Draft Environmental Impact Report

APPENDIX C

MARITIME RISK ASSESSMENT

Appendix C-1

Maritime Risk Assessment for the P66 Rodeo Refinery Renewable Diesel Project (AcuTech May 2, 2021)

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Maritime Risk Assessment for the P66 Rodeo Refinery Renewable Diesel Project

Prepared for:

Phillips 66
Rodeo Refinery
Rodeo, CA

May 2, 2021

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1. Introduction

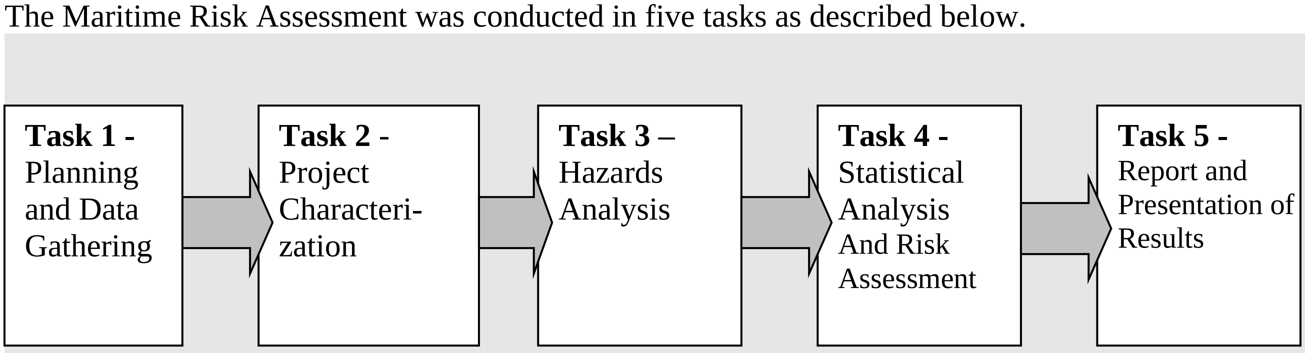
AcuTech was engaged by Phillips 66 Company ("Phillips 66") to conduct a Maritime Risk Assessment of the projected increase in marine vessel and barge traffic associated with Phillips 66's proposed Rodeo Renewed Project ("Project") at its current Rodeo Refinery ("Refinery") in Rodeo, California. When the Project is operational, the Refinery's Marine Terminal will receive vessels to offload renewable feedstocks, including vegetable oil, beef tallow, and soybean oil, which will be used at the Refinery for the manufacturing of renewable transportation fuels. The scope of AcuTech's risk assessment also includes vessels arriving at the Marine Terminal to load renewable fuels and treated feedstocks and to offload gasoline blendstocks to be used in the Project's petroleum-based gasoline blending operation.

2. Analysis Scope

This Maritime Risk Assessment quantifies the increased risk of vessel or barge accidents in the San Francisco Bay area caused by the Project. For the purposes of this Maritime Risk Assessment, AcuTech received the Project assumptions from Phillips 66 as described below. For analysis purposes, the expected number of transits for the Project are 201 Handymax vessels and 161 barges. The Project assumes Handymax vessels will be used at the Marine Terminal and they are within the size range of earlier vessels calling on the existing terminal – the ships hold approximately 350,000 bbl. Crude ships calling at Rodeo are larger. Handymax vessels are bulk carriers with a capacity less than 60,000 DWT. A Handymax vessel typically has a capacity between 35,000 and 58,000 DWT and are well suited for small ports with length and draught restrictions, or ports lacking transshipment infrastructure. Tug assist is required on the transits of Handymax vessels.

3. Project Approach

The Maritime Risk Assessment was conducted in five tasks as described below.



3.1. Task 1 – Planning and Data Gathering

Initial planning was completed through a meeting by teleconference between Phillips 66 and AcuTech. The meeting confirmed the purpose, scope, approach, and schedule for the project phases and provided an opportunity for clarifications on AcuTech's project approaches. AcuTech also reviewed the current project plans, current engineering and permitting schedule and approach, and gathered data necessary for the analysis.

3.2. Task 2 – Project Characterization

AcuTech analyzed available data for the waterway and evaluated project assumptions provided by Phillips 66 and area onshore and offshore data such as vessel population, traffic, types of vessels transiting the San Pablo Bay. AcuTech also reviewed and evaluated incident summaries from historical data provided by the USCG, USACE, and Marine Exchange. The expected number of transits for the Project are 201 Handymax vessels and 161 barges, which were used as the basis of the Maritime Risk Assessment.

3.3. Task 3 – Hazards Analysis

AcuTech's technical approach for the risk assessment is to base the assessment on the analysis of best available data that has been developed in the Bay that is useful for estimating Marine Scenarios such as collisions, allisions, or groundings. The specific project assumptions regarding traffic were then used to adjust the previous statistical analysis with current and projected data for the waterway.

3.4. Task 4 – Statistical Analysis and Risk Assessment

AcuTech analyzed the scenarios identified in Task 3 in further detail and evaluated best available data for estimation of the Project risk. AcuTech prepared a statistical summary based on the number of expected marine releases of 100 gallons or more over the number of transits and compared this with previous risk assessments done for approved EIRs . AcuTech conducted a statistical summary of the number of expected project vessels taking the route to and from the refinery wharf, the number of total vessels taking those same routes or in near proximity posing marine incident risks, and calculated the incremental increase of risk from the Project.

3.5. Task 5 - Report and Presentation of Results

AcuTech presents its results in this report.

4. Results

The probability of marine vessel collisions, allisions, and groundings that can cause a significant (greater than 100 gallons) spill of hazardous materials into the San Pablo Bay as a result of the Project is based on 1) previous analyses performed in the Environmental Impact Reports (EIR) of other marine terminals and similar facilities in the San Pablo Bay, Carquinez Straits, and Suisun Bay area, and 2) an extensive study done by the U.S. Department of Transportation (DoT) in 1991 to support the design and installation of the Vessel Traffic System (VTS) for major U.S. ports. Information in the EIRs relied on by AcuTech made use of the relevant information needed to determine probabilities of incidents, similar to the goal of this Maritime Risk Assessment. In these EIRs, the probabilities of marine releases of 100 gallons or more was calculated based on historical data for past spills, marine traffic in that area of San Francisco Bay in certain years, and a common methodology that U.S. DoT had developed.

4.1. Probability Analysis

AcuTech relied upon data obtained from the following documents to perform this Maritime Risk Assessment:

- Unocal San Francisco Refinery Marine Terminal Environmental Impact Report (EIR) (Chambers Group, 1994)
- Tosco Avon Marine Oil Terminal EIR (TRC, 2015)
- Tesoro Amorco Marine Oil Terminal EIR (TRC, 2014)
- WesPac Pittsburg Energy Infrastructure Project (TRC, 2012)
- Shell Martinez Marine Lease Consideration Final EIR (CSLC, 2011a)
- Port Needs Study (John A. Volpe Transportation Center of the U.S. Department of Transportation (DoT), Cambridge, MA, 1991)
- San Francisco Marine Exchange traffic data from 2017-2019.

The first five references are EIRs submitted to California agencies for various projects in the vicinity of the proposed P66 Rodeo Renewable Diesel Project location at the existing marine terminal at the Rodeo refinery. One of the past projects referenced was for the exact same marine terminal being proposed for use in the renewable fuels Project – i.e., the marine terminal at issue in the Unocal San Francisco Marine Terminal Environmental Impact Report. The sixth source referenced is the technical basis for the marine release probability calculations contained in the five EIRs, and the seventh source is the basis for current marine tanker and barge traffic.

The Port Needs Study was performed by the John A. Volpe Transportation Center of the U.S. Department of Transportation (DoT) in Cambridge, MA in 1991 to provide a detailed cost-benefit analysis in support of the new national Vessel Traffic System (VTS) being proposed at the time for 23 deep draft ports in the U.S. This study included a detailed probabilistic navigational risk analysis for each port (called a zone in the study). Each port/zone was subdivided into subzones for the analysis. San Francisco Bay was one of the ports/zones in the study, and the San Pablo Bay to the Carquinez Straits area of the Bay was one of the subzones analyzed.

The results of a detailed linear regression analysis was used in the Port Needs Study to adjust the marine casualty rate of events with significant consequences, including spills of hazardous materials into the water, for the specific navigational risk factors in the subzones, e.g., wind conditions, weather conditions, width of channel, etc. Marine traffic for the base year of 1987 and casualty occurrence data for the period 1979-1989 were used for the base casualty probability calculations in the study.

In the Port Needs Study, as well as in the five EIRs referenced, the results were adjusted by applying anticipated differences in marine traffic in the area of the facility being proposed. This was done by multiplying the corrected double hull probability of spills per transit by the number of transits for the subzone of concern. Therefore, the methodology used in the DoT Port Needs Study and adapted for use in these prior EIRs for facilities in the northeast portion of San Francisco Bay are considered relevant for use and the best means of estimation of incidents associated with the Project.

Table 2 presents oil spill probabilities from barges and tankers from three causes: (1) collisions, which are impacts between two or more moving vessels; (2) rammings (or allisions), for which moving vessels collide with stationary objects; and (3) groundings. These probabilities were calculated from the individual probabilities of small, medium, and large tankers and liquid-carrying barges, considering the volume of traffic in each category and the characteristics of the northeast area of San Francisco Bay (derived from data in DoT Port Needs Study).

In accordance with the methodology in the Unocal San Francisco Refinery Marine Terminal EIR (which involved the same marine terminal as the Project), and which was applied in the other San Francisco Bay marine project EIRs, a 0.10 reduction factor has been applied in this Maritime Risk Assessment to tanker and barge groundings for double-bottom and double-hull vessels, and a 0.71 reduction factor has been applied to tanker and barge collisions for double-hull vessels. The estimated probabilities of spills from the various types of tankers and barges, after applying the reduction factors, are presented in Table 2.

Federal regulations established a timeline for eliminating single-hull vessels carrying petroleum or petroleum products from operating in inland waterways or in the Exclusive Economic Zone of the United States after January 1, 2010 (the Exclusive Economic Zone extends outward to a distance of 200 nautical miles from the shoreline), and eliminating double-bottom or double-sided vessels by January 1, 2015. Only vessels carrying petroleum or petroleum products equipped with a double hull, or with an approved double-containment system, are allowed to operate after those dates. The tankers and barges that are anticipated to be used for the delivery of oils to the refinery that will be processed into renewable diesel fuel, as well as the shipment of the final products from the refinery, will be double-hull vessels.

For the purposes of this analysis it has been assumed that currently 80 tankers and 90 barges carrying oil or fuel materials call annually at the Marine Terminal. This is based on traffic data for years 2017-2019. These are all double-hulled vessels per current federal regulation. Based on this mix of tanker vessels/barges, Table 3 presents the annual probabilities of a spill greater than 100 gallons inside the San Francisco Bay resulting from a vessel transiting to the Marine Terminal. The overall current probability of a release over 100 gallons of 5.19 X 10^{-4} equates to approximately one spill every 1,927 years.

The Project is estimated to add an additional 192 vessel calls annually (121 tankers and 71 barges) at the Marine Terminal to deliver renewable feedstocks and gasoline blendstocks to the refinery, and to ship finished renewable transportation fuels and pre-treated renewable feedstock from the refinery. Therefore, the new total tanker and barge traffic at the Phillips 66 wharf after the Project is operational and used for this analysis is 201 tankers and 161 barges. Table 4 presents the annual probabilities of a spill greater than 100 gallons at the Marine Terminal once the Project is commissioned. This additional tanker and barge traffic will increase the estimated release probability to 9.77×10^{-4}, or approximately one spill of 100 gallons or more every 1,024 years. This represents approximately 0.049 releases over a 50-year history of operations, which is a typical assumption of the life span of many large-scale industrial facility processes.

During the approximately seven - month interim period between the start of construction of the renewables Project at the Rodeo refinery and the startup of the renewables Project, the traffic at the Marine Terminal is estimated to be 96 tankers and 92 barges on an annual basis. Because the increase in traffic during the interim period is less than the Project increase, the probability of a marine release of 100 gallons at the Marine Terminal during the interim period will be less than the probability after the Project is commissioned.

Table 2: Spill Probabilities by Vessel Type
Probability of Spill Greater than 100 Gallons, per Vessel Calling

Vessel Type	Spill Probabilities (No Reduction Factors)				Applying Reduction Factor for Double Hull Vessels
	Collision	Allision	Grounding	Total	
Tanker	9.12×10^{-7}	1.42×10^{-7}	5.58×10^{-7}	1.61×10^{-6}	8.45×10^{-7}
Barge	4.86×10^{-6}	1.50×10^{-6}	6.02×10^{-7}	6.96×10^{-6}	5.01×10^{-6}

Source: Derived from John A. Volpe National Transportation Center, 1991

Table 3: Current Probability of Annual Spills from Vessels Calling at the Marine Terminal

Vessel Type	Probability of Release
Tankers	6.76×10^{-5}
Barges	4.51×10^{-4}
Tankers & Barges	$\mathbf{5.19 \times 10^{-4}}$

Table 4: Probability of Annual Spills from Vessels Calling at the Marine Terminal Post-Project

Vessel Type	Probability of Release
Tankers	1.70×10^{-4}
Barges	8.07×10^{-4}
Tankers & Barges	$\mathbf{9.77 \times 10^{-4}}$

4.2. Conclusions

The final probability of significant spills into the Bay from the Project is approximately one spill every 1,024 years, which is lower than the other projects in the same area listed above. The underlying data and methodology derived from the DoT Volpe Center Port Needs Study is approximately 30 years old but is considered valid for the purposes of estimating spill probabilities into the marine environment from vessels and to yield a conservative spill probability result for the following reasons:

- The marine traffic for the portion of San Francisco Bay where the project is located, i.e., the San Pablo Bay and Carquinez Strait area, has decreased in the past 30 years. The Port Needs Study data for that part of the Bay shows that there were 3,347 tanker and 3,893 liquid barge transits in that area for the base year of the study (1987). For CY 2019, marine traffic data from the U.S. Army Corps of Engineers for San Francisco Bay shows that there were 1,780 tanker and 777 barge transits in the same area of the Bay. The overall marine traffic of vessels carrying hazardous materials has reduced by 65%, which would result in a lower navigational risk in the area of interest if the Port Needs Study were to be repeated in the near future.

- In recent years a much improved VTS has been installed in San Francisco Bay. This system includes modern digital radar and communications systems, more visual monitoring using CCTV, improved communications, incorporation of the Automated Identification System (AIS) into the VTS, as well as 24/7 manning and operation of the system by the Coast Guard. AIS is a particularly important part of reducing navigational risk as it provides a system for the continuous identification and monitoring of vessel movements and their locations in a marine area, in a manner that is analogous to the air traffic control system. If the Port Needs Study were to be repeated, it should reflect the reduction in the overall navigational risk in all areas of San Francisco Bay due to the installation and operation of this improved VTS.

- The Port Needs Study provides a common methodology and data set from which to predict marine spill probabilities that can be easily compared for different facilities. The use of another method or data would create differences that would have to be correlated to confirm that they are not introducing factors, assumptions, and data that are not correct for comparison of spill probabilities for this particular purpose.

Appendix C-2

Rodeo Renewed Spill Modeling Report
(ERM July 20, 2021)

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Technical Memo

To	Chaitali Dave, P66 Rodeo Renewed
From	Paul Krause, Ph.D., ERM
Date	July 20, 2021
Subject	Rodeo Renewed Spill Modeling Report

1. OIL SPILL MODELING - INTRODUCTION

Modeling was performed to estimate the trajectory of potential spill events related to operation of the Phillips 66 refinery in in Rodeo, CA in the Bay Area as part of the Rodeo Renewed project. Large spills (i.e., 20,000 barrels (bbl)) were assess at the refinery pier and from a vessel travelling by the Golden Gate Bridge. Probabilistic spill modeling was performed using a tool provided by the US National Oceanic and Atmospheric Administration (NOAA) and their Office of Response and Restoration's (OR&R) called the Trajectory Analysis Planner (TAP II).[1] Through TAP II, probabilistic summaries of hundreds of simulated spills are provided. These probabilistic summaries were performed for spills originating at two locations, during two seasons, for three different types of oils.

1.1 TAP II Model

NOAA offers versions of the TAP model for various regions throughout the United States. One of these is the San Francisco Bay area (NOAA, 2000). For this region, NOAA's On-Scene Spill Model (OSSM) provided a database of model output covered 233,000 modeled trajectories covering 233 locations throughout the San Francisco Bay area. Spills were simulated at these locations for two seasons (March through August ("summer") and September through February ("winter"). For each season, the model was run 500 times covering a range of tide, wind, and current conditions in the Pacific Ocean and inside the bay. For each simulation, 1,000 particles were used to describe the movement of the oil; each particle contains an evenly divided fraction of the total volume of oil spilled.

The model includes analysis of wind data compiled from seven stations in the region over a seven year period from September 1989 through August 1996. From this data, a statistical summary of the two seasons were obtained and applied to the model.

Tidal currents were obtained from NOAA's WAC model inside the bay driven by tidal information available from seven years of records from NOAA Tidal Current Tables[2]. Outside the bay, the model uses a constant mean seasonal current; ocean currents travel from south to north in the summer and oppositely from north to south in the winter.

Freshwater inflows were not included in the San Francisco Bay TAP II model.

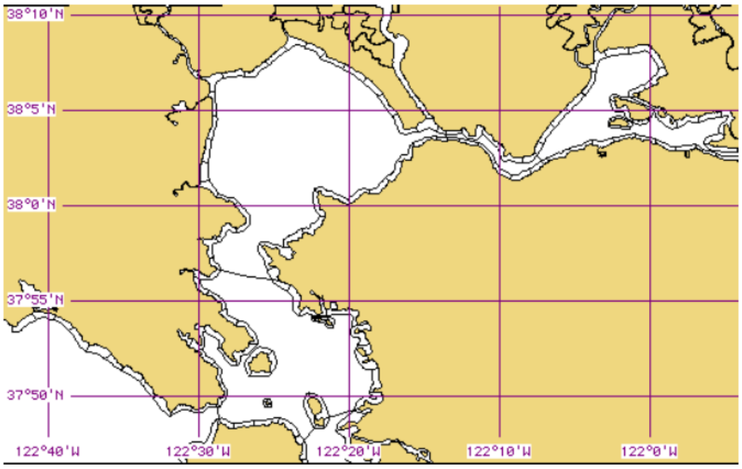
[1] https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/trajectory-analysis-planner.html

[2] https://tidesandcurrents.noaa.gov/tide_predictions.html

Oil fate (e.g. loss due to evaporation) is estimated using a simplified version of NOAA's ADIOS[3] model.

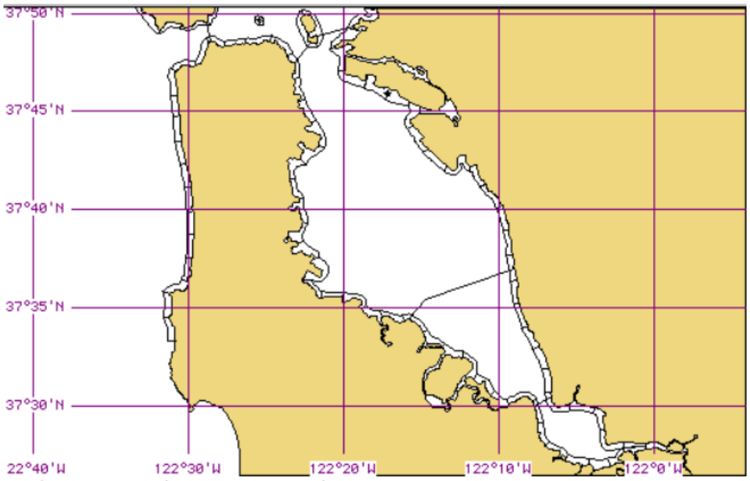
The probability of oil contacting shoreline, based on the 1,000 simulations performed at each location (500 per season), is provided as a series of colored polygons (i.e. "receptor sites") defining the shoreline. A total of 185 receptor sites, ranging from 0.5 miles to 1.0 miles in length, line the coastlines. See Figure 1-1 and Figure 1-2 for the receptor sites in the northern and southern bay, respectively.

Figure 1-1 TAP II San Francisco Bay Model Receptor Sites (North)



Source: NOAA, 2000

Figure 1-2 TAP II San Francisco Bay Model Receptor Sites (South)



Source: NOAA, 2000

[3] https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/adios.html

2. MODEL INPUTS

2.1 Modeled Spill Details

Two hypothetical spill locations were selected by the Golden Gate Bridge entering the bay and off the pier by the P66 San Francisco refinery in Rodeo (see Figure 2-8). Simulations were performed for three types of oil (e.g., gasoline, diesel, and non-weathering oil suitable to represent renewable feedstocks such as vegetable oils), assuming a conservatively high volume released if a spill were to occur. For the purposes of modeling, a spill volume of 20,000 barrels (bbl) of oil released was considered for each spill simulation. The “level of concern” threshold value for shoreline oiling was set to 0.6 barrels (bbl) of oil per shoreline receptor site. Probabilities of oil contacting each shoreline zone were generated for both winter and summer seasons. Therefore, a total of 12 simulations were performed: two seasons, three oils, with spills at two locations (Table 2-1).

Table 2-1: Model Scenarios List

Scenario No.	Oil Type	Oil Type	Location
1	Gasoline	Summer	P66 Refinery Pier
2	Diesel		
3	Non-weathering oils		
4	Gasoline	Winter	
5	Diesel		
6	Non-weathering oils		
7	Gasoline	Summer	East of Golden Gate Bridge
8	Diesel		
9	Non-weathering oils		
10	Gasoline	Winter	
11	Diesel		
12	Non-weathering oils		

Figure 2-1 Map Showing the Two Spill Locations

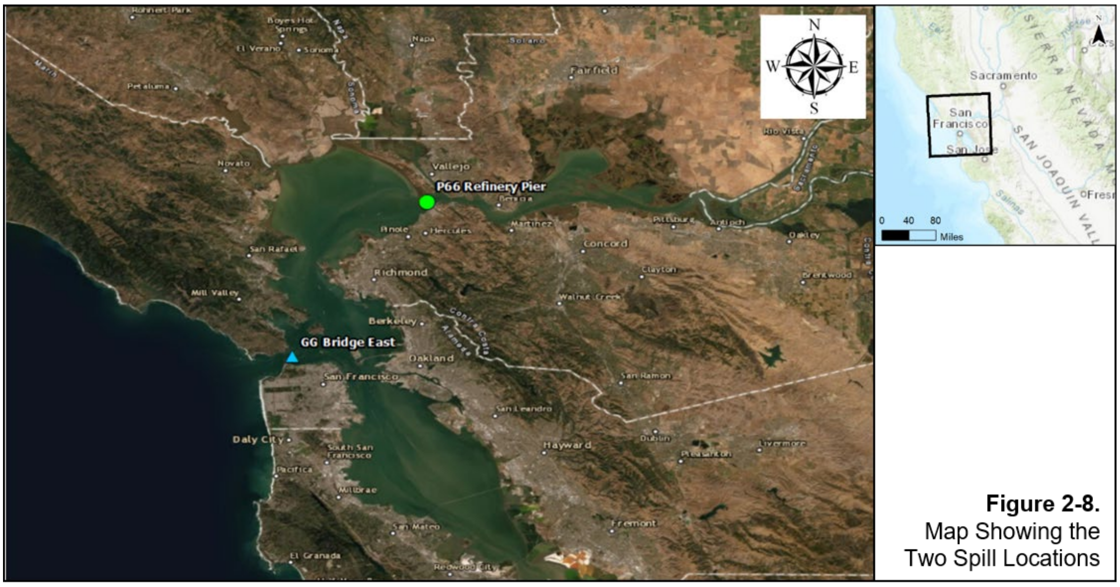


Figure 2-8. Map Showing the Two Spill Locations

3. RESULTS

The locations of shoreline oil estimated using the TAP II model for the 12 oil spill scenarios listed in Section 2 for releases at the P66 Refinery Pier and at a location east of Golden Gate Bridge are presented below in Section 3.1 and Section 3.2 respectively.

3.1 TAP II Results

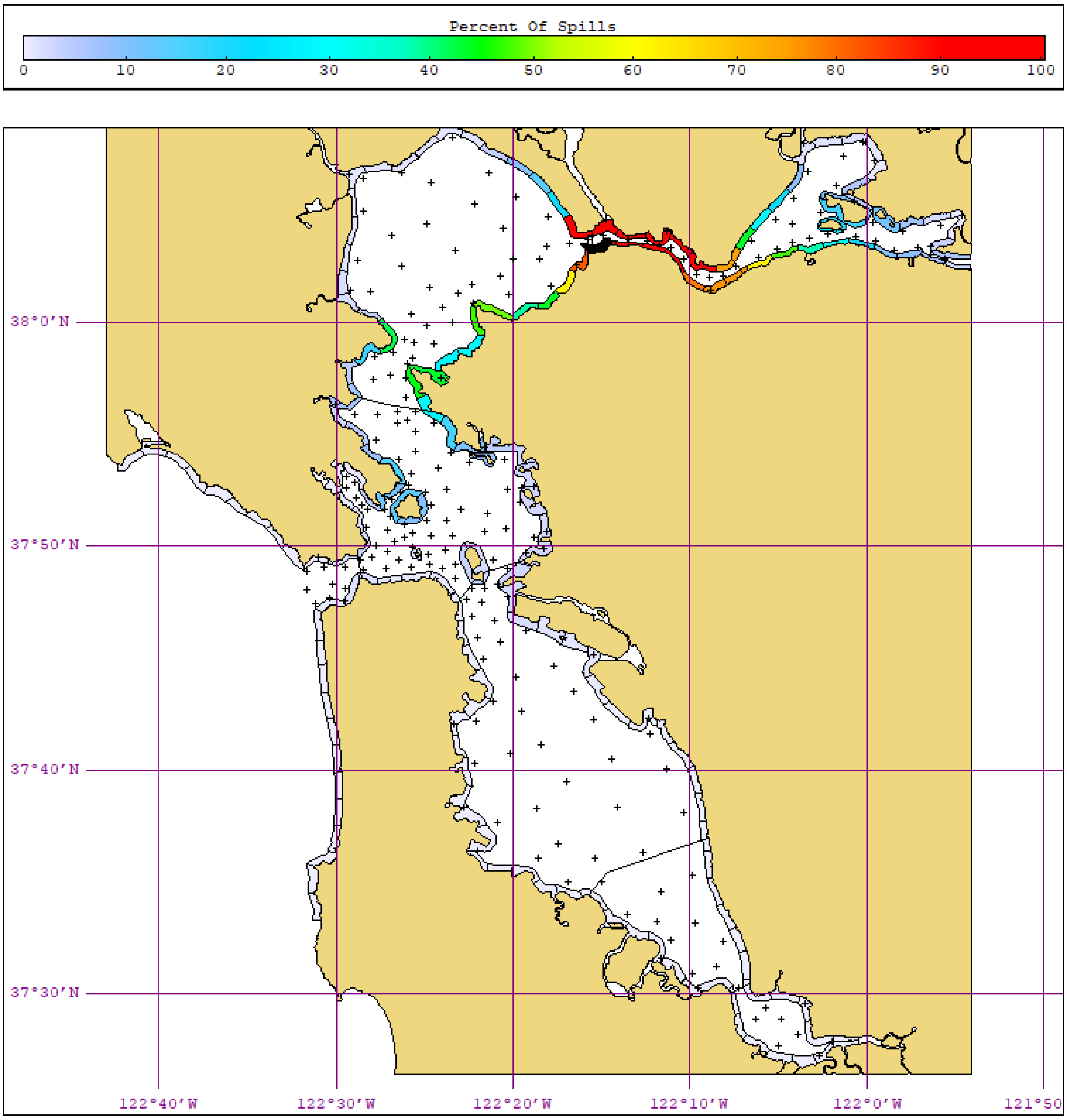
3.1.1.1 Spills at P66 Refinery Pier

Shoreline oiling locations after 24 hours from the start of the spills at P66 Refinery Pier for various spill scenarios in this study are presented in Figure 3-1 through Figure 3-6 for summer and winter conditions. In summer, shoreline oiling locations along the East Bay due to spills at P66 Refinery Pier were present from the Port of Richmond through the Carquinez Straights and into Suisun Bay. The highest probability of oiling was on both shorelines in the Carquinez Straights between San Pablo Bay and Suisun Bay. Within Suisun Bay probability of oiling of several of the islands including Roe, Ryer, and Freeman showed low probabilities (i.e., 20 to 30%) of oiling potential. Low to no probability of oiling occurred on the western side of San Pablo Bay. Low probability (i.e., 30 to 40%) of oiling occurred on the eastern shoreline of Marin County and around Angel Island as well.

During the winter conditions, oiling was slightly more wide spread, likely driven by wind conditions with diesel and non-weathering oil showing probabilities of extent of oiling including a greater area of the western side of San Pablo Bay (See figures 3-5 and 3-6).

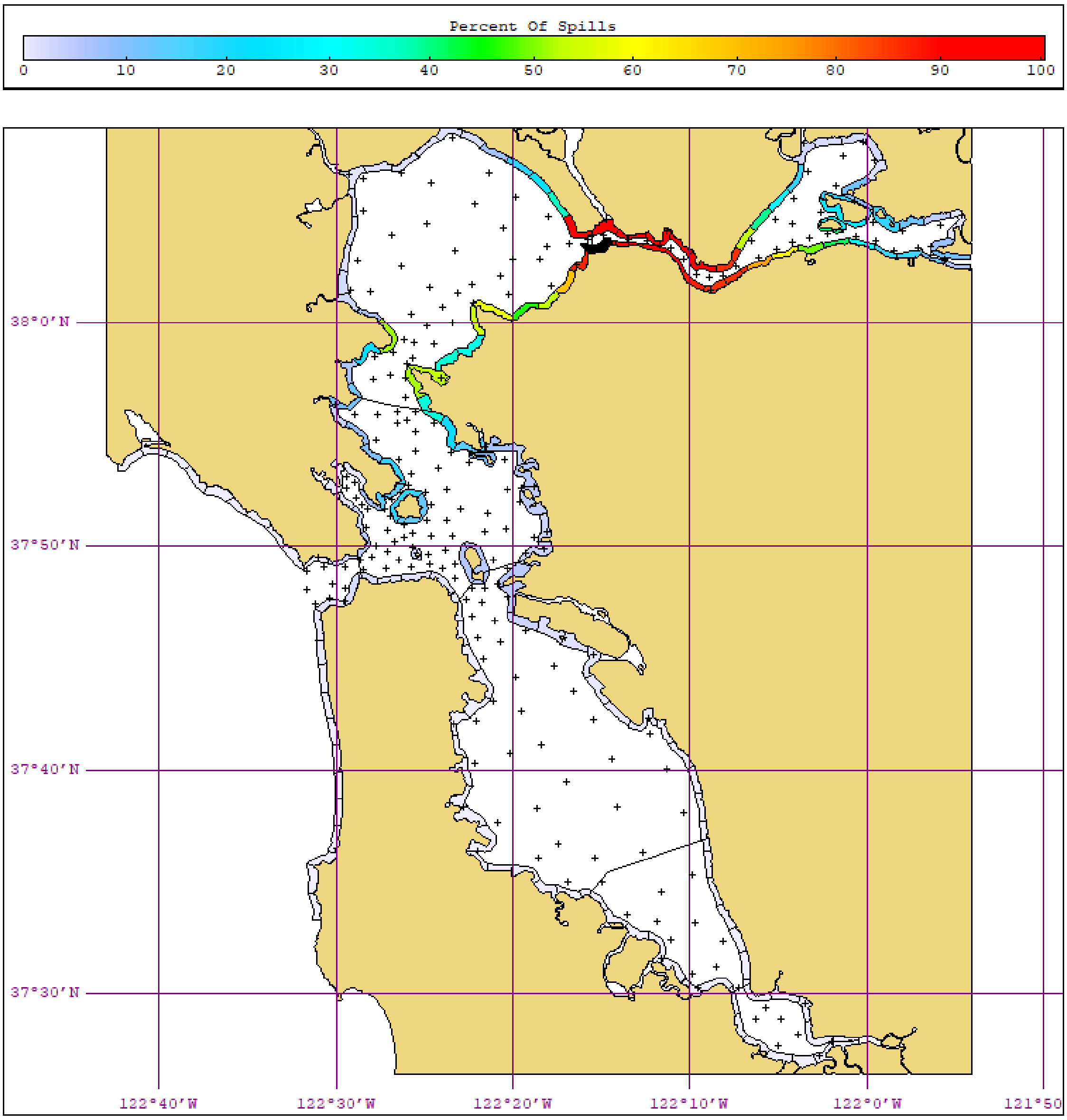
The differences between gasoline, diesel, and non-weathering oil may not be readily apparent in these simulations, as the differences in evaporation is most strongly observed after the first day.

Figure 3-1 Scenario 1: Shoreline oiling probability after 24 hours due to a gasoline spill near P66 Refinery Pier – Summer*



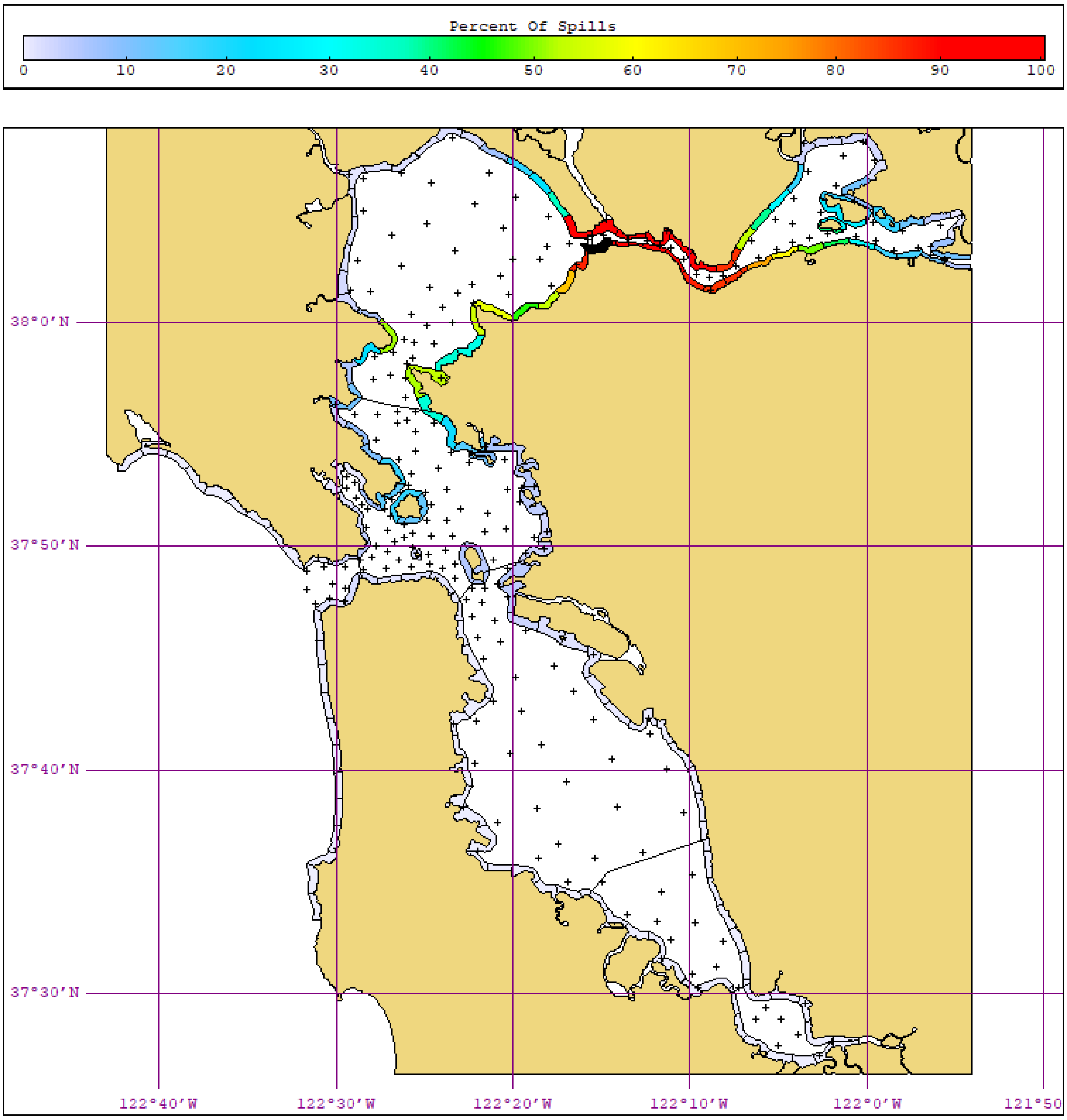
*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

Figure 3-2 Scenario 2: Shoreline oiling probability after 24 hours due to a diesel spill near P66 Refinery Pier – Summer*



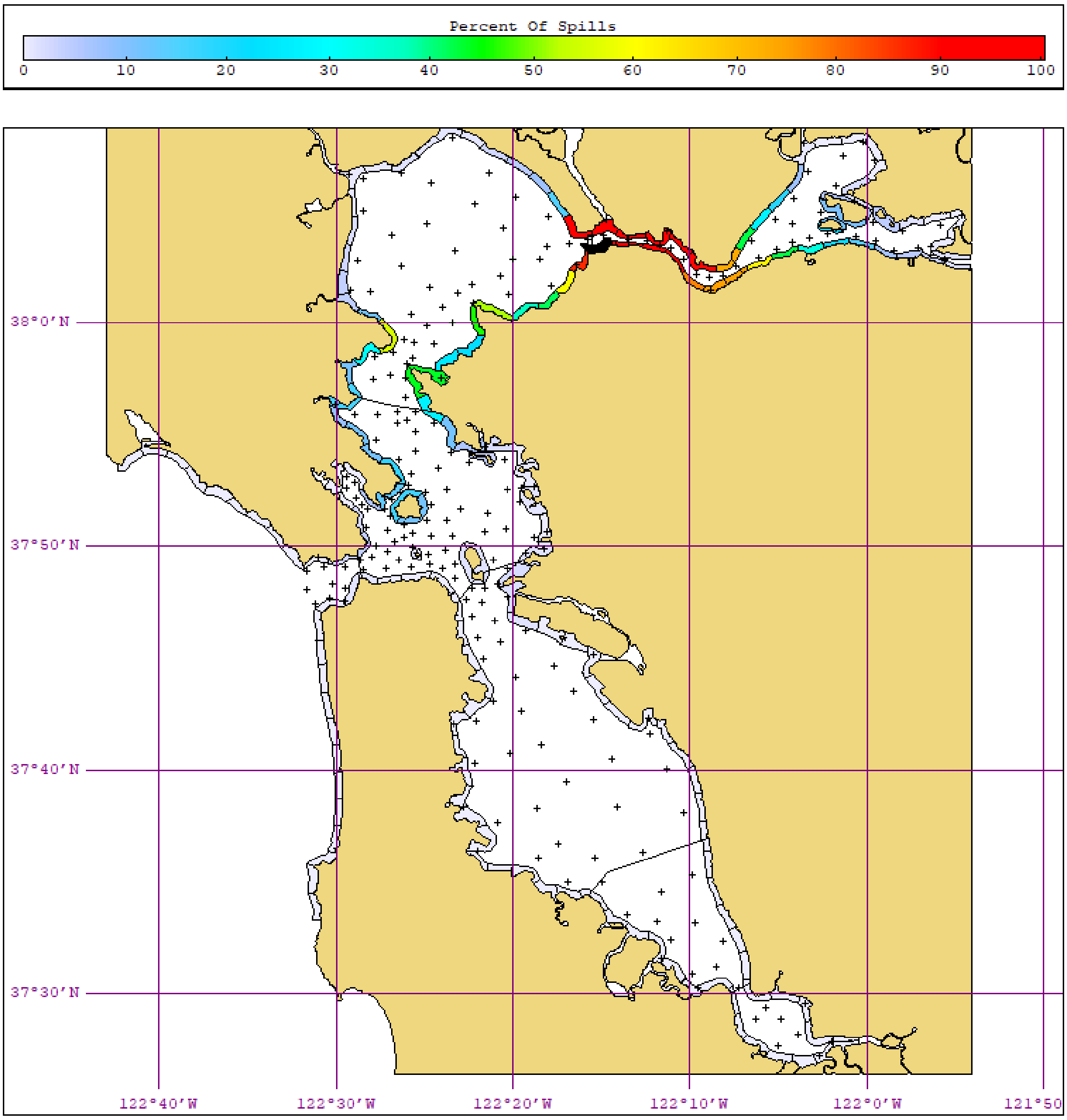
*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

Figure 3-3 Scenario 3: Shoreline oiling probability after 24 hours due to a non-weathering spill near P66 Refinery Pier – Summer*



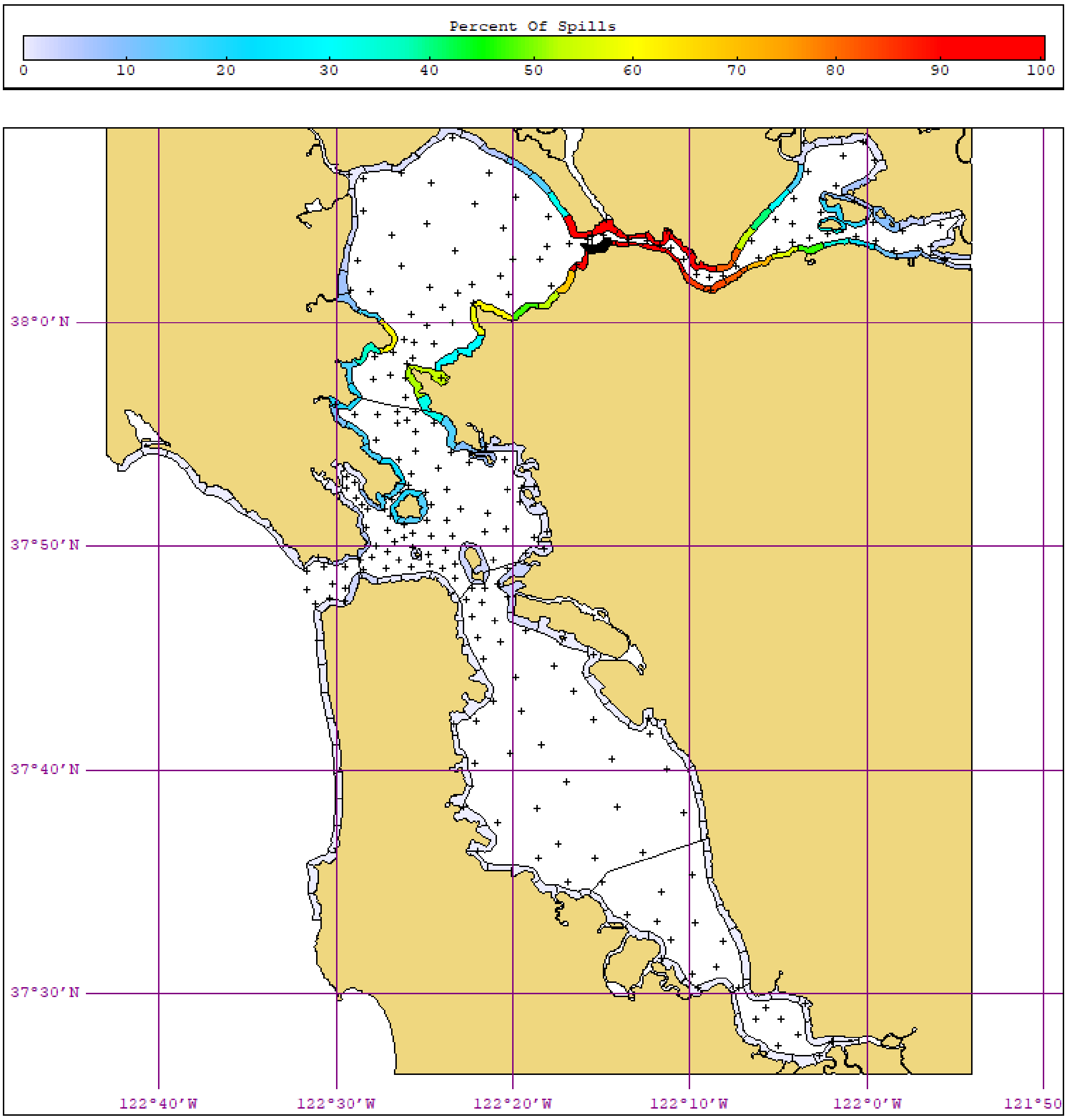
*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

Figure 3-4 Scenario 4: Shoreline oiling probability after 24 hours due to a gasoline spill near P66 Refinery Pier – Winter*



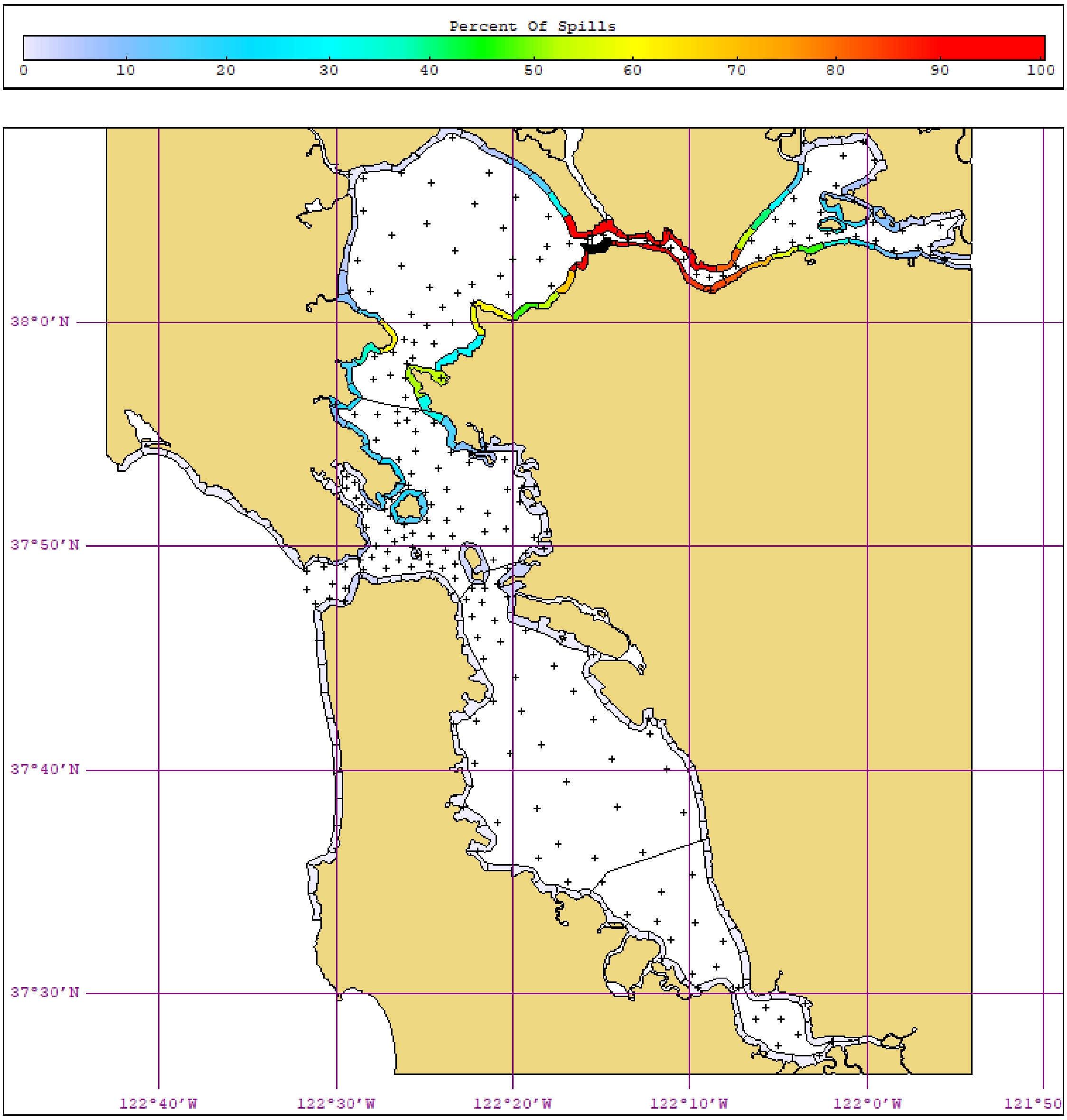
*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

Figure 3-5 Scenario 5: Shoreline oiling probability after 24 hours due to a diesel spill near P66 Refinery Pier – Winter*



*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

Figure 3-6 Scenario 6: Shoreline oiling probability after 24 hours due to a non-weathering spill near P66 Refinery Pier – Winter*



*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

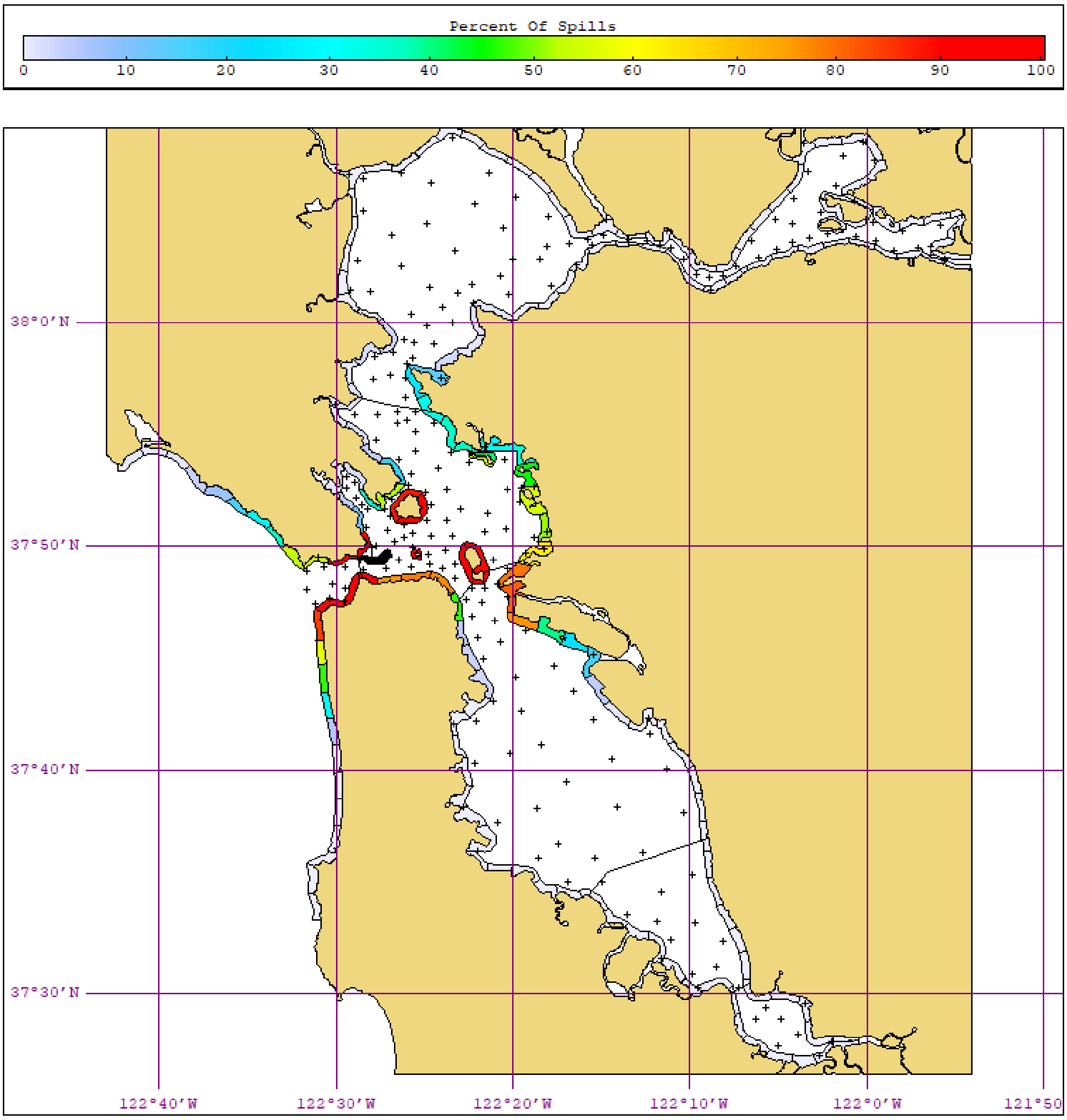
3.1.1.2 Spills at Golden Gate Bridge East

Shoreline oiling locations after 24 hours from the start of the spills at the east side of Golden Gate Bridge for various spill scenarios in this study are presented in Figure 3-7 through Figure 3-12 for summer and winter conditions.

In general, with a spill release just east of the Golden Gate Bridge, the southern shorelines of the Marin Peninsula (northern side of Golden Gate) and the northern shorelines of the San Francisco Peninsula received the highest probability of oiling. This extended to Angel Island and Treasure Island with high probabilities of oiling with wind and tidal driven currents. Oiling along the Marin Headlands extended northwards to the Point Reyes seashore received low to medium probability of oiling (i.e., 20 to 50%) as did the western shoreline of the San Francisco Peninsula. This was true for both summer and winter scenarios and for all release products.

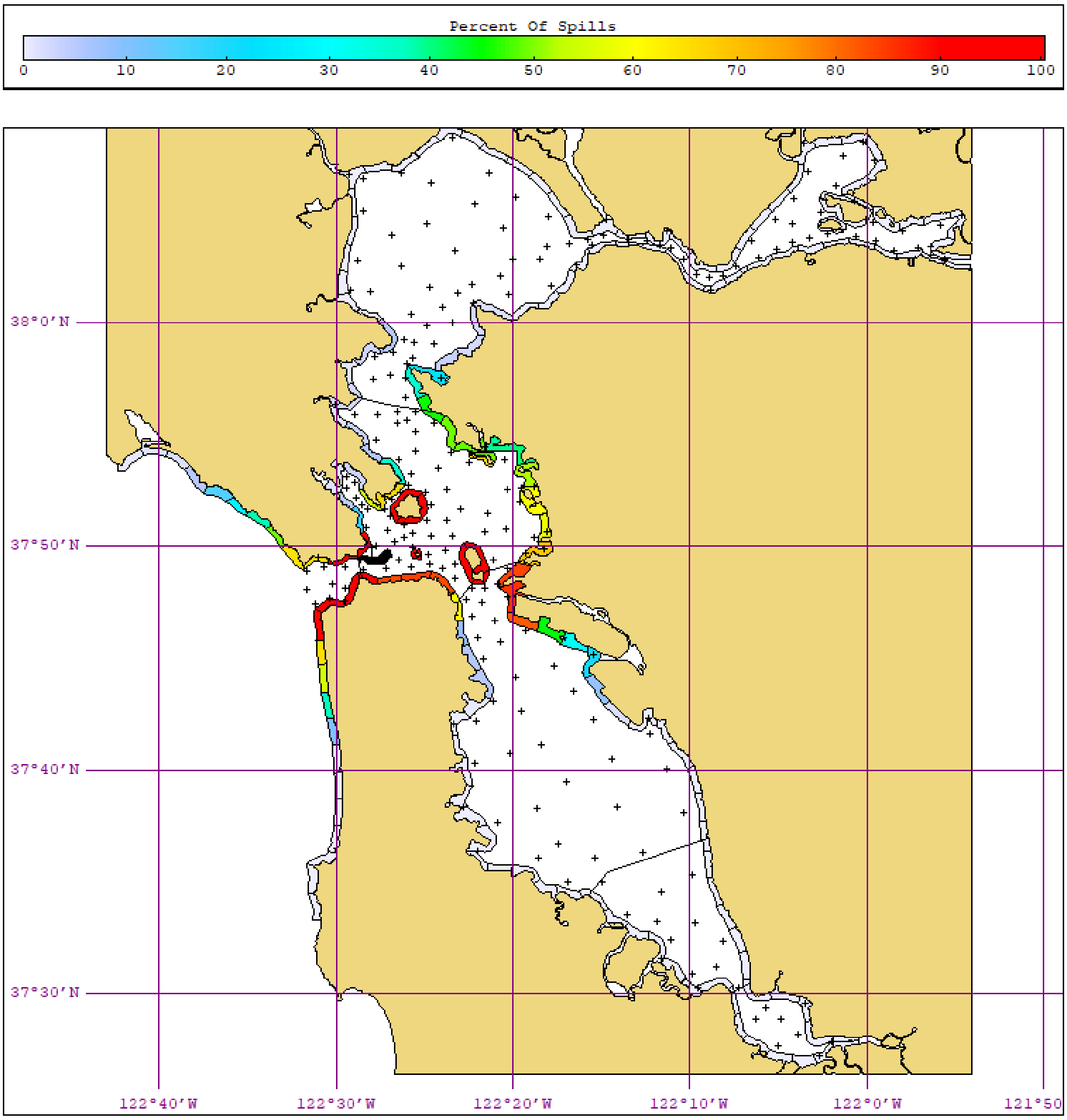
Similar to the spills at P66 Refinery Pier, the differences between gasoline, diesel, and non-weathering oil may not be apparent in these simulations, as the differences in evaporation is most strongly observed after the first day.

Figure 3-7 Shoreline oiling probability after 24 hours due to a gasoline spill near Golden Gate Bridge – Summer*



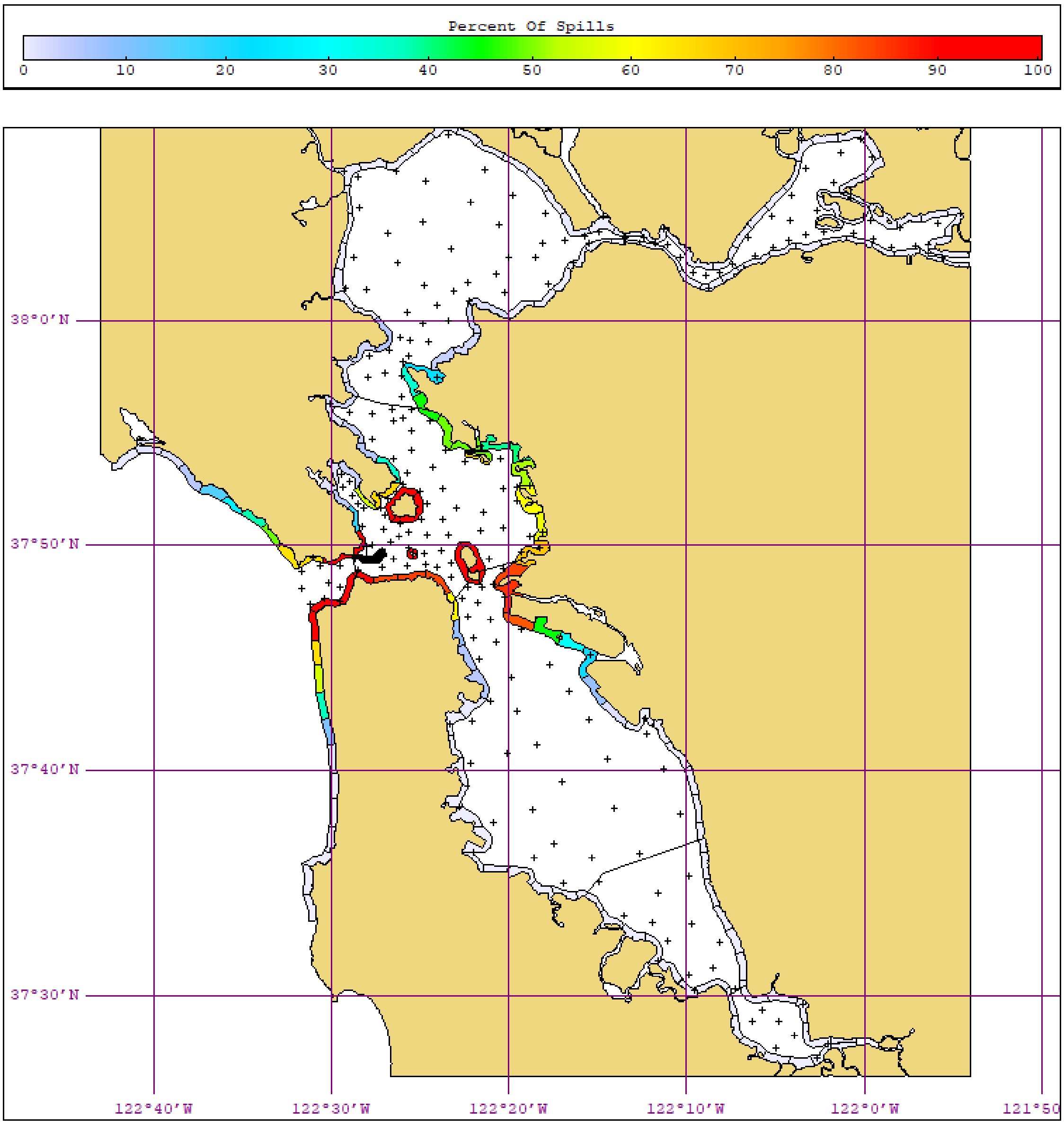
*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

Figure 3-8 Shoreline oiling probability after 24 hours due to a diesel spill near Golden Gate Bridge – Summer*



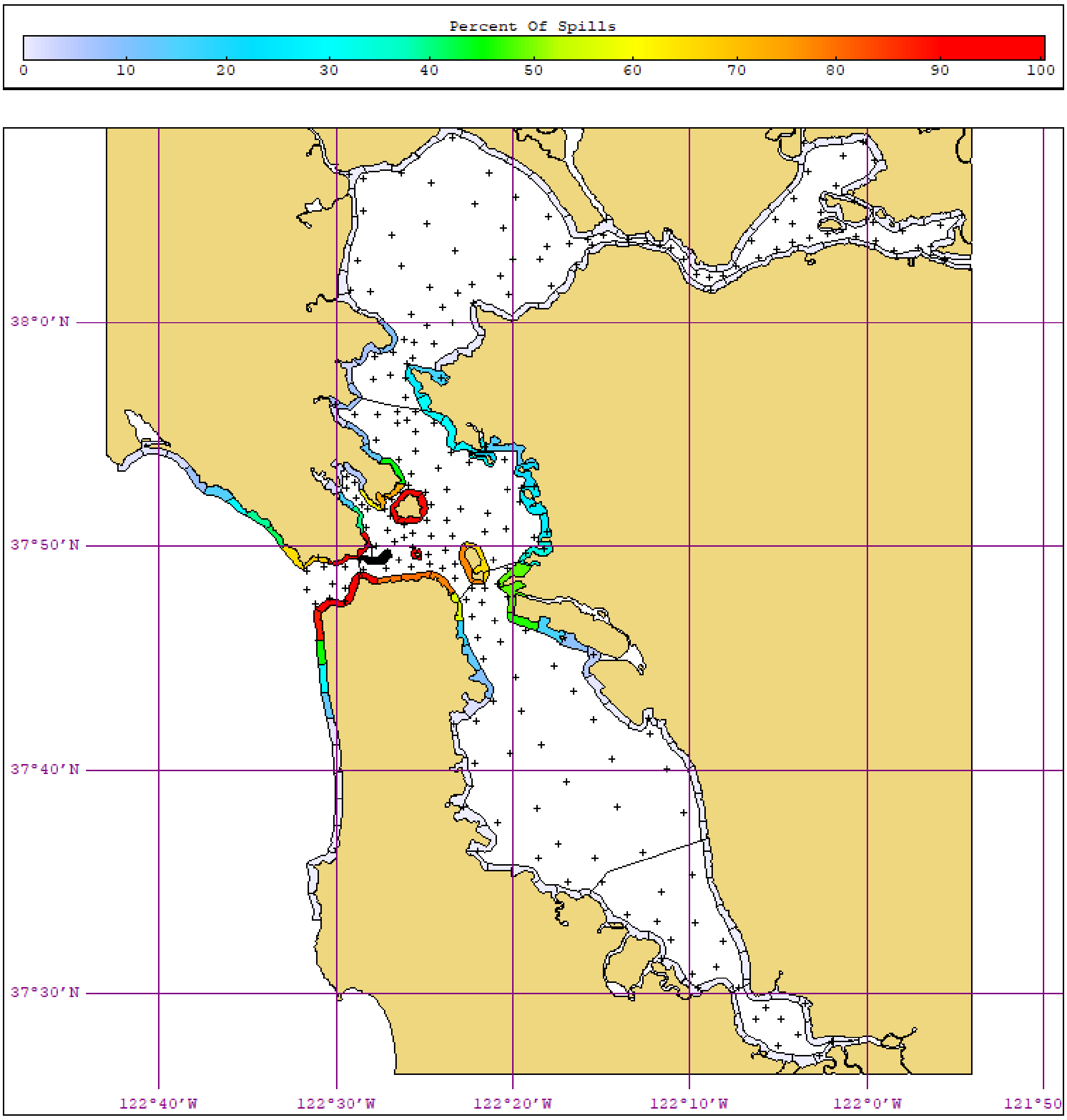
*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

Figure 3-9 Shoreline oiling probability after 24 hours due to a non-weathering spill near Golden Gate Bridge – Summer*



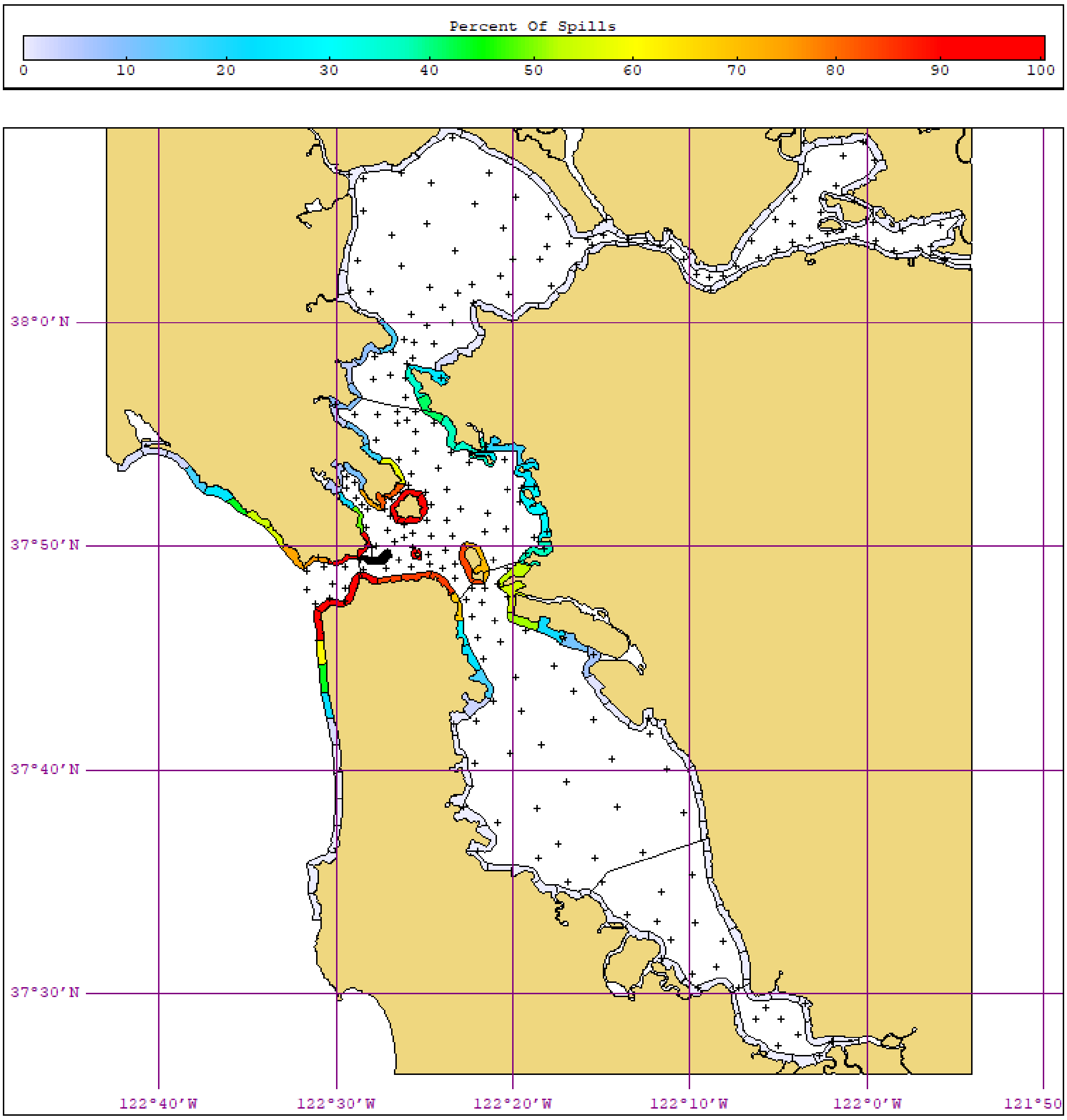
*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

Figure 3-10 Shoreline oiling probability after 24 hours due to a gasoline spill near Golden Gate Bridge – Winter*



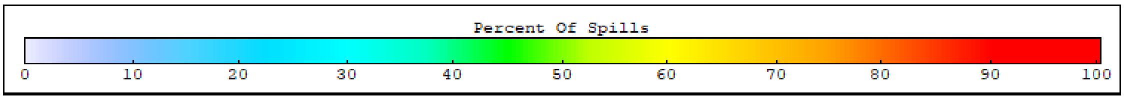
*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

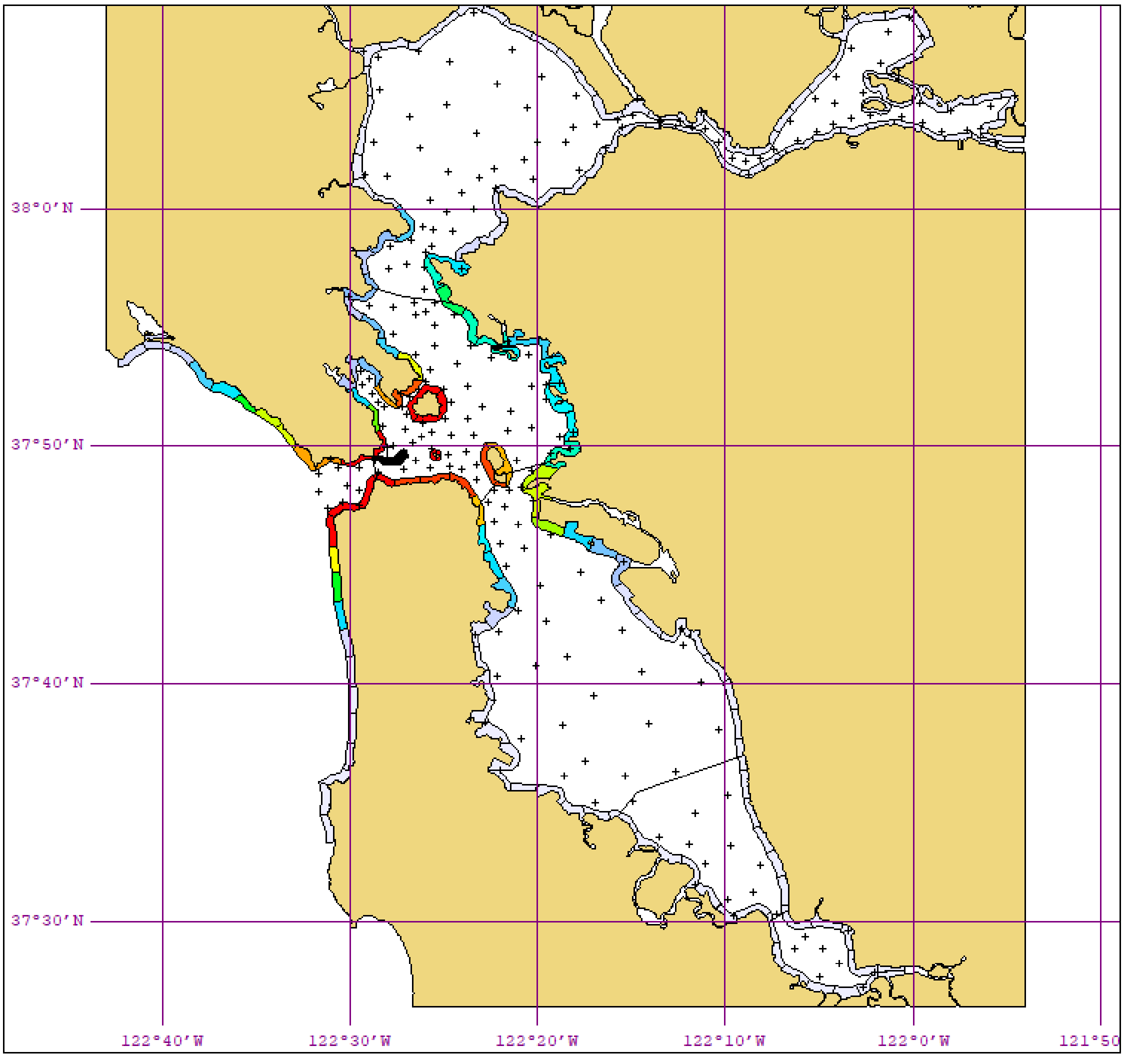
Figure 3-11 Shoreline oiling probability after 24 hours due to a diesel spill near Golden Gate Bridge – Winter*



*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

Figure 3-12 Shoreline oiling probability after 24 hours due to a non-weathering spill near Golden Gate Bridge – Winter*





*Composite of 500 Spills 24-Hours after Release. No Mitigation or Clean-up

4. CONCLUSIONS

Three different product spills were assessed in this study. This included releases at both for releases at the Rodeo pier and on the ship transit route during summer and winter conditions. Spills were evaluated using the TAP II tool to assess spill conditions across many years of varying winds, tides, and current conditions. Results showed that during all scenarios after 24 hours significant shoreline oiling occurred both in and outside of the Bay.

All spill modeling scenarios are for unmitigated spills. This is an important fact to keep in mind when reviewing the results. Any spill will be mitigated by immediate spill notification and response to lessen the mobility of the released product and thereby decrease damages. Regardless, spill are considered significant impacts, but mitigated through response. The likelihood of spills of this size and nature remain extremely low. Coupled together, the significance level and likelihood still result in a significant impact should a spill occur at either the Rodeo pier or within transit.

5. REFERENCES

NOAA. 2000. “TAP II™ 1.1 San Francisco Technical Documentation” U.S. Department of Commerce. National Oceanic and Atmospheric Administration National Ocean Service. Office of Response & Restoration. March 2000.