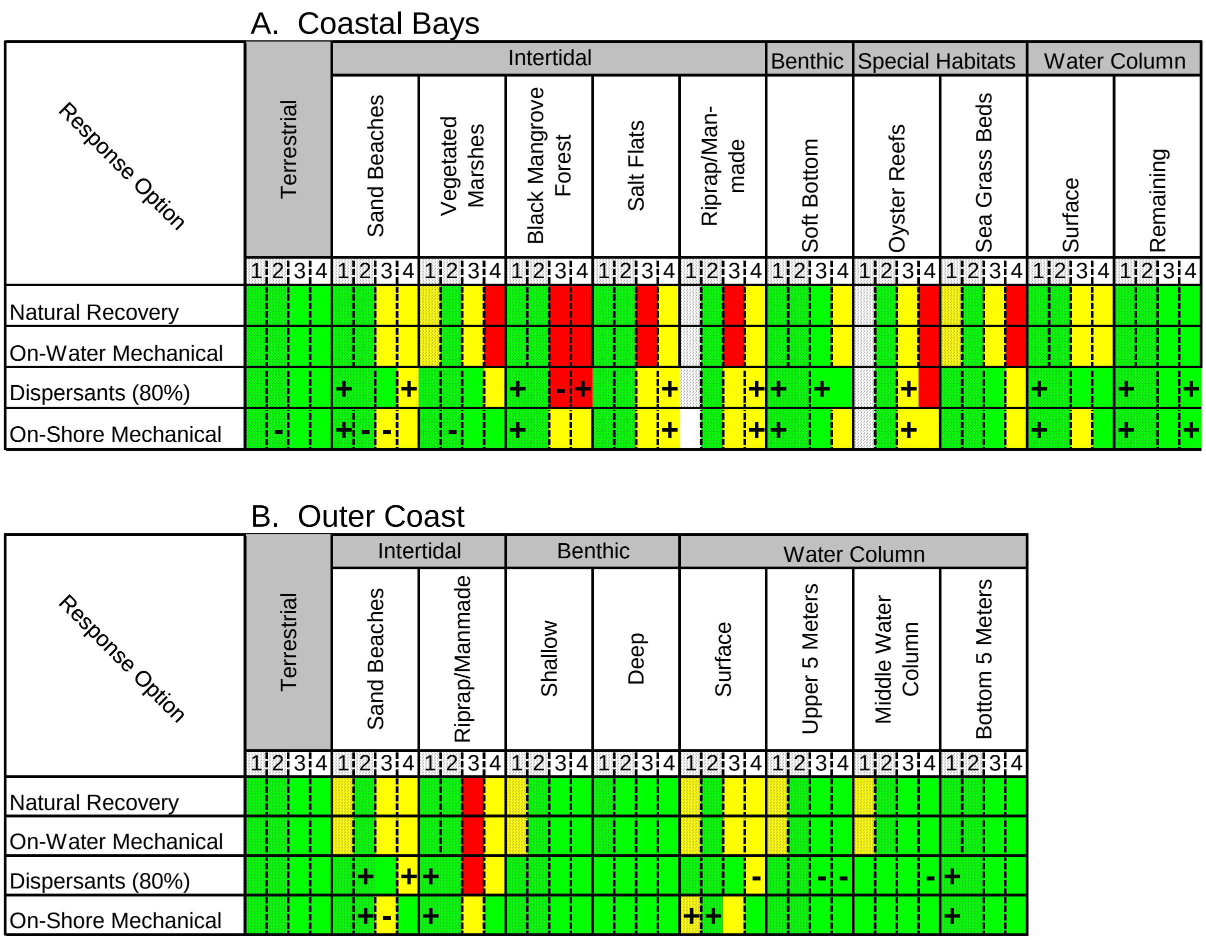
B. Outer Coast

Reference Area codes: L = local, A = lower Texas and upper Mexico and adjacent waters, and R = Gulf-wide or greater (see Section 2 for definitions).

Figure 4.4 *Detailed focus group risk analysis results for on-shore mechanical recovery.*

5.0 Summary Risk Analysis Results and Lessons Learned

Figure 5.1 presents the summary results for this workshop. Four response options were analyzed: natural recovery, on-water mechanical recovery, dispersant application at 80% effectiveness and on-shore mechanical recovery. This figure is based on the detailed data in Section 4 and allows an easy comparison across response options. In summary, participants felt impacts would be similar for both spills, with the greatest concern being for habitats in the inner coastal bays.



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 four 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. Groups 1 and 2 (crosshatched) analyzed Spill 2 (Mexico) and Groups 3 and 4 analyzed Spill 1 (Texas).

Figure 5.1 *Final relative risk matrix for the Mexico – United States Gulf of Mexico Coastal Border Region risk assessment.*

There would have been more concern for the outer coast if turtles had been nesting. Impacts from dispersant use were viewed as being minimal (in this scenario and location) and offered the best option to protect inshore habitats. On-water mechanical recovery was not seen as significantly reducing the risk, but was important as a part of the response. Shoreline protection and diversion booming are important element of planning in this area, and, along with early use of dispersants offshore, offer the best opportunity to protect the Laguna Madre.

5.1 Key Factors Influencing Decisions in this Scenario

At the end of the second workshop, the participants were presented with five questions by the facilitators and asked to break into their focus groups and discuss each of the questions in preparation for developing recommendations and lessons learned (see Section 2). The talking points developed by each of the focus groups are presented below for each of the five questions. It should be noted that these points represented the views only of the particular group, and the opinions represented were refined while developing the consensus recommendations in Section 5.2.

5.1.1 Group 1 Discussion Points

Question 1 – What are your critical concerns about the possible consequences of the spill?

The areas of concern are:

<u>Outer Coast</u>

- The turtles – during their birth and entrance to the sea.
- The bird's food during their migration period.

<u>Inner Coast</u>

- Marshes and Mangroves – it is difficult to recover hydrocarbons without damaging marshes and mangroves and the associated species that feed and live there (fish, arthropods and first phase crustaceans).

Question 2 – What would your group's recommendations be concerning possible response tactics for this spill, and what are the key issues related to the response options proposed?

Possible response tactics would be the application of dispersants during the first 48 hours, using boomings in the northern side of the jetties in order to deflect the spill to the coast and minimize the hydrocarbons going in with the help of the coastal current going from South to North.

Another tactic is the use of mechanical recovery equipment at the coast. In the canal access to the lagoon, set boomings in a cascading way to recover hydrocarbons reaching that point.

Question 3 – How would your conclusions change if the spill were five times as large (300,000 gallons/450,000 gallons)?

The use of booming would be increased in the exterior and interior, using the same response strategies for a larger spill.

Question 4 – How would your conclusions change if it were a different season?

We have to take special care of the endangered and sensitive species such as turtles, red headed duck and brown shrimp.

Question 5 – List the key assumptions in your discussions and any issues/concerns you had about the information that would be available.

We would need to have more detailed map showing vegetation in the area, e.g. mangroves and marches. We would also need more information on tides and local currents.

5.1.2 Group 2 Discussion Points

Question 1 – What are your critical concerns about the possible consequences of the spill?

Areas of concern: Protect critical areas because there is a natural protected area that is important for nesting and reproduction for birds, turtles, endemic species, wetlands and mangroves.

Our major concern is to prevent as much as possible the impacts to this area and the ecosystem by the oil spill by using available resources.

Question 2 – What would your group's recommendations be concerning possible response tactics for this spill, and what are the key issues related to the response options proposed?

Our recommendation for possible tactics for this oil spill would be first to contain the oil spill out in the open sea using barriers and skimmers. If conditions of water depth and distance from the coast allow it, dispersants will be applied and barriers used to protect the coast and prevent the entrance of oil into the lagoon.

Question 3 – How would your conclusions change if the spill were five times as large (300,000 gallons/450,000 gallons)?

Mobilize the federal and state resources to contain the oil spill out at sea and/or divert to an area not critical for faster recuperations. If the oil is not contained, we would protect the most sensitive areas on land and reduce the impacts on the coast by mobilizing the available tactics and resources.

Question 4 – How would your conclusions change if it were a different season?

Depending on the time of the year (season) where the oil spill incident occurs, the level of concern, tactics, and strategies change because the species cycles are found in different stages along with the climatic and ocean conditions where the incident occurred.

Question 5 – List the key assumptions in your discussions and any issues/concerns you had about the information that would be available.

Issues/Concerns

- Have the inventory of the dispersants and pre-authorized areas to use them available to consider for the oil spill.
- Incorporate the simulation models that exist in Mexico and the U.S. and exchange information to utilize in sensitive areas.
- Update and incorporate the most recent species information that exists in the sensitive areas.

5.1.3 Group 3 Discussion Points

Question 1 – What are your critical concerns about the possible consequences of the spill?

Protect in-shore and nursery habitats as much as possible, in particular, the black mangrove forests, salt flats and vegetated marshes. The ecosystem as a whole must be addressed. Nursery areas, sensitive areas, and endangered species (birds, such as pelicans and piping plovers, and turtles) in marshes and other areas are a higher priority for protection. Focus on system drivers.

Question 2 – What would your group's recommendations be concerning possible response tactics for this spill, and what are the key issues related to the response options proposed?

Go "big" early. Note - given that ship channel will be closed to traffic, use all possible cleanup and preventive strategies.

- Seek early approval for dispersants. Dispersants are the most effective way to remove large volumes of oil from surface and put it in the water column to protect sensitive environments.
- Protective booming strategies and tactics; focus mainly on any oil coming to in-shore habitats, use all available boom to keep it out of in-shore environment.

Question 3 – How would your conclusions change if the spill were five times as large (300,000 gallons/450,000 gallons)?

Still use all resources (skimming, protection booming), focus on simultaneous use of all oil response strategies (dispersants, protection booming, skimming).

Question 4 – How would your conclusions change if it were a different season?

- Flora will go dormant in winter months (sea grass, etc.).
- There are different migratory patterns to take into account with each season. Note that outer shores will be impacted regardless of season.
- In the summer, the timeline for dispersant use is compressed as "light ends" cook off and dispersant use becomes less or even ineffective.

Question 5 – List the key assumptions in your discussions and any issues/concerns you had about the information that would be available.

- More specific tidal information.
- Weather forecasts (temperature ranges, wind speeds and directions – greatly impacts where accumulations will occur).
- Surface and subsurface currents (referring to dispersed oil).
- Include contracts in risk assessment process and solicit local knowledge and expertise.
- Drift studies for more detailed information for booming strategies in jetties.

5.1.4 Group 4 Discussion Points

Question 1 – What are your critical concerns about the possible consequences of the spill?

Our group's critical concerns were limited in the outer coast. Most of our critical concerns were in the inshore habitats, specifically vegetated marshes, black mangrove forests, oyster reefs, salt flats, riprap/man-made features, and seagrass beds.

Question 2 – What would your group's recommendations be concerning possible response tactics for this spill, and what are the key issues related to the response options proposed?

Based on information provided and models available, we would recommend the use of dispersants (if it can be accomplished within 24 hours and inside the pre-approved zone) and protective booming to prevent as much oil as possible from entering the inshore habitats. We would not recommend the use of dispersants shoreward of 3 nautical miles based on concerns of toxicity (unknown ecological effects and validity of model in relation to proximity of shoreline). By using protective booming, we are planning on diverting as much of the spill as possible to the outer coast habitat that does not contain as many sensitive resources as inshore. We would then use manual/mechanical recovery techniques to remove the oil. Mechanical methods used would depend on the specific area of beach impacted.

Question 3 – How would your conclusions change if the spill were five times as large (300,000 gallons/450,000 gallons)?

Our conclusions and recommendations would remain the same for this larger spill. The larger spill would lead us to recommend more emphasis on onshore mechanical recovery.

Question 4 – How would your conclusions change if it were a different season?

If the spill occurred during sea turtle nesting season (April through August) we would be much more concerned about the impacts to sea turtles in the outer coast habitat. This would also require protective measures to be followed during onshore mechanical cleanup to protect nesting sea turtles and their nests.

If the spill occurred during major shorebird migration movements (April, May) the impact would be greater for a larger number of birds due to the oil and/or cleanup activities. Tactics to scare birds away from the affected areas may need to be employed.

Question 5 – List the key assumptions in your discussions and any issues/concerns you had about the information that would be available.

<u>Issues and Concerns</u>

- We had issues/concerns with the dispersed oil in the model not reaching the shore and the undispersed oil moving directly onshore.
- We had issues/concerns with the bias towards the use of dispersants and the negative portrayals of onshore mechanical recovery.
  - Some slides depicted proper or positive aspects of mechanical cleanup would be appreciated. All we saw were people in no Personal Protective Equipment (PPE), or inappropriate PPE, improperly installed booming causing environmental damage or sensitive areas where onshore mechanical cleanup should not be conducted.
- We need to have habitat scaling clearly defined. Maybe assess all concerns initially on a local level and then compare the results to the area and regional levels.

5.2 Consensus Recommendations

On the morning of the last day of the workshop, the participants reviewed the results of their discussions throughout the week in plenary session and developed a list of recommendations for future consideration by the response community. These recommendations are listed below in the order that they were developed. They are not in priority order. The section is repeated in Spanish.

Question 1 – In the event that this type of threat was real, where would you start?

- You need real-time accurate information on resources at risk. Information available in advance (Environmental Sensitivity Index, ESI, atlas, etc.) needs to be supplemented by ground truth.
- Seasonal data in ESI atlas and similar references could be improved.
- There needs to be a list of local experts that is continuously maintained.
- Operations should not be delayed for detailed resource information, but may need to be modified as better information becomes available.

Question 2 – What could be done to improve on-water mechanical recovery?

- Limited equipment for off-shore use is available locally. Resources are available within the region. Resources should be deployed in the most effective manner.
- Trans-border availability of resources is an issue, which is addressed in the Gulf Annex of the MEXUS Agreement.
- There are regulatory requirements for mechanical recovery that must be met.
- Both countries have a tiered response structure, which will enable local resources to be supplemented as necessary.
- Based on information available at this meeting for this scenario, off-shore mechanical recovery was determined not to be effective in reducing the exposure to shoreline resources. Nevertheless, any oil recovered will be a benefit and under the right conditions could be more significant. Local planning should be cognizant of possible limitations and should focus on other options as well.

Question 3 – What other offshore response options would we consider?

- Offshore burning was discussed, but under this scenario was subject to the same limitations and no more effective than off-shore recovery in the US spill. Mexico does not have on-water on-situ burning (ISB) equipment available.
- Dispersants were considered and if they could be used in a timely manner in the pre-approved zone (US) they would be a viable option. Dispersant use in the expedited approval zone (US) was not discussed. It would be a good issue for discussion at a later exercise.
- For the spill which occurred in Mexican waters, the location (within the current approval zone in Mexico – 50 meters in depth, not distance from shore) and conditions for dispersant use were very favorable, and would have resulted in protection for shoreline resources. Near-shore dispersant use was evaluated, but was not applicable.

Question 4 – What are your conclusions about shoreline protection and cleanup on the outer coast?

- Fine-grained sand beaches that are accessible are relatively easy to clean but cannot be protected. The way you would clean these beaches varies based on the seasonal presence of sensitive resources (sea turtles and birds). Even remote beaches would be cleaned, but the logistics would be more difficult.

- There should be an attempt to prevent oil from entering passes providing access to the back bay areas. There needs to be additional development work on protection strategies for these areas. Rip rap located around the inlets provides important and unique habitat and there needs to be particular attention paid to appropriate clean up methods in those areas.
- It is very important that we have appropriate clean up endpoints to prevent damage from unnecessary activities. In this scenario, the level of contamination and the remote location of some shorelines meant that manual, not mechanical cleanup would be most appropriate.

Question 5 – What are your conclusions about shoreline protection and cleanup on the inner coast?

- Some of these areas are very sensitive (for example, black mangroves, algal mats, or oyster reefs) and require aggressive protection. With appropriate protection at the pass, impacts in the inner bays may be minimized by directing the oil to sand beaches on the outer coast.
- The protection strategy should be based on "protection in depth" by providing secondary protection behind the inlet; for example, additional exclusion booming at the entrance to South Bay.
- If deflection is not successful, subsequent cleanup efforts need to be based on surveys done by trained Shoreline Cleanup and Assessment Teams (SCAT) involving all of the appropriate stakeholders. Cleanup endpoints need to be developed by experts familiar with sensitivities of the local habitats.
- Better hydrographic information for the inner bays would help develop better modeling and appropriate protection strategies. Extending the existing systems with additional monitoring stations (both in the US and Mexico) for hydrographic and weather information would be valuable. This would have additional benefits for safe navigation.
- Review the existing contingency plans (both in the US and Mexico), especially the sections related to protective booming, to evaluate and update as appropriate.

5.2 Consenso Recomendaciones

On the morning of the last day of the workshop, the participants reviewed the results of their discussions throughout the week in plenary session and developed a list of recommendations for future consideration by the response community. These recommendations are listed below in the order that they were developed. They are not in priority order. The section is repeated in Spanish.

Pregunta 1 – ¿En el caso que este tipo de amenaza fuese real, por donde comenzarían?

- Ustedes necesitan información correcta y en tiempo real sobre los recursos que estén en riesgo. La información que este disponible por adelantado (ESI atlas, etc.) necesita ser suplementada con total certeza.
- Datos de las estaciones en ESI y referencias similares podrían ser mejoradas.
- Necesita haber una lista de expertos locales que sea continuamente actualizada.
- Las operaciones no deberían de retrasarse por información detallada, pero puede necesitar ser modificada tan pronto como información mejor este disponible.

Pregunta 2 – ¿Que podría hacerse para mejorar la recuperación mecánica sobre agua?

- Equipo limitado para su uso en mar adentro esta disponible localmente. Recursos están disponibles dentro de la región. Los recursos deberían de ser movilizados en la forma más efectiva.
- Disponibilidad de recursos a través de la frontera es un problema, del cual se trata en el Anexo Golfo del Acuerdo MEXUS.
- Hay requisitos regulatorios para recuperación mecánica que se deben cumplir.
- Ambos países tienen una estructura de niveles para responder, lo cual incrementará la capacidad de los recursos que sean suplementados según sea necesario.
- Basados en la información disponible en esta reunión para este escenario, se determinó que la recuperación mecánica en alta mar no era efectiva para reducir la exposición de los recursos litorales. Sin embargo, cualquier recuperación de hidrocarburo será un beneficio y bajo las condiciones adecuadas, podría ser más significativa. Planificación local debería estar conciente de limitaciones posibles y debería también de enfocarse en otras opciones.

Pregunta 3 – ¿Que otras opciones de respuesta en alta mar deberían ser consideradas?

- Se discutió la quema en alta mar, pero bajo este escenario estuvo sujeta a las mismas limitaciones y no fue más efectiva que la recuperación en alta mar en el derrame de los Estados Unidos. México no cuenta con equipo para quemar en el sitio (ISB) sobre el agua.
- Se consideró el uso de dispersos y si estos podrían ser utilizados a tiempo en la zona pre-autorizada (USA) ello podría ser una opción viable. El uso de

dispersante en la zona expedita autorizada (USA) no se discutió. Seria un buen punto de discusión en el siguiente ejercicio.
- Para el derrame ocurrido en aguas mexicanas, la ubicación (dentro de la zona autorizada actual en México – 50 metros de profundidad, no la distancia desde la orilla) y condiciones para el uso de dispersos fueron muy favorable, y dando buenos resultados en la protección de los recursos litorales. El uso de dispersos cerca de la orilla fue evaluado pero no se aplico.

Pregunta 4 – ¿Cuales son sus conclusiones sobre la protección de la costa y la limpieza fuera de la costa?

- Las playas de arena fina que son accesibles son relativamente fáciles de limpiar, pero no pueden ser protegidas. La forma en que se limpiarían estas playas varia basadas en la presencia estacional de recursos sensible (tortugas marinas y aves). Incluso las playas más lejanas se limpiarían, pero la logística seria más difícil.
- Debe intentarse evitar que el hidrocarburo entre a canales que provean acceso a las áreas posteriores de las bahías. Se necesita un trabajo adicional de desarrollo sobre las estrategias de protección para estas áreas.
- Es muy importante que tengamos puntos finales de limpieza adecuados para evitar el daño ocasionado por actividades no necesarias. En este escenario, el nivel de contaminación y la ubicación remota de algunas costas significo que la limpieza manual y no mecánica seria la más adecuada.

Pregunta 5 – ¿Cuales son las conclusiones sobre la protección en la costa y la limpieza en la costa interior?

- Algunas de estas áreas son muy sensibles (por ejemplo, manglares negros, las esteras de algas, o los bancos de ostras) y requieren protección agresiva. Con la protección apropiada en el paso, los impactos en las bahías internas pueden ser minimizados dirigiendo el aceite hacia las playas arenosas en la costa externa.
- La estrategia de protección debería estar basada en la “protección a profundidad” proveyendo protección secundaria detrás de la entrada; por ejemplo, las barreras de exclusión adicionales a la entrada de la Bahía Sur.
- Si la deflección no tuviese éxito, esfuerzos de limpieza adicionales necesitarán ser basados en reexaminaciones hechas por Equipos de Evaluación y Limpieza Litoral (SCAT) involucrando a todas las agencias y empresas interesadas. La conclusión de los esfuerzos de limpieza debe ser desarrollada por expertos familiares con las sensibilidades de hábitat local.
- Mejor información hidrográfica de las bahías internas ayudaría a desarrollar mejores modelos y estrategias de protección apropiadas. El extender los sistemas existentes con estaciones de monitoreo adicionales (tanto en los Estados Unidos como en México) para obtener la información de hidrodinámica y meteorológica añadiendo el valor que beneficiaría a la seguridad en la navegación. Adicionalmente, se beneficiaría la seguridad en la navegación.

- Revisar los planes de contingencia existentes (tanto en los Estados Unidos como en México), especialmente las secciones relacionadas a barreras protectoras, para evaluaciones y actualizaciones apropiadas.

6.0 References

Aurand, D., L. Walko and R. Pond. 2000. Developing Consensus Ecological Risk Assessments: Environmental Protection in Oil Spill Response Planning. A Guidebook. United States Coast Guard, Washington, DC. 148 pages. (Also Ecosystem Management & Associates, Inc. Technical Report 00-01).

Aurand, D. and G. Coelho (Compilers). 2003. E cological Risk Assessment: Consensus Workshop. Environmental Tradeoffs Associated With Oil Spill Response Technologies. U.S. and British Virgin Islands. A Report to US Coast Guard District 7. Ecosystem Management & Associates, Inc., Lusby, MD 20657. Report 03-03, 34 pages.

Ballou, T. G., R. Dodge, S. Hess and A. Knapp. 1989. Tropical oil pollution investigations in coastal systems (Tropics): the effects of untreated and chemically dispersed Prudhoe Bay crude oil on mangroves, seagrasses, and corals in Panama. Oil Dispersants: New Ecological Approaches. L. M. Flaherty, Philadelphia, ASTM**:** 229-256.

Baca, B., G.A. Ward, C.H. Lane and P.A. Schuler. 2005. Net Environmental Benefit Analysis (NEBA) of dispersed oil on nearshore tropical ecosystems derived from the 20 year "TROPICS" study. Proceedings, 2005 International Oil Spill Conference: Prevention, Preparedness, Response and Restoration – Raising Global Standards. American Petroleum Institute Publication 14718A (Compact Disk). 4 pages.

Barth, H.J. 2003. The influence of cyanobacteria on oil polluted intertidal soils at the Saudi Arabian Gulf shores. Mar. Poll. Bull. 46(10): 1245-1252.

Barth, H.J. 2007. Crab induced salt marsh regeneration after the 1991 Gulf War oil spill. Aquatic Ecosys. Hlth. Mgmt. 10(3): 327-334.

Durako, M.J, W.J. Kenworthy, S.M.R. Fatemy, H. Valavi and G.W.Thayer. 1993. Assessment of the toxicity of Kuwait crude oil on the photosynthesis and respiration of seagrasses of the Northern Gulf. Marine Pollution Bulletin 27: 223-227.

Fuller, C.B., J.S. Bonner, T.J. McDonald, C.A. Page, C.E. Bragin, C.R. Clark, D.V. Aurand, A. Hernandez and A.N.S. Ernest. 1999. Comparative toxicity of simulated beach sediments impacted with both whole and chemical dispersions of weathered Arabian Medium crude oil. AMOP Technical Seminar 22b: 659-670.

Gilfillan, E.S., D. S. Page, and J.C. Foster (1986). Tidal area dispersant project: fate and effects of chemically dispersed oil in the nearshore benthic environment. Washington, DC, American Petroleum Institute. Publication Number 4440.

Kenworthy, W.J., M.J. Durako, S.M.R. Fatemy, H. Valavi and G.W. Thayer, G.W. 1993. Ecology of seagrasses in Northeastern Saudi Arabia one year after the Gulf War oil spill. Marine Pollution Bulletin 27: 213-222.

National Oceanic and Atmospheric Administration (NOAA). 1999. Screening Quick Reference Tables (SQuiRTs). NOAA HazMat Report 99-1. Seattle, WA.

National Research Council (NRC). 2005. Oil Spill Dispersants: Efficacy and Effects. National Academy of Sciences Press, Washington, DC. 377 p.

Pond, RG., D.V. Aurand, and J.A. Kraly (compilers). 2000. Ecological Risk Assessment Principles Applied to Oil Spill Response Planning in the San Francisco Bay Area. California Office of Spill Prevention and Response. California Department of Fish and Game, Sacramento, CA.

U.S. Environmental Protection Agency. 1998. Guidelines for Ecological Risk Assessment. Federal Register 63 (93) of Thursday, May 14, 1998. pp. 26846-26924.

Appendix A

Participants

Group #	NAME	AGENCY	ADDRESS	PH NUMBER	e-MAIL	October Attendance			November Attendance		
						16	17	18	6	7	8
	Aurand, Don	Ecosystem Management & Associates, Inc.	13325 Rousby Hall Road, Lusby, MD 20657	410-394-2929	d.aurand@ecosystem-management.net	✓	✓	✓	✓	✓	✓
3	Baccigalopi, Michael	TGLO	414 Travis Street Port Lavaca, TX 77979	361-552-8081	michael.baccigalopi@glo.state.tx.us	✓	✓	✓	✓	✓	✓
3	Banuelos, Cecilio	U.S. Coast Guard	555 N. Carancahua St Suite 500 Corpus Christi, TX 78478	361-888-3162	cecilio.banuelos@dhs.gov	✓	✓		✓	✓	✓
4	Biel, Mark	Padre Island National Seashore	P.O. Box 181300	361-949-8173	mark_biel@nps.gov	✓	✓	✓	✓	✓	✓
2	Cocanour, Amy	U.S. Coast Guard	500 Poydras Street NO, LA 70130	504-671-2231	amy.b.cocanour@uscg.mil				✓	✓	✓
2	Darst, Keeli	USCG	Sector Houston/Galveston 9640 Clinton Drive Houston, TX 77029	713-671-5111	keeli.s.darst@uscg.mil	✓	✓	✓			
3	Dorf, Barbara	Texas Parks and Wildlife Department	702 Navigation Circle Rockport, TX 78382	361-729-2328	barbara.dorf@tpwd.state.tx.us	✓	✓	✓	✓	✓	✓
1	Eckard, Chris	U.S. Coast Guard	555 N. Carancahua St. Suite 500 Corpus Christi, TX 78478	361-888-3162	christopher.s.eckard@uscg.mil	✓	✓				
3	Forsythe, Barry	U.S. Fish and Wildlife Service	1445 Ross Avenue Ste 1200 Dallas, TX 75202	214-665-8467	forsythe.barry@epa.gov	✓	✓	✓	✓	✓	✓
	Henry, Charlie	NOAA U.S.C.G. 8th District P-SSC	500 Poydras Street, NO LA 70130	206-849-9928	Charlie.Henry@noaa.gov	✓	✓	✓	✓	✓	✓
	Gavilanes, Carlos	U.S. Coast Guard	555 N. Carancahua St Suite 500 Corpus Christi, TX 78478	361-443-7212	carlos.f.gavilanes@uscg.mil	✓	✓	✓	✓	✓	✓
3	Goetzee, Bill	U.S. Coast Guard	500 Poydras Street, Suite 1330 New Orleans, LA 07130	504-671-2234	william.w.goetzee@uscg.mil	✓	✓	✓	✓	✓	✓
	González, Benito	U.S. Coast Guard		956-534-4915	benito.gonzalez@uscg.mil	✓	✓	✓	✓	✓	✓
3	Hensley, Rebecca	Texas Parks and Wildlife Department	1502 E 517 FM Dickinson, TX 77539	281-534-0108	rebecca.hensley@tpwd.state.tx.us	✓	✓	✓			
4	Hockaday, Don	University of Texas – Pan Am Coastal Studies Lab	100 Marine Lab Drive South Padre Island, TX 78597	956-761-2644	hockaday@utpa.edu	✓	✓	✓	✓	✓	✓
1	Jones, Elizabeth	NOAA	1240 East 9th Street Rm 307 Cleveland, OH 44199	206-849-9918	elizabeth.jones@noaa.gov	✓	✓	✓			
4	Koza, Brent	TGLO	6300 Ocean Drive Corpus Christi, TX 78412	361-825-3300	brent.koza@glo.state.tx.us	✓	✓	✓	✓	✓	✓
4	Lee, Clare	U.S. Fish and Wildlife Service	6300 Ocean Drive Corpus Christi, TX 78412	361.994.9005	Clare_Lee@fws.gov	✓	✓	✓	✓	✓	✓
	Leiva, Blanca	USCG	555 N. Carancahua Suite 500 Corpus Christi, TX 78478	361-888-3162	blanca.a.leiva@uscg.mil	✓	✓	✓	✓	✓	✓
	Lopez, Javier	U.S. Coast Guard	228 Tarawa Circle Belle Chase, LA 70037	504-671-2232	javier.e.lopez@uscg.mil	✓	✓	✓	✓	✓	✓
3	Marshall, Patrick	U.S. Coast Guard	555 N. Carancahua Suite 500 Corpus Christi, TX 78478	361-888-3162	patrick.a.marshall@uscg.mil	✓	✓	✓	✓	✓	✓
3	Martin, Buzz	TGLO	P.O. Box 12873 Austin, TX 12873	512-475-4611	buzz.martin@glo.state.tx.us	✓	✓	✓			
4	McNeer, Stacy	U.S. Coast Guard	555 N. Carancahua St. Suite 500 Corpus Christi, TX 78478	361-888-3162	stacy.l.mcneer@uscg.mil	✓	✓		✓	✓	✓
3	Miget, Russell	Texas Sea Grant Extension	6300 Ocean Drive Corpus Christi, TX 78412	361-825-3460	rmiget@falcon.tamucc.edu	✓	✓	✓			
3	Neahr, Todd	TPWD-Coastal Fisheries	Corpus Christi, TX 78412	361-825-3354	todd.neahr@tpwd.state.tx.us	✓					
3	Nettesheim, Therasa	U.S. Coast Guard	555 N. Carancahua Suite 500 Corpus Christi, TX 78478	361-888-3162	therasa.m.nettesheim@uscg.mil	✓	✓	✓	✓	✓	✓

Group #	NAME	AGENCY	ADDRESS	PH NUMBER	e-MAIL	October Attendance			November Attendance		
						16	17	18	6	7	8
4	Nuñez, Alex	Texas Parks and Wildlife Department	6300 Ocean Dr Corpus Christi, TX 78412	361 825-3246	alex.nunez@tpwd.state.tx.us	✓	✓	✓	✓	✓	✓
	Reger, Walter	U.S. Coast Guard	500 Poydras St Suite 1330 New Orleans, LA 70130	504-671-2059	walter.j.reger@uscg.mil	✓	✓	✓			
2	Reyes, Ernesto	U.S. Fish and Wildlife Service	Rte. 1 Box 202-A Alamo, TX 78516	956-784-7560	ernesto_reyes@fws.gov	✓	✓	✓	✓	✓	✓
4	Russell, Richard	U.S. Coast Guard	500 Poydras Street, Suite 1122 New Orleans, LA 07130	504-671-2082	richard.russell@uscg.mil	✓	✓	✓			
1	Salgado, Juan	TGLO	2145 EMS Brownsville, TX 78521	956-504-1417	juan.salgado@glo.state.tx.us	✓	✓	✓	✓	✓	✓
	Simons, Peter	U.S. Coast Guard	8930 Ocean Drive Corpus Christi, TX 78419	361-939-6202	peter.s.simons@uscg.mil	✓	✓	✓	✓	✓	✓
	Slaughter, Ann	Ecosystem Management & Associates, Inc.	13325 Rousby Hall Rd Lusby, MD 20657	410-394-2929	a.slaughter@ecosystem-management.net	✓	✓	✓	✓	✓	✓
2	Solum, Sherrill	U.S. Coast Guard	555 N. Carancahua Suite 500 Corpus Christi, TX 78478	361-888-3161	sherrill.c.solum@uscg.mil	✓	✓	✓	✓	✓	✓
	Trevino, Jorge	Translation Services	1765 Old Creek Ct., Brownsville, TX 78521	956-545-7758	trevinojorge@prodigy.net	✓	✓	✓	✓	✓	✓
2	Torres, Alberto	U.S. Coast Guard	Sector Houston/Galveston 9640 Clinton Drive Houston, TX 77029	713-671-5168	alberto.torres@uscg.mil	✓	✓	✓			
3	Wood, Carolyn	Tx Commission on Env. Quality	1804 West Jefferson Avenue	956-389-7431	cawood@tceq.state.tx.us	✓	✓				
	Arauz Arredondo, Adalberto	Secretaria de Marina	Av. Alvaro Obregon S/N Col. Emilio Carranza Madero, Tamaulipas 89540	52 833 215 7915	manito000@hotmail.com	✓	✓	✓	✓	✓	✓
2	Camacho Martínez, Luis Manuel	Comisión Nacional del Agua (Calidad del Agua e Impacto Ambiental)	Zaragonza No. 212 Col. Ampliacion de la Unidad Nacional Madero, Tamauplipas 89210	833 211 4315	luis.camachom@cna.gob.mx	✓	✓	✓	✓	✓	✓
2	De Olaguibel Domínguez, Jesús Salvador	Secretaría de Marina (E.I.O.T.)	Av. Alvaro Obregon S/N Col. Emilio Carranza, Cd. Madero, Tamaulipas 89540	(52-833) 215 48 99 / 103 83 05	jesusdeolaguibel@hotmail.com	✓	✓	✓	✓	✓	✓
2	Díaz Arredondo, Miguel Ángel	SEMAR - Instituto Oceanografico del Golfo	Int. Heroica Escuela Naval Militar Anton Lizardo Alvarado Veracruz 95263	297-95-60-109	mdiaz12@hotmail.com	✓	✓	✓	✓	✓	✓
1	González Barcelata, Julio C.	Armada de Mexico	Sria de Marina Eje 2 Ote #681 Mexico D. F.	55 56246500	s3jemg@semar.gob.mx	✓	✓	✓			
	González Nakagawa, Otilia	Secretaría de Marina (Bentos Moluscos)	Av. Alvaro Obregon S/N Col. Emilio Carranza Madero, Tamaulipas 89590	52 833 2157915	fer_bsb16@hotmail.com	✓	✓	✓	✓	✓	✓
1	Gorbea Uribe, María Teresa	Secretaría de Marina	Xicotencatl S/N Edif Faro Venusitiano Carranza Veracruz, Veracruz 91700	22 99 320066	tgorbea@hotmail.com dapav_ver@yahoo.com.mx	✓	✓	✓	✓	✓	✓
1	Guadarrama Mendoza, Teresa Alejandra	Secretaría de Marina	Av. Alvaro Obregon S/N Col. Emilio Carranza Madero, Tamaulipas 89540	52 833 215 4899	terezalejandra@hotmail.com	✓	✓	✓	✓	✓	✓
1	Hernandez Ramirez, Norma Angelica	Armada de Mexico	Boulevard Costero S/N y Sangines Pedro Loyola 357-58 Ensenada, Baja Mexico 22800	646 177 3966 EXT 2155	normaahrmz@hotmail.com	✓	✓	✓			
1	Lorenzo Domínguez, Elsa Patricia	Secretaría de Marina	Eje 2 OtE. T.H.E.N. #861 Edif B Mexico, D.F. 04830	(52 56) 266223 / 246223	promamdir@yahoo.com.mx	✓	✓	✓	✓	✓	✓
	Monterrey Rangel, Jonathan	Armada de Mexico	Delfin Madrigal 95 A3-304 Copilco Coyoacan Mexico, D.F.	52 552 336 9691	jonathanemr@yahoo.com.mx	✓	✓	✓	✓	✓	✓
1	Reyes Mar, Marco Antonio	Administración Portuaria Integral de Altamira (Ecologia)	Rio Tamesi Km 0 + 800 Lado Sur Puerto Industrial de Altamira, Altamira Tamaulipas 89608	(52 833) 260 6060/272 6383	mreyes@puertoaltamira.com.mx	✓	✓	✓	✓	✓	✓
2	Tapia Entenza, Alfredo Jonas	Instituto Tecnológico Altamira (Meteorologia)	Carr. Tampico-Mante Km 24.5, Altamira, Tampico, Tamaulipas 89329	833-227-68-13	alfredojtentenza@hotmail.com	✓	✓	✓	✓	✓	✓
2	Velázquez Molina, Francisco	Secretaría de Marina	Eje 2 Oto. T.H.E.Navel #861 Edif B Mexico, D.F. 04830	56 24 65 00	promamdir@yahoo.com.mx	✓	✓	✓	✓	✓	✓

Appendix B

HOPE ESPERANZA Incident

MEXUS ERA: Tanker Vessel HOPE ESPERANZA Incident

The following scenario creates similar threats and decisions on both sides of the US-Mexico boarder during the planned MEXUS Ecological Risk Assessment (ERA) Exercise. The scenario should provide exploration of future contingency planning, an opportunity to exercise elements of the MEXUS Plan, and evaluate the RRT6 Nearshore Expedited Dispersant Approval Process. The scenario allows for dispersant use off the waters of Texas and Tamaulipas as an oil spill mitigation response technique.

While the true possibility of the scenario occurring as outlined is similar to the chances of winning a lottery, the ERA exercises are designed to test response options regardless of the origin of the oil spill. What is import for the ERA exercise is that oil has entered the nearshore waters and response actions will affect the impact of the spill to highly sensitive coastal resources. Forcing the oil to impact two highly sensitive bay-side estuary complexes in two separate countries from a single event was a challenge. That said, the possibility of a tanker incident due to a multitude of causes off the western Gulf of Mexico coast is a true risk along the Western Gulf of Mexico.

Chronology of Events:

8 October 2007

1800 hrs The Tanker Vessel HOPE ESPERANZA reports that there was an explosion in the engine room and that the vessel is adrift and on fire.

9 October 2007

0005 hrs The ship reports that there was a second explosion in the area of the number 5 Port Cargo Hold and the crew are preparing to abandon ship. The vessel continues to burn and drift.

This second explosion created a hole between the deck and the Number 5 Port Cargo Hold. While the hold currently contains 1.2 Million Gallons of Angola Soyo Crude Oil, only 60,000 gallons was thought to be lost because the damage was well above the waterline. The double hull construction has limited both the release and the intensity of the fire because the hold is only partially open. The entire vessel has 26 million gallons of crude oil, 170,000 gallons of IFO-180, and various quantities of diesel and lube oils on board. At the time of the incident, the coastal current was relatively slack, but down-coast current flow is expected to pick up. The winds have an easterly or on-shore component.

Note: Angola Soyo was the generic oil selected to run the models, there are some basic assumptions that were made in developing this scenario. First, under the sea state conditions, emulsification will be such that the oil will remain dispersible for two full days. Once fully emulsified, the residual oil will be a mousse with percent water content of 80 percent. Like the scenario itself, the oil must have a broad enough weathering behavior to allow many different response techniques to be evaluated.

0300 hrs Dispersant aircraft in Houma Louisiana are put on standby.

0730 hrs USCG reports that the vessel is still burning and adrift. The overflight indicates an oil slick is visible west of the vessel. Although still burning, the fire appears to be contained to engine spaces and a single hold. Very little oil continues to escape. Oil continues to slowly burn. The size of the hole and restricted airflow are believed to reducing the size of the fire.

0830 hrs The USCG reports that the crew has been recovered. There are no fatalities, but several of the crew were reported injured from attempting to fight the engine room fire and possibly due to the explosion.

(1500 hrs Dispersant operations, if used, are completed.)

10 October 2007

0700 hrs Oil is reported on South Padre Island Beaches. The expected down coast current flow is now in effect (during October, it is not uncommon for these currents to flip-flop). Winds continue to blow from the east.

0900 hrs Fire suppression efforts are believed to have exhausted the fire, but cooling water and foam are still being applied to reduce the risk of additional fire or explosion. The situation is still reported as “wait and see.”

1200 hrs The fire is believed to have essentially stopped. The vessel has begun to take on a STBD list.

11 October 2007

0700 hrs Salvage crews are on the vessel conducting a damage inspection and working to correct the reported list.

1300 hrs Salvage crews have used a helo lift to drop several pumps to control the list by pumping a ballast tank to sea. Tugs have secured the tanker from uncontrolled drift. The lightering vessel will arrive on-scene later today.

1800 hrs During the operations to correct the starboard list, number 5 PORT Cargo Hold cracks and a second oil spill has been reported by the marine salvors, or salvage team. The list has only been controlled, and not fully corrected to reduce additional oil release.

The second release is estimated at 80,000 gallons. The oil is reported moving to the southwest.

12 October 2007

1200 hrs The vessel has been stabilized and is being positioned for lightering. The oil spill from the day before continues to move toward shore. Response vessels are on-scene and skimming.

13 October 2007

(1500 hrs Dispersant operations, if used, are completed. Note, in this current outline, dispersants are used on the second full day of response to the second release. This allows a different prospective as to weathering and an opportunity to work any “red-tape” issues between the RP’s spill management team and the United States of Mexico. The oil will still be dispersable.)

14 October 2007

1200 hrs Oil is reported to be coming ashore near Santa Maria, Tamaulipas.

Appendix C

Resources At Risk

Resources At Risk

Region	Habitat	Subhabitat	Resource Category	Example Organisms
Outer Coast	Terrestrial (Barrier Island)		Vegetation	Railroad vine, beach morning glory, sea oats, seashore saltgrass, pennywort, ground cherry, phlox
			Birds	Osprey, gulls, doves, starling, warblers, sparrows, eastern meadowlark, American kestrel
			Mammals	spotted ground squirrel, kangaroo rat, coyote, white tailed deer, racoon, opossum
			Reptiles/amphibians	frogs, toads, snakes , lizards
			Arthropods	insects, spiders
	Intertidal Shoreline	Sand Beaches	Birds	Laughing gull, Willet, Ruddy Turnstone, Curlew, terns
			Mammals	coyote, spotted ground squirrel, racoon
			Reptiles/amphibians	Kemps ridley sea turtles, loggerhead sea turtle, green sea turtle
			Arthropods	mole crab, ghost crab
			Molluscs	Variable Coquina
			Infauna	amphipods, nematodes, copepods
		Riprap/man-made	Vegetation	sea lettuce, red and brown algae
			Birds	Laughing gull, Brown Pelican
			Mammals	rodents
			Reptiles/amphibians	Kemps ridley sea turtles, loggerhead sea turtle, green sea turtle
			Fish	blennies, gobies, sheepshead, mullet
			Arthropods	hermit crabs, stone crab, blue crab
			Molluscs	snails
			Epifauna	mussels, anemones, sea squirts, barnacles, sponges
	Benthic (Subtidal)	Shallow (<5 meters)	Vegetation	macroalgae
			Birds	diving ducks, cormorants, loons, grebes, coots
			Reptiles/amphibians	Kemps ridley sea turtles, loggerhead sea turtle, green sea turtle
			Fish	rays, flounder, toadfish, eel, drum
			Arthropods	blue crab, brown shrimp, hermit crabs
			Molluscs	bay scallop, snails, clams
			Infauna	amphipods, polychaete worms
		Deep (>5 meters)	Reptiles/amphibians	Kemps ridley sea turtles, loggerhead sea turtle, green sea turtle
			Fish	rays, flounder, toadfish, eel, drum
			Arthropods	blue crab, brown shrimp, hermit crabs
			Molluscs	bay scallop, snails, clams
			Infauna	amphipods, polychaete worms
	Water Column	Water Surface (microlayer)	Plankton	larval invertebrates (esp. shrimp, crabs, molluscs), copepods, fish eggs and larvae, diatoms
			Birds	diving ducks, cormorants, loons, grebes, coots, geese, swans, gulls, pelicans, terns
			Reptiles/amphibians	Kemps ridley sea turtles, loggerhead sea turtle, green sea turtle
			Fish	shark, silverside, flying fish, halfbeak, anchovy, mullet

Resources At Risk (Cont.)

Region	Habitat	Subhabitat	Resource Category	Example Organisms
Outer Coast (cont.)	Water Column (cont.)	Upper 5 meters	Plankton	larval invertebrates, copepods, fish eggs and larvae, diatoms
Outer Coast (cont.)	Water Column (cont.)	Upper 5 meters	Birds	diving ducks, cormorants, loons, grebes, coots, pelicans, terns
Outer Coast (cont.)	Water Column (cont.)	Upper 5 meters	Reptiles/amphibians	Kemps ridley sea turtles, loggerhead sea turtle, green sea turtle
Outer Coast (cont.)	Water Column (cont.)	Upper 5 meters	Fish	shark, silverside, flying fish, halfbeak, anchovy, mullet, drum, grunt, rays, sardine, perch, redfish
Outer Coast (cont.)	Water Column (cont.)	Upper 5 meters	Arthropods	shrimp, swimming crabs
Outer Coast (cont.)	Water Column (cont.)	Upper 5 meters	Molluscs	squid
Outer Coast (cont.)	Water Column (cont.)	Upper 5 meters	Coelenterates	jellyfish, ctenophores
Outer Coast (cont.)	Water Column (cont.)	From 5 meters below surface to 5 meters above bottom	Plankton	larval invertebrates, copepods, fish eggs and larvae, diatoms
Outer Coast (cont.)	Water Column (cont.)	From 5 meters below surface to 5 meters above bottom	Reptiles/amphibians	Kemps ridley sea turtles, loggerhead sea turtle, green sea turtle
Outer Coast (cont.)	Water Column (cont.)	From 5 meters below surface to 5 meters above bottom	Fish	shark, silverside, flying fish, halfbeak, anchovy, mullet, drum, grunt, rays, sardine, perch, redfish
Outer Coast (cont.)	Water Column (cont.)	From 5 meters below surface to 5 meters above bottom	Arthropods	shrimp, swimming crabs
Outer Coast (cont.)	Water Column (cont.)	From 5 meters below surface to 5 meters above bottom	Molluscs	squid
Outer Coast (cont.)	Water Column (cont.)	From 5 meters below surface to 5 meters above bottom	Coelenterates	jellyfish, ctenophores
Outer Coast (cont.)	Water Column (cont.)	Bottom 5 meters	Plankton	larval invertebrates, copepods, fish eggs and larvae, diatoms
Outer Coast (cont.)	Water Column (cont.)	Bottom 5 meters	Reptiles/amphibians	Kemps ridley sea turtles, loggerhead sea turtle, green sea turtle
Outer Coast (cont.)	Water Column (cont.)	Bottom 5 meters	Fish	shark, mullet, drum, grunt, rays, perch, redfish, flounder
Outer Coast (cont.)	Water Column (cont.)	Bottom 5 meters	Arthropods	shrimp, swimming crabs
Outer Coast (cont.)	Water Column (cont.)	Bottom 5 meters	Molluscs	squid
Outer Coast (cont.)	Water Column (cont.)	Bottom 5 meters	Coelenterates	jellyfish, ctenophores
Inshore Habitats	Terrestrial		Vegetation	sea oats, sedge, beach morning glory, glasswort
Inshore Habitats	Terrestrial		Birds	Osprey, gulls, doves, starling, warblers, sparrows, eastern meadowlark, American kestrel
Inshore Habitats	Terrestrial		Mammals	spotted ground squirrel, kangaroo rat, coyote, white tailed deer, racoon, opossum
Inshore Habitats	Terrestrial		Reptiles/amphibians	frogs, toads, snakes , lizards
Inshore Habitats	Terrestrial		Arthropods	insects, spiders
Inshore Habitats	Intertidal Shoreline	Sand Beaches	Birds	Laughing gull, Willet, Ruddy Turnstone, Curlew, terns
Inshore Habitats	Intertidal Shoreline	Sand Beaches	Mammals	coyote, spotted ground squirrel, racoon
Inshore Habitats	Intertidal Shoreline	Sand Beaches	Arthropods	mole crab, ghost crab
Inshore Habitats	Intertidal Shoreline	Sand Beaches	Molluscs	Variable Coquina
Inshore Habitats	Intertidal Shoreline	Sand Beaches	Infauna	amphipods, nematodes, copepods

Resources At Risk (Cont.)

Region	Habitat	Subhabitat	Resource Category	Example Organisms
Inshore Habitats (cont.)	Intertidal Shoreline (cont.)	Vegetated Marshes	Vegetation	saltwort, glassworts, saltgrass, keygrass, sea purslane
			Birds	herons, ibis, spoonbills, rails, American Oystercatcher, blue and green-winged teal, widgeon, shovelers, egrets.
			Mammals	racoon, opossum
			Reptiles/amphibians	diamondback terrapin, marsh snake
			Fish	killifish, silversides, sheepshead, spot, gobies, juveniles (many species), seahorse, pipefish
			Arthropods	grass shrimp, fiddler crab, hermit crabs, mud crabs
			Molluscs	snails, mussels
			Epifauna	anemones, sea squirts
			Infauna	amphipods, nematodes, copepods, polychaete worms
		Black Mangrove Forest	Vegetation	black mangrove, diatoms, macroalgae
			Birds	herons, ibis, spoonbills, rails, gulls
			Mammals	racoon, opossum
			Reptiles/amphibians	diamondback terrapin, marsh snake
			Fish	killifish, silversides, sheepshead, spot, gobies, juveniles (many species), seahorse, pipefish
			Arthropods	grass shrimp, fiddler crab, hermit crabs, mud crabs, barnacles
			Molluscs	snails, mussels
			Epifauna	mussels, anemones, sea squirts, barnacles
			Infauna	amphipods, nematodes, copepods, polychaete worms
		Infrequently Flooded Salt Flats	Vegetation	blue-green algae
			Birds	herons, ibis, spoonbills, rails, American Oystercatcher, blue and green-winged teal, widgeon, shovelers, egrets.
			Mammals	racoon, opossum
			Fish	killifish, silversides, anchovy
			Arthropods	hermit crabs, mud crabs
			Molluscs	snails
			Infauna	amphipods, nematodes, copepods, polychaete worms
		Riprap/man-made	Vegetation	macroalgae, diatoms
			Birds	Laughing gull, Brown Pelican
			Mammals	racoon, opossum
			Reptiles/amphibians	Kemps ridley sea turtles, loggerhead sea turtle, green sea turtle
			Fish	blennies, gobies
			Arthropods	hermit crabs, stone crab, blue crab
			Molluscs	snails
			Epifauna	mussels, anemones, sea squirts, barnacles, sponges

Resources At Risk (Concluded)

Region	Habitat	Subhabitat	Resource Category	Example Organisms
Inshore Habitats (cont.)	Benthic (Subtidal)	Soft Bottom	Vegetation	macroalgae
			Birds	diving ducks, cormorants, loons, grebes, coots
			Reptiles/amphibians	Kemps ridley sea turtles, loggerhead sea turtle, green sea turtle
			Fish	rays, flounder, toadfish, eel, drum
			Arthropods	blue crab, brown shrimp, hermit crabs
			Molluscs	bay scallop, snails, clams
			Infauna	amphipods, polychaete worms
Inshore Habitats (cont.)	Special Habitats (Intertial and Benthic)	Oyster Reefs	Birds	egrets, diving ducks, gulls, terns
			Fish	gobies, silversides, pinfish, juvenile fish, gobies, blennies
			Arthropods	mud crabs, hermit crabs, snapping shrimp, juvenile brown shrimp
			Molluscs	oysters, snails, mussels
			Epifauna	anemones, sea squirts, barnacles, sponges
		Sea Grass Beds	Vegetation	sea grasses (widgeon grass, manatee grass, shoal grass, halophila), macroalgae, benthic diatoms
			Birds	wading birds (reddish egret, sandhill cranes, American and least bittern), ducks
			Fish	pipefish, seahorse, killifish, sheepshead minnow, juvenile fish
			Arthropods	grass shrimp, hermit crabs, mud crabs, blue crab
			Molluscs	snails
			Epifauna	anemones, sea squirts, filamentous algae, diatoms
			Infauna	amphipods, nematodes, copepods, polychaete worms
	Water Column	Water Surface (microlayer)	Plankton	larval invertebrates, copepods, fish eggs and larvae, diatoms
			Birds	ducks (scaup, northern pintail, readhead, bufflehead), gulls, wading birds
			Fish	silverside, halfbeak, anchovy, mullet
		Remaining Water Column	Plankton	larval invertebrates, copepods, fish eggs and larvae, diatoms
			Birds	diving ducks
			Fish	silverside, flying fish, halfbeak, anchovy, mullet, drum,sardine, perch, redfish
			Arthropods	shrimp, swimming crabs
			Coelenterates	jellyfish, ctenophores