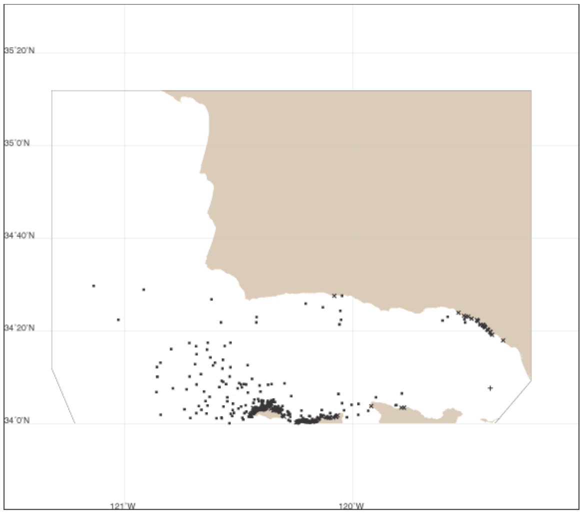
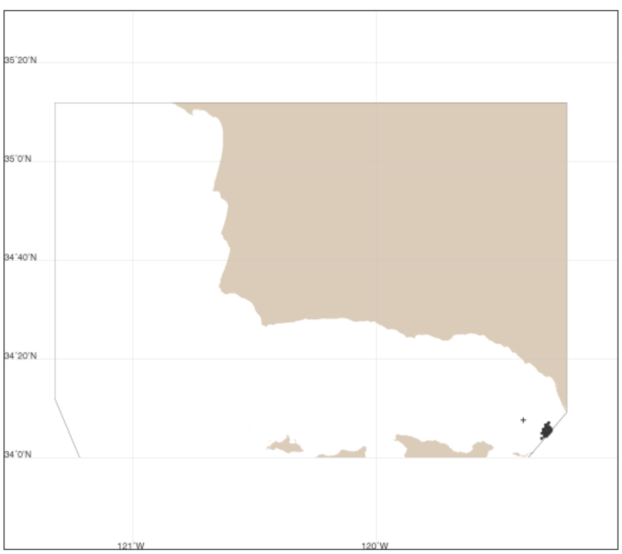
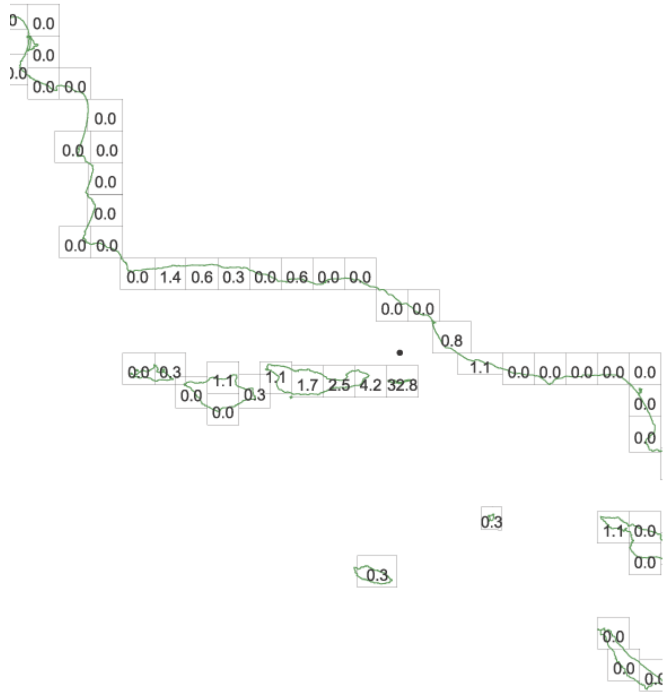


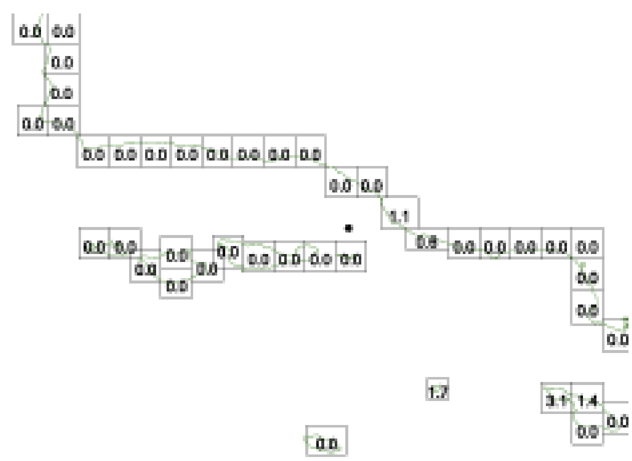
Appendix Figure 5.2-17. GNOME Modeled 10 day, 2000 bbl oil spill scenario for platform Gail (depicted by "+"), located in the center of the Channel near its eastern entrance, during a convergent flow regime and a 7 m/s NW wind. GNOME model output indicates that of 2000 bbl released: 410 bbl beach, 964 bbl evaporate or are dispersed, 366 bbl are still floating, and 260 bbl have moved out of the model domain heading south to southeast offshore of the Southern California Bight.



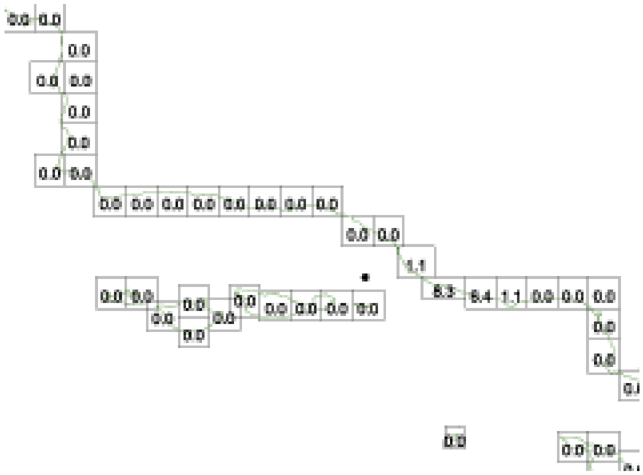
Appendix Figure 5.2-18. GNOME Modeled 7 hour, 2000 bbl oil spill scenario for platform Gail (depicted by "+"), located in the center of the Channel near its eastern entrance, during an upwelling flow regime and a 1.5 m/s NW wind. GNOME model output indicates that of 2000 bbl released: 0 bbl beach, 148 bbl evaporate or are dispersed, 160 bbl are still floating, and 1692 bbl have moved out of the model domain heading southeast out of the eastern Santa Barbara Channel entrance and along the southern California coastline. After 3 and 10 days, the GNOME model gives the same output of 150 bbl of oil evaporated and dispersed and 1850 bbl out of the model domain heading southeast out of the Santa Barbara Channel by way of its eastern entrance and along the southern California coastline.



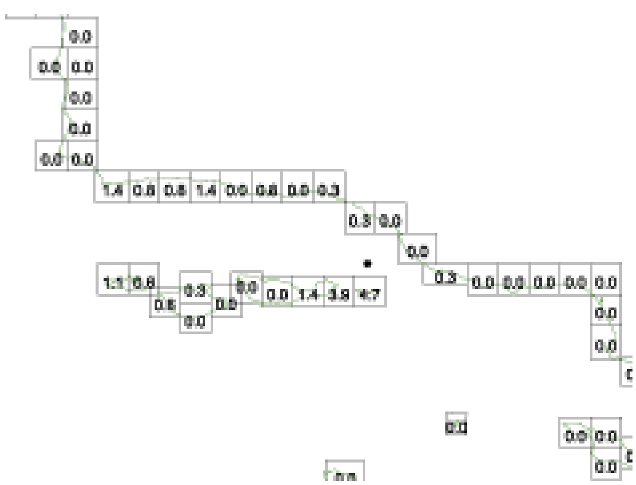
Appendix Figure 5.2-19. MMS OSRA Model output for a 10 day event at platform Gail during the winter season. The boxes are U. S. Geological Survey 7.5 Minute Quad series maps presenting the calculated probabilities (in percentages) of oil contact with the shoreline contained within each map.



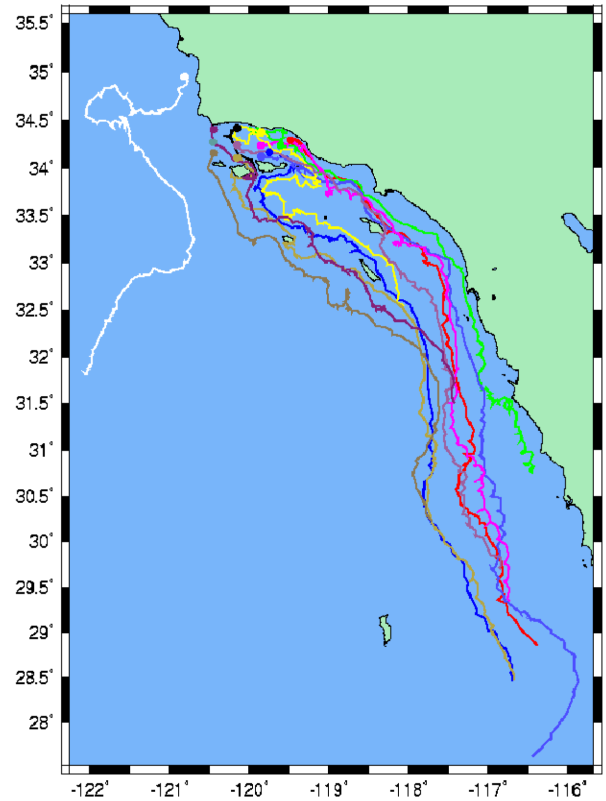
Appendix Figure 5.2-20. MMS OSRA Model output for a 10 day event at platform Gail during the spring season. The boxes are U. S. Geological Survey 7.5 Minute Quad series maps presenting the calculated probabilities (in percentages) of oil contact with the shoreline contained within each map.



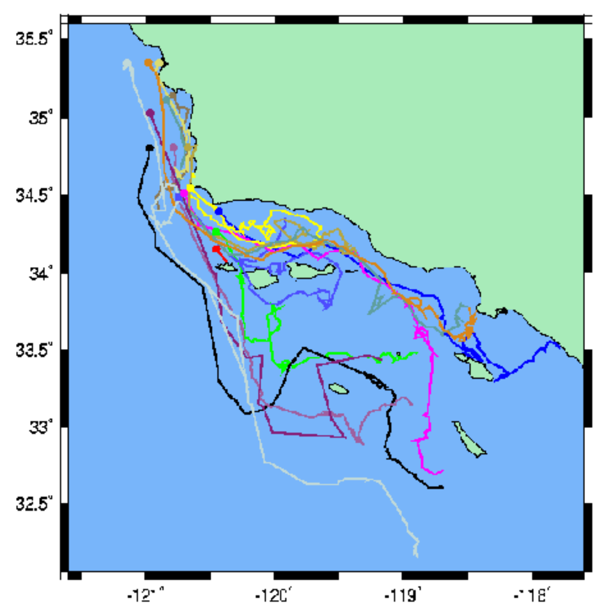
Appendix Figure 5.2-21. MMS OSRA Model output for a 10 day event at platform Gail during the summer season. The boxes are U. S. Geological Survey 7.5 Minute Quad series maps presenting the calculated probabilities (in percentages) of oil contact with the shoreline contained within each map.



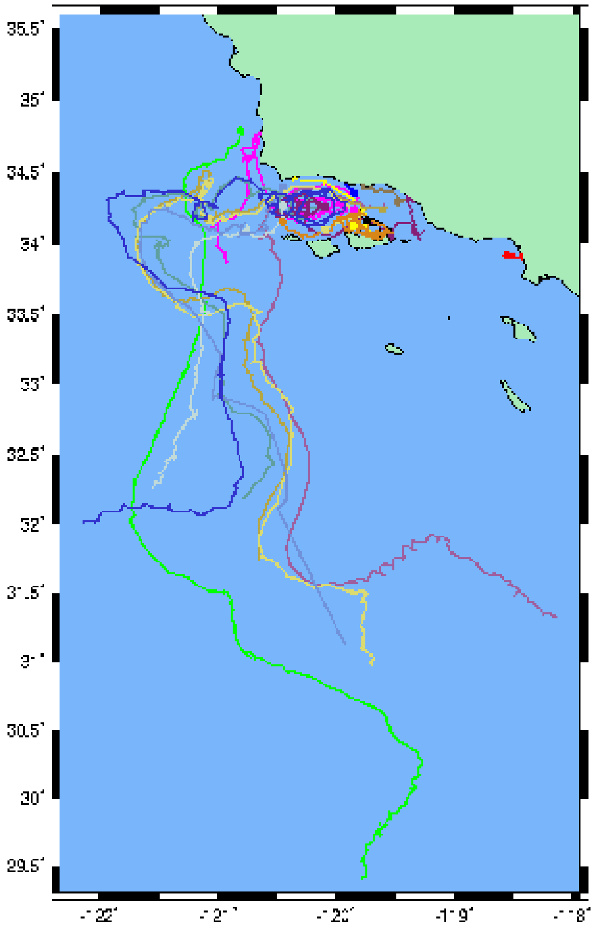
Appendix Figure 5.2-22. MMS OSRA Model output for a 10 day event at platform Gail during the fall season. The boxes are U. S. Geological Survey 7.5 Minute Quad series maps presenting the calculated probabilities (in percentages) of oil contact with the shoreline contained within each map.



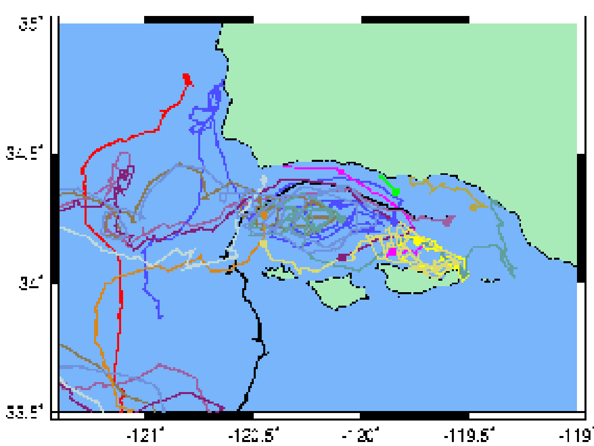
Appendix Figure 5.2-23. (a). Free-floating drifter tracks from March 1995 deployment in the Santa Barbara Channel primarily depicting the upwelling flow regime (<u>http://www-ccs.ucsd.edu/olspill/</u> - click "Interactive Drifter Track Plotting").



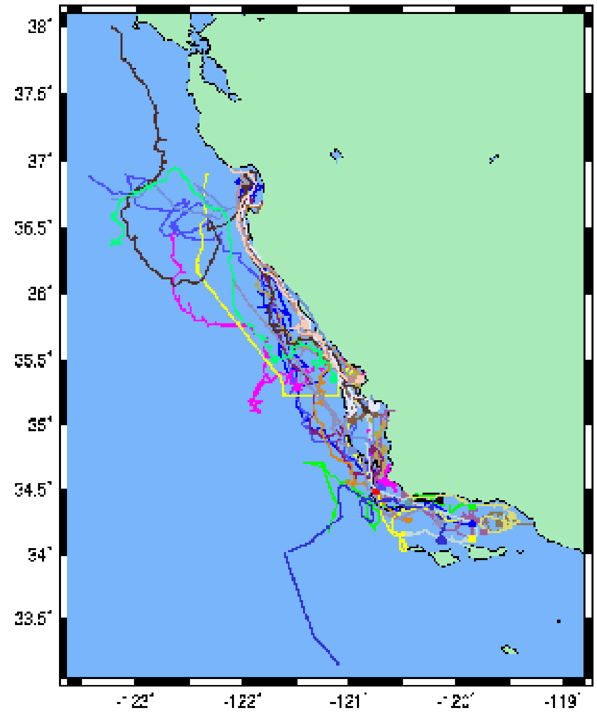
Appendix Figure 5.2-23. (b). Free-floating drifter tracks from April 1998 deployment in the Santa Maria Basin primarily depicting the upwelling flow regime. Note that many drifters traveled southeast through the Santa Barbara Channel to get into the southern portion of the Southern California Bight (<u>http://www-ccs.ucsd.edu/olspill/</u> - click "Interactive Drifter Track Plotting").



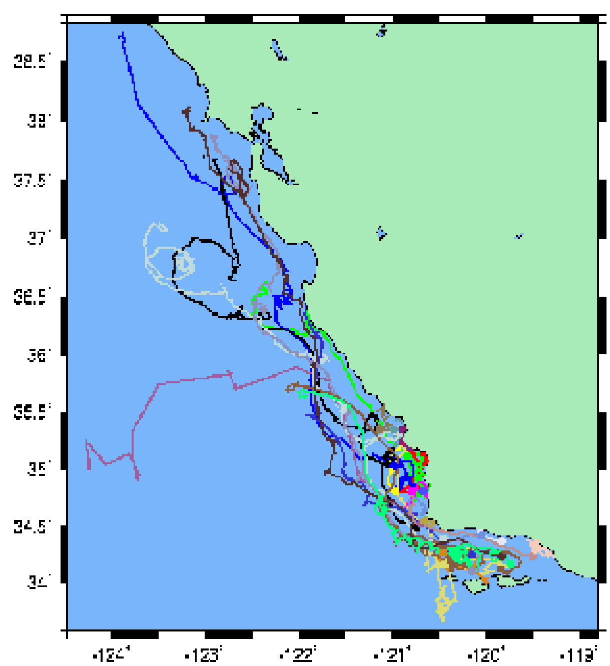
Appendix Figure 5.2-24. (a). Free-floating drifter tracks from September 1994 deployment primarily in the Santa Barbara Channel depicting the "cyclonic," also called "convergent," flow regime (<u>http://www-ccs.ucsd.edu/olspill/</u> - click "Interactive Drifter Track Plotting").



Appendix Figure 5.2-24. (b). Enlargement of Santa Barbara Channel portion of Appendix Figure 5.2-24 (a): "cyclonic," also called "convergent," flow regime (<u>http://www-ccs.ucsd.edu/olspill/</u> - click "Interactive Drifter Track Plotting").



Appendix Figure 5.2-25. (a). Free-floating drifter tracks from December 1996 deployment in the Santa Barbara Channel depicting the "relaxation" flow regime (<u>http://www-ccs.ucsd.edu/olspill/</u> - click "Interactive Drifter Track Plotting").



Appendix Figure 5.2-25. (b). Free-floating drifter tracks from the November 1997 deployment in both the Santa Barbara Channel and the Santa Maria Basin depicting the "relaxation" flow regime (<u>http://www-ccs.ucsd.edu/olspill/</u> - click "Interactive Drifter Track Plotting").

482-924 bbl of oil will continue to float, and 8-180 bbl of oil will continue to move north in the SMB or south offshore the western SBC entrance to the SCB and out of the model domain.

The 3-day Convergent flow regime scenario indicates that 192 bbl of oil will beach at Carpenteria, Santa Barbara, Gaviota, and Ventura. Additionally, 794 bbl of oil will weather, 1014 bbl of oil will continue to float, and 0 bbl will travel off the model domain. The 10-day Convergent flow scenario indicates that 418 bbl of oil will beach on San Miguel, Santa Rosa, and Santa Cruz Islands, and at Carpenteria on the SBC mainland. Additionally, 956 bbl of oil will weather, 366 bbl of oil will continue to float, and 260 bbl of oil will travel south, offshore of the western SBC entrance into the SCB and out of the model domain.

The 3-day and 10-day Upwelling flow regime scenarios give the same results: 0 bbl of oil will beach, 148 bbl of oil will weather, 0 bbl of oil will continue to float, and 1852 bbl of oil will travel southeast out of the eastern SBC entrance into the SCB and off the model domain. A 7 hour Upwelling flow scenario indicates that 0 bbl of oil will beach, 146 bbl of oil will weather, 162 bbl of oil will continue to float, and 1692 bbl of oil will travel southeast out of the eastern SBC entrance into the SCB and out of the model domain.

OSRA Model Results

The winter 3-day OSRA Model run for the Santa Clara Unit indicates a 1 to 29 percent probability of an oil spill landfall at the eastern tip of Santa Cruz Island to Anacapa Island. The winter 10-day run indicates a 1 percent probability of an oil spill landfall at Pt. Hueneme, Coal Oil Pt., Gaviota, Drake on the SBC mainland, and on the northwestern shore of Santa Catalina Island. The winter 10-day run also indicates a 1 to 5 percent probability that the shorelines of Santa Rosa to Santa Cruz Islands will experience contact with spilled oil and a 32 percent probability that Anacapa Island will experience landfall of spilled oil.

The spring 3-day scenario indicates a 1 percent probability that spilled oil will contact Port Hueneme. The spring 10-day scenario indicates a 1 percent probability that Port Hueneme and San Clemente Island will experience contact with spilled oil. The 10-day scenario also indicates there will be a 2 and 3 percent chance that the shorelines of Santa Barbara and Santa Catalina Islands respectively will experience contact with spilled oil.

The summer 3-day scenario indicates no shorelines will experience oil spill contact. The summer 10-day scenario indicates there is a 1 to 8 percent probability of an oil spill contacting Pt. Dume to Port Hueneme.

The fall 3-day scenario indicates a 1 percent probability of spilled oil landfall at the eastern end of Santa Cruz Island to Anacapa Island. The fall 10-day scenario indicates that there is a 1 percent probability of oil spill landfall on the SBC mainland from Coal Oil Pt. to Pt. Conception. The fall 10-day model run also indicates a 1 percent chance that spilled oil will make landfall on Santa Rosa and San Miguel Islands and a 1 to 5 percent probability that spilled oil will contact the eastern end of Santa Cruz Island to Anacapa Island.

APPENDIX 5.2.2 DISCUSSION

As stated in the introduction, there is only a remote probability that an oil spill of 200 bbl or greater will occur for the proposed delineation well projects. The probabilities presented in the Oil Spill Trajectory Analysis section are in the conditional context that a significant oil spill has occurred for the cumulative impact analysis.

For the cumulative impact analysis, the geographical limits of the potentially affected area are defined by the farthest locations on the California coastline that could be contacted by oil within 10 days of a spill event occurring in the area of proposed developed activities. The drifter analysis indicates that during an extended period of relaxed winds, the extreme northern boundary of the potentially affected area is Pt. Lobos on the central California coast. The drifters also indicate that during this same wind condition, the northern limits of the area where contact with a spill is "most likely" is Ragged Point, which is further south on the central California coast. Both the drifter and the OSRA Model analyses indicate that both the extreme and "most likely" southern boundaries of the potentially affected area coincide at Santa Catalina Island in the Southern California Bight, and Palos Verdes on the Southern California mainland.

The analysis indicates that spilled oil from activity in the eastern-most Unit in the SBC, the Santa Clara Unit, may contact the shoreline as far north as Point San Luis on the central California coast. The central California coast is found to be most likely to be contacted by oil from a spill occurring during a Relaxation flow regime, which occurs 27 percent of the time during a year (Section 4.4 Physical Oceanography).

The composite analysis indicates that oil from a spill occurring anywhere in the SBC may contact either the SBC mainland, the Channel Islands, or both. The Channel Islands have the highest probability of contact, according to both models and the drifter data, with San Miguel and Santa Rosa Islands being the most likely islands contacted by spilled oil. The area between Goleta Point and Gaviota seems to be the most likely area along the SBC mainland to experience contact with spilled oil. Oil spill contact with SBC shorelines is most likely during a Convergent or Upwelling flow regime. These flow regimes occur 31 and 35 percent of the time respectively during the year. This is because there is strong re-circulation within the SBC associated with these two flow regimes. During a Convergent flow regime, a spill in the northern area of the SBC tends to affect the western-most Islands: San Miguel and Santa Rosa a little more than the others. During an Upwelling flow regime, a spill in the same area will tend to affect the eastern most Islands: Santa Cruz and Anacapa a little more than their western neighbors. Purisima Point to Point Arguello on the central California coast and San Miguel and Santa Rosa Islands in the SBC are the most likely areas of shoreline contact with oil spilled in the Lions Rock Unit during an Upwelling event.

Spills occurring in the eastern portion of the SBC (in the Santa Clara Unit) will likely move south and southeast out of the SBC by way of the eastern SBC entrance, and into the area offshore of the Santa Monica Bay-Redondo Beach coastlines in the Southern California Bight. The composite analysis indicates that at times Santa Catalina Island, and to a lesser extent San Nicolas Island, may be contacted by a spill occurring in the SBC. This is largely during the spring when the Upwelling flow regime occurs most prominently. Additionally, the composite analysis indicates that a spill in the SBC could affect the southern California shoreline as far south as Palos Verdes. The probability that spilled oil will continue south of Santa Catalina Island within a 10 day time frame is remote.

APPENDIX 5.2.3 SURFACE DRIFTER AND GNOME MODEL DATA AND ANALYSIS

The free-floating drifter data and the GNOME Model run data that were summarized in appendix section 5.2.1 Oil Spill Trajectory Analysis are presented in more detail and in tabular form in this section. This section also contains the full drifter analysis papers entitled: “Surface Drifter Analysis for the Rocky Point Unit Project Oil Spill Risk Assessment” and “Surface Drifter Analysis for the Cavern Point Unit Project Oil Spill Risk Assessment.” The data and analyses are organized as follows:

- Appendix Table 5.2-3 Santa Barbara Channel Drifters: drifter data from launch points 5,6,7, and 8
- Appendix Table 5.2-4 Santa Maria Basin Drifters: drifter data from launch points 17, 18, 19, and 20
- Appendix Exhibit 5.2-1 “Surface Drifter Analsyis for the Rocky Point Unit Project Oil Spill Risk Assessment”
- Appendix Exhibit 5.2-2 “Surface Drifter Analsyis for the Cavern Point Unit Project Oil Spill Risk Assessment”
- Appendix Table 5.2-21. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at launch point SMB-A.
- Appendix Table 5.2-22. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at launch point SMB-A.
- Appendix Table 5.2-23. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Hidalgo.
- Appendix Table 5.2-24. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Hidalgo.
- Appendix Table 5.2-25. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Harvest.
- Appendix Table 5.2-26. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Harvest.
- Appendix Table 5.2-27. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Hermosa.
- Appendix Table 5.2-28. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Hermosa.
- Appendix Table 5.2-29. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Heritage.
- Appendix Table 5.2-30. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Heritage.

Appendix Table 5.2-3. Santa Barbara Channel Drifters: 5,6,7, and 8: drifter data used for Santa Ynez Unit drifter analysis.

		Launch Area Direction (Second Area Direction)								Second Area(s) of	Land	
Flow Regime	Month/Year	N	NE	NW	E	W	S	SE	SW	Drifter Trajectory	Strike	Land Strike Locations
Relaxation	Nov-97	(3)		1		3				SMB	yes/3	Capitan (SBC), Pt Arguello & Pt. Sur north
Relaxation	Dec-96	(4)				4				SMB	yes/3	Drake (SBC), Cambria, Pt Sur, & Monterey Bay
Relaxation	Oct-95	(1)				4	(3)			SMB, SCB	yes/3	S Maria River, S Miguel I, & S Nicolas I
Relaxation	Nov-94	(2)				4, (1)	(2)			SMB, SCB	yes/2	Pt Sal & Surf
Relaxation	Dec-93					3	C1			SMB, SCB	Yes/2	S Miguel I & Pt Sal
Relaxation	Oct-93	(3)				4		(1)		SMB, SCB	Yes/1	Lopez Pt
		N	NE	NW	E	W	S	SE	SW			
Cyclonic	Nov-99						C1	2	1	SCB	Yes/2	S Miguel I & S Cruz I
Cyclonic	Jul-98	(1)					C1,(1)	C1	C1	SMB, SCB	Yes/3	S Miguel I, S Rosa I, & S Cruz I
Cyclonic	Jul-97					1	C1,(2)	2		SMB, SCB	Yes/3	Purisima Pt, S Rosa I, & S Cruz I
Cyclonic	Sep-96		1			2	(2)			SCB	Yes/1	Capitan (SBC)
Cyclonic	Aug-96		1			1, (1)		2, (1)		SMB, SCB	Yes/2	Coal Oil Pt & South S Cruz I
Cyclonic	May-96					2	1, (3)			SMB, SCB	No	
Cyclonic	Aug-95					C2,(1)	(2)	2		SMB, SCB	Yes/2	S Miguel I & South S Rosa I
Cyclonic	Jul-95			2		1	(2)	1		SBC	Yes/2	Gaviota & Drake
Cyclonic	Sep-94	(1)		1	C1	C2,(1)				SMB	Yes/3	Purisima Pt (SMB),Coal Oil Pt & Sea Cliff (SBC)
Cyclonic	Jul-93					2,(2)	1,(3)		1	SMB, SCB	Yes/2	S Rosa I
		N	NE	NW	E	W	S	SE	SW			
Upwelling	Mar-99	(1)				C1,1	(2)	C2		SMB, SCB	Yes/2	Pismo Beach (SMB) & Anacapa I (SBC)
Upwelling	Mar-97		C1				1(1)	C2(1)		SCB	Yes/4	S Miguel I, S Barbara, Ventura, & Pt Mugu
Upwelling	Jan-96					2	C1,(4)	C1		SCB	Yes/1	S Cruz I
Upwelling	May-95						(4)	C3,1		SCB	Yes/1	South S Cruz I
Upwelling	Mar-95						1	3,(3)		SCB	Yes/1	South S Rosa I
Upwelling	Jan-95					C2,(1)	(1)	C2,(1)		SCB	Yes/1	South S Cruz I
Upwelling	Jun-94					C2,(1)	(2)	2, (1)		SCB	Yes/1	Santa Monica
Upwelling	Apr-94			1	C2, 1			(1)		SCB	Yes/4	Coal Oil Pt, Oxnard, S Cruz I, & Palos Verdes
Upwelling	Feb-94			1				3, (3)		SCB	Yes/2	S Barbara & Anacapa I
Upwelling	May-93						1,C1	2(3)		SCB	Yes/2	S Cruz I & Redondo Beach

The SBC is the launch area for drifters 5, 6, 7, and 8.

Appendix Table 5.2-4. Santa Maria Basin Drifters: 17, 18, 19, and 20: drifter data used for Lion Rock Unit drifter analysis.

Santa Maria Basin Drifters: 17, 18, 19, and 20

		Launch Area Direction (Second Area Direction)								Second Area(s) of	Land	
Flow Regime	Month/Year	N	NE	NW	E	W	S	SE	SW	Drifter Trajectory	Strike	Land Strike Locations
Relaxation	Sep-99	2					2 (1)			W SCB	Yes/2	San Simeon Pt & Pt Sal
Relaxation	Nov-97	4									Yes/3	Pt Buchon, Pt Sal, & Pt Sur
Relaxation	Dec-96	4									Yes/4	Pt Sur, Monterey Bay
Relaxation	Sep-96	4					(2)			W SCB	Yes/1	Estero Bay
Relaxation	Jan-96	2					2,(1)		(1)	W SCB	Yes/2	Estero Bay & Pt Sal
		N	NE	NW	E	W	S	SE	SW			
Cyclonic	Nov-99						4 (2)	(2)		SBC, W SCB	Yes/2	Pt Conception & S Miguel I
Cyclonic	Oct-98					C1	2	(2)		W SCB	No	
Cyclonic	Aug-96						4 (4)			W SCB	Yes/1	Pt Sal
Cyclonic	May-96						4 (4)			W SCB	No	
		N	NE	NW	E	W	S	SE	SW			
Upwelling	Mar-99	1					2(3)			W SCB	Yes/2	Pt Buchon & Pt Sal
Upwelling	Jul-98						C3, 1			W SCB	No	
Upwelling	Apr-98						3	1,(4)		SCB	Yes/2	Santa Monica Bay & San Clemente Island
Upwelling	Mar-97	3			1		(1)			W SCB	Yes/3	Estero Bay & Pismo Beach

The SMB is the launch area for drifters 17, 18, 19, and 20.

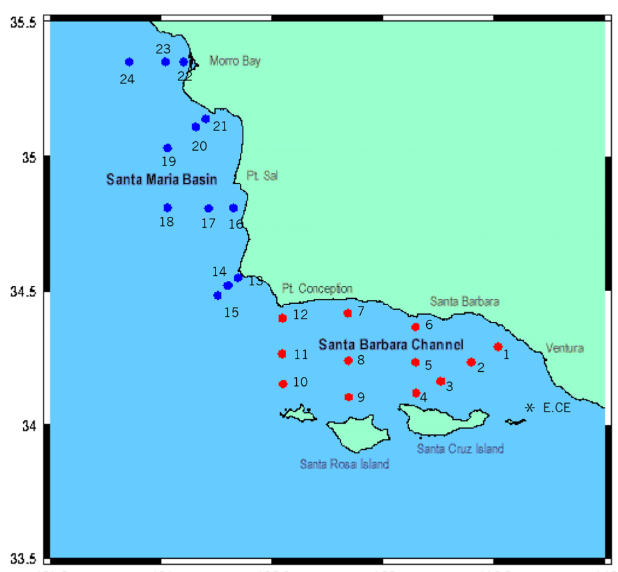
APPENDIX EXHIBIT 5.2-1: SURFACE DRIFTER ANALYSIS FOR THE ROCKY POINT UNIT PROJECT OIL SPILL RISK ASSESSMENT

David R. Browne, MMS

This surface drifter analysis is presented along with the MMS OSRA Model results as part of the best available information regarding oil spill risk analysis for the Rocky Point Unit Project. A comparison between the two analyses will be made in the discussion section.

As part of the Santa Barbara Channel-Santa Maria Basin Circulation (SBC-SMBC) Study conducted by the Scripps Institution of Oceanography, 29 drifter deployments were conducted over a 6 - year period. A "drifter" is a free floating drifting buoy drogued to follow the top 1 meter of the water column. Most deployments consisted of launching drifters at 12 locations within the Santa Barbara Channel (SBC) or 12 locations in the Santa Maria Basin (SMB). There were also deployments where drifters were launched at all 24 locations.

Trajectories of drifters launched from four locations in the proximity of the Rocky Point area (Deployments Sites 12, 13, 14, and 15, Figure D.1) were examined, described (Table D.1), and categorized according to dominant/effective direction, dominant/effective direction by season, final direction, and whether shoreline contact was made. Examination of all drifter tracks advecting through the Rocky Point



Appendix Figure 5.2-26. Figure D.1 of Appendix Exhibit 5.2-1.

Appendix Table 5.2-5. Table D1 for drifter location 12 of Appendix Exhibit 5.2-1.

Table D.1. Rocky Point Drifter Analysis Trajectory Descriptions

Launch Point	Flow Regime	Month/Year	Direction/Path Description	DDIR*	land Strike	Where
12	Cyclonic/Upwelling	Nov. 1999	South, through SR/SCI pass	S	no	
12	Relaxation/ ?	Sep. 1999	wOWC, north, south (few data)	N	no	
12	Cyclonic/Upwelling	Mar. 1999	wOWC,eIWC, s thr SM/SRI pass	S	yes	North coast San Miguel I
12	Cyclonic/Upwelling	Oct. 1998	wOWC, turns s	W	no	
12	Cyclonic	Jul. 1998	South OWC	S	no	
12	Upwelling - Flow East	Apr. 1998	seOEC, se then e	E	yes	S. Catalina I. then Hunt. Beach
12	Relaxation	Nov. 1997	wOWC, north	N	near	Pt. Buchon
12	Cyclonic/Relaxation	Jul. 1997	northwest	N	yes	west Pt. Conception
12	Upwelling	Mar. 1997	s, wOWC, eddy, s	W	no	
12	Relaxation	Dec. 1996	no data, but drifter 7 w th 12, w, n	N	near	Pt. Piedras Blancas
12	Relaxation/Cyclonic	Sep. 1996	swOWC, then se	S	no	
12	Cyclonic	Aug. 1996	swOWC, then s	S	no	
12	Cyclonic	May. 1996	nwOWC	N	yes	Pt. Arguello
12	Relaxation - Upwelling Transition	Jan. 1996	West OWC/ Northwest/Southwest	W	no	
12	Cyclonic/Relaxation	Oct. 1995	sOWC/SE twds Huntington Beach	S	near	Long Beach - Huntington Beach
12	Cyclonic/Upwelling	Aug. 1996	South	S	yes	Northwest tip of San Miguel I.
12	Cyclonic OWC	July. 1995	Northwest	N	yes	Pt. Arguello
12	Upwelling	May. 1995	South - Bad Data - infrequent reporting	X	no	
12	Upwelling	Mar. 1995	S thru SR/SCI - SRI south shore then S	S	yes	SE shore of Santa Rosa I
12	Upwelling then Relaxation	Jan. 1995	S then Eddy then S	S	no	
12	Cyclonic	Nov. 1994	W-OWC then north to Pt. Sal	N	yes	Pt. Sal
12	Cyclonic	Sep. 1994	S/W-OWC, then W, then S	W	no	
12	Cyclonic then Upwelling	Jun. 1994	SW-OWC, then S	S	no	
12	Upwelling	Apr. 1994	SE-OEC, caught in 2 SCB eddys	E	near	Northeast shore Anacapa I.
12	Upwelling	Feb. 1994	NW then S-OWC, South	N	near	Pt. Conception & Pt. Arguello
12	Relaxation	Dec. 1993	NW-OWC to Pt. San Luis, then S, then N	N	near	Pt. San Luis
12, 7**	Relaxation	Oct. 1993	12 no data/ 7 eddy then W-OWC,SW,SE	W	near	Islands offshore San Diego
6**	Relaxation	Oct. 1993	W-OWC then north	N	no	
12	Cyclonic-Relaxation	July. 1993	W-OWC/NW/South	W	no	
12	Upwelling	May. 1993	W/S-OWC, SW then SE	S	no	

*DDIR means Dominant Direction
** Trajectory data not substitued for launch point 12 in Rocky Point Drifter Analysis Discussion

Appendix Table 5.2-6. Table D1 for drifter locations 13 and 14 of Appendix Exhibit 5.2-1.

Table D.1. Rocky Point Drifter Analysis Trajectory Descriptions - Continued

Launch Point	Flow Regime	Month/Year	Direction/Path Description	DDIR	land Strike	Where
13	Cyclonic/Upwelling	Nov. 1999	North to Pt. Arguello	N	yes	Pt. Arguello
13	Relaxation/ ?	Sep. 1999	North to Pt. Arguello then S-OWC	N	yes	Pt. Arguello
13	Cyclonic/Upwelling	Mar. 1999	S then E to SCI, E-OEC, SE to S.Catl I	E	yes	N coast SCI & N Coast S. Catalina I.
13	Cyclonic/Upwelling	Oct. 1998	South, West, then South - Never in SBC	W	no	
13	Cyclonic	Jul. 1998	West-Southwest then North	N	no	
13	Upwelling - Flow East	Apr. 1998	SE to mid SBC, then W to Pt.C then Pt.A	N	yes	Near Pt. Conception & hits N. Pt. Arguello
13	Relaxation	Nov. 1997	SE to Jalama area (between Pt. C & Pt. A	E	yes	Jalama area
13	Cyclonic/Relaxation	Jul. 1997	NW, N, S, then W, then S	N	no	
13	Upwelling	Mar. 1997	NW, SW, then S	W	no	
13	Relaxation	Dec. 1996	N, SE, N then Pt. Estero, then W, then N	N	yes	Pt. Arguello & Pt. Estero
13	Relaxation/Cyclonic	Sep. 1996	no apparent data	X	no	
13	Cyclonic	Aug. 1996	NW then SW then South	W	no	
13	Cyclonic	May. 1996	SW then S	S	no	
13	Transition-Relax/Upwell	Jan. 1996	no apparent data	X		
14	Cyclonic/Upwelling	Nov. 1999	N to S to N Coast of SRI	S	yes	N Coast of Santa Rosa Island
14	Relaxation/ ?	Sep. 1999	N to S	N	near	Pt. Arguello
14	Cyclonic/Upwelling	Mar. 1999	Eddy @ WE of SBC then S	S	no	
14	Cyclonic/Upwelling	Oct. 1998	NE to Pt Arguello then SW	X	near	Pt. Arguello
14	Cyclonic	Jul. 1998	SW then NW then S	W	no	
14	Upwelling - Flow East	Apr. 1998	SE into SBC then S-OEC	E	no	
14	Relaxation	Nov. 1997	N then W	N	no	
14	Cyclonic/Relaxation	Jul. 1997	W then S	W	no	
14	Upwelling	Mar. 1997	N then S	S	no	
14	Relaxation	Dec. 1996	N then NW	N	no	
14	Relaxation/Cyclonic	Sep. 1996	NW then SW then South	N	no	
14	Cyclonic	Aug. 1996	NW then SW then South	W	no	
14	Cyclonic	May. 1996	SW then S	S	no	
14	Transition-Relax/Upwell	Jan. 1996	W then N	W	no	

*DDIR means Dominant Direction

Appendix Table 5.2-7. Table D1 for drifter location 15 of Appendix Exhibit 5.2-1.

Table D.1. Rocky Point Drifter Analysis Trajectory Descriptions - Continued

Launch Point	Flow Regime	Month/Year	Direction/Path Description	DDIR*	land Strike	Where
15	Cyclonic/Upwelling	Nov. 1999	N then SE into SBC, then thru SMI & SRI	S	near	N. Coast of San Miguel
15	Relaxation/ ?	Sep. 1999	N then S	N	near	Pt. Arguello
15	Cyclonic/Upwelling	Mar. 1999	S then E into SBC, then W then S	E	no	
15	Cyclonic/Upwelling	Oct. 1998	NW then SW then S	W	no	
15	Cyclonic	Jul. 1998	S	S	no	
15	Upwelling - Flow East	Apr. 1998	SE into SBC circles SCI-SRI, N intoSBC	S	yes	NSRI, then NSCI, then SSRI
15	Relaxation	Nov. 1997	N along Coast	N	no	
15	Cyclonic/Relaxation	Jul. 1997	W, then Eddy N, then W	W	no	
15	Upwelling	Mar. 1997	NW then SW then S	W	no	
15	Relaxation	Dec. 1996	No data	X		
15	Relaxation/Cyclonic	Sep. 1996	SW to SE	W	no	
15	Cyclonic	Aug. 1996	W, then S	W	no	
15	Cyclonic	May. 1996	S	S	no	
15	Transition-Relax/Upwell	Jan. 1996	W, S, N, E but not into SBC, then N	W	no	

*DDIR means Dominant Direction

area, regardless of their origin, is deferred for later analysis. If no trajectory data existed for a launch point during a particular deployment, no attempt was made to fill that data break with trajectory data from another drifter launch point. There were a total of 65 successful drifter launches from all four locations during the 6 years of deployments. There were 27 successful launches at one location, 12 successful launches at another, and 13 at each of the other two launch points.

Non-Seasonal Analysis

The dominant/effective direction of a drifter trajectory is defined as the direction the drifter traveled in the proximity of the SBC and SMB area, or its direction prior to its contact (or near contact) with a shoreline. When looking at the totals over all deployments (Table D.2), irrespective of season or flow regime, the tendency for a drifter to travel north, west, or south is about even with a slight edge to the northerly direction (around Points Conception and Arguello and up the central California coast) at 32.3 percent of all drifter trajectories. The southerly direction was second in dominance with 30.8 percent of all trajectories, and the west was third with 27.7 percent of all trajectories. The tendency to go east accounted for 9.2 percent of all trajectories.

Drifters that went north were twice as likely to strike the shoreline as those that went south. Two thirds of the drifters that traveled north made contact with the shoreline, whereas only one third of the drifters travelling south experienced the same fate. Two thirds of the drifters traveling east made contact with the shoreline. None of the drifters traveling west ever made contact with land, even after becoming entrained in the equatorward California Current.

When looking at the final direction of all drifter trajectories (Table D.3), again irrespective of season or flow regime, the California Current system comes into play with a clear dominance in direction to the south at 66.2 percent of all trajectories. The north is second at 26.2 percent of all trajectories, then the west at 4.6 percent and finally the east at 3.1 percent. Since all trajectories represent 40 days of transmitting data, the category of “final direction” of free floating surface drifters is probably the least important to oil spill trajectory. The effect of weathering on oil makes the first 10 days of the oil spill trajectory the most important in a risk analysis.

In looking at drifter contact with the shoreline, a drifter can contact the shore without necessarily beaching there. A drifter can, and usually does, travel offshore after making contact with land to yet a new fate. This analysis limits the definition of shoreline contact of a drifter to first contact with a beach. First contact means the first location at which a drifter made actual contact with the shoreline or was close enough that, if it were oil, oil spill response experts and the public alike would consider it a land strike. For the purposes of comparing shoreline contacts in the north versus those in the south (Table D.4), north is defined as the shoreline from Pt. Conception north. South is defined as all shoreline areas south and east of Pt. Conception. The results of this analysis are that 23.1 percent of all trajectories made shoreline contact in the north as opposed to 15.4 percent of all trajectories making shoreline contact to the south. In other words, 60 percent of all drifters launched from the Rocky Point area that contacted the shoreline, made landfall along the central California coast from Pt. Conception northward.

Appendix Table 5.2-8. Table D2, D3, and D4 of Appendix Exhibit 5.2-1.

Non-Seasonal Analysis

Table D.2. Rocky Point Drifter Analysis - Dominant/Effective Direction
(number in "()" indicates number of land strikes)

Launch Pts.	North	South	West	East	No. Traject
12	9 (8)	11 (4)	5 (0)	2 (2)	27
13	6 (4)	1 (0)	3 (0)	2 (2)	12
14	4 (1)	4 (1)	4 (0)	1 (0)	13
15	2 (1)	4 (2)	6 (0)	1 (0)	13
Totals	21 (14)	20 (7)	18 (0)	6 (4)	65
Ratio	21/65	20/65	18/65	6/65	
Percentage	**32.30%**	**30.80%**	**27.70%**	**9.20%**	

Table D.3. Rocky Point Drifter Analysis - Final Directions

Launch Pts.	North	South	West	East	No. Traject
12	8	17	1	1	27
13	5	6	0	1	12
14	2	10	1	0	13
15	2	10	1	0	13
Totals	17	43	3	2	65
Ratio	17/65	43/65	3/65	2/65	
Percentage	**26.20%**	**66.20%**	**4.60%**	**3.10%**	

Table D.4. Rocky Pont Drifter Analysis - Shoreline Contact, North vs. South

Launch Pts.	North/Hit	North/Near	**North/Comp**	South/Hit	South/Near	**South/Comp**	**No. Traject**
12	5	3	8	4	2	6	27
13	5	0	5	1	0	1	12
14	0	1	1	1	0	1	13
15	0	1	1	0	2	2	13
Total	10	5	15	6	4	10	65
Comp Ratio			15/65			10/65	
Percentage			**23.10%**			**15.40%**	

Seasonal Analysis

The seasonal organization of months matches the seasonal synoptic current maps provided to the MMS from the SBC-SMBC Study as input to MMS’s OSRA Model. These seasonal current maps are statistical representations of both drifter current data and current data obtained from moorings that were deployed as part of the study's field program. Thus, to provide consistency, the 6 years of drifter deployments are grouped according to their months of deployment into the same seasons as defined for the OSRA Model.

Spring Season (March – May): There were 19 drifters successfully launched from the four launch points in the proximity of Rocky Point during the spring (Table D.5). Drifters tended to go south 47.4 percent of the time in the spring, with 33.3 percent of those drifters making shoreline contact. The second most dominant direction was east claiming 26.3 percent of the trajectories with a 60-percent shoreline contact rate. Drifters moved toward the west 15.8 percent of the time, with no drifters making contact with a beach. Drifters moved to the north only 10.5 percent of the time, but with a 100-percent shoreline contact rate.

Summer Season (June – August): There were 16 drifters successfully launched from the proximity of Rocky Point during the summer (Table D.5). The west is the most dominant direction for drifter trajectory in the summer, accounting for 43.8 percent of the total, but with no shoreline contact. The second most frequent direction for drifter movement was the south, with 31.25 percent of drifter trajectory and a shoreline contact rate of 20 percent. Drifters advected to the north 25 percent of the time with a 50-percent shoreline contact rate. No drifters moved to the east during the summer.

Fall Season (September – November): There were 21 drifters successfully launched from the four launch points in the proximity of Rocky Point during the fall (Table D.6). Drifters tended to go to the north 47.6 percent of the time, with 60 percent of them making contact with the shoreline. Another 23.8 percent of the launches made during this season went south, making contact with the shoreline 60 percent of the time. Drifter trajectories toward the west accounted for another 23.8 percent of the total number of launches, but with no shoreline contacts. Only one drifter launched (4.8 percent of the trajectories) during the fall advected to the east; this drifter also made shoreline contact.

Winter Season (December – February): There were 9 drifters successfully launched from the proximity of Rocky Point during the winter (Table D.6). Drifters tended to go north 55.6 percent of the time with an 80-percent shoreline contact rate. Drifters advected south only 11.1 percent of the time with no shoreline contact. The westerly direction was the second most prominent direction for drifter movement during the winter, claiming 33.3 percent of the drifters launched, again with none making shoreline contact. There were no drifter trajectories toward the east during the winter.

Discussion

The drifter data and analysis above provide a measure of the likelihood that a drifter, and therefore probably a surface floating pollutant, will be transported in a certain direction. Because of the small number of drifter observations, the calculated percentage (probability) that a drifter will move in a certain direction, or make contact with a shoreline

Appendix Table 5.2-9. Table D5 of Appendix Exhibit 5.2-1.

Seasonal Analysis

Table D.5. Rocky Point - Dominant Direction (Including Shoreline Contact) in Spring and Summer Seasons

Spring Season

Launch Pts.		North	N. Strike	South	S. Strike	West	W. Strike	East	E. Strike	Launches
12		1	1	3	2	1	0	2	2	7
13		1	1	1	0	1	0	1	1	4
14		0	0	3	0	0	0	1	0	4
15		0	0	2	1	1	0	1	0	4
	Total	2	2	9	3	3	0	5	3	19
	Ratio	2/19		9/19		3/19		5/19		
	Percentage	**10.50%**		**47.40%**		**15.80%**		**26.30%**		

Summer Season

Launch Pts.		North	N. Strike	South	S. Strike	West	W. Strike	East	E. Strike	Launches
12		2	2	4	1	1	0	0	0	7
13		2	0	0	0	1	0	0	0	3
14		0	0	0	0	3	0	0	0	3
15		0	0	1	0	2	0	0	0	3
	Total	4	2	5	1	7	0	0	0	16
	Ratio	4/16		5/16		7/16		0		
	Percentage	**25.00%**		**31.25%**		**43.80%**		**0.00%**		

Appendix Table 5.2-10. Table D6 of Appendix Exhibit 5.2-1.

Seasonal Analysis

Table D.6. Rocky Point - Dominant Direction (Including Shoreline Contact) in Fall and Winter Seasons

Fall Season

Launch Pts.		North	N. Strike	South	S. Strike	West	W. Strike	East	E. Strike	Launches
12		3	2	3	1	2	0	0	0	8
13		2	2	0	0	1	0	1	1	4
14		3	1	1	1	0	0	0	0	4
15		2	1	1	1	2	0	0	0	5
	Total	10	6	5	3	5	0	1	1	21
	Ratio	10/21		5/21		5/21		1/21		
	Percentage	**47.60%**		**23.80%**		**23.80%**		**4.80%**		

Winter Season

Launch Pts.		North	N. Strike	South	S. Strike	West	W. Strike	East	E. Strike	Launches
12		3	3	1	0	1	0	0	0	5
13		1	1	0	0	0	0	0	0	1
14		1	0	0	0	1	0	0	0	2
15		0	0	0	0	1	0	0	0	1
	Total	5	4	1	0	3	0	0	0	9
	Ratio	5/9		1/9		3/9		0		
	Percentage	**55.60%**		**11.10%**		**33.30%**		**0.00%**		

should be viewed cautiously. However, based on the drifter data it can be surmised that a surface floating pollutant originating in the Rocky Point area has an equal likelihood of moving north, west, or south. If the pollutant were to move in the northerly, southerly, or easterly direction, then there also would be a reasonable possibility of shoreline contact. A surface pollutant spill originating from Rocky Point would be likely to move north or west during the fall and winter, south and east in the spring, and west and south in the summer. This is because the relaxation and cyclonic circulation flow regimes are dominant in the fall and winter, the upwelling circulation flow regime is dominant in the spring, and the cyclonic circulation flow regime is dominant in the summer. The uncertainty of direction of movement of a drifter (or a surface pollutant) during a particular season is due to the fact that all of these oceanic flow regimes (including their transition states) characteristic of the SBC-SMB area can occur during any time of the year.

The surface drifter trajectories emanating from the Rocky Point Unit Project area vary with the trajectories calculated for that area by the MMS Oil Spill Risk Analysis (OSRA) model. MMS OSRA model trajectories make very few shoreline contacts north of Pt. Arguello throughout the entire year. One of the reasons for this is that the OSRA model is heavily dependent on wind fields in performing its trajectory calculations and therefore, its probabilities of shoreline contact. It calculates numerous trajectories from the same launch point by varying the wind over a static ocean current field and applying the deep ocean 3.5-percent wind rule to account for the supposed movement of oil over the surface layer of the water. The prevailing wind characteristic of the SBC-SMB area is from the northwest. Therefore, the probabilities computed from this present OSRA model run are based on oil spill trajectories that tend to be biased toward the south and southeast relative to the drifter trajectories. This has produced higher than expected probabilities of shoreline hits on the north shores of the Santa Barbara Channel islands, and lower than expected probabilities of shoreline hits along the central California coast.

Experimental time varying synoptic current fields representing conditions in the SBC-SMB area have been developed from both observations and dynamic modeling techniques. Preliminary runs using these new current fields have produced OSRA model trajectories more in line with those of the surface drifters. However, the drifter data and the present OSRA Model calculations both provide important insights. The drifter analysis is based on actual field observations and provides information on actual surface current flow variability to be considered with the computer-generated results calculated for the SBC-SMB area by the OSRA Model. Together, the two analyses present a more complete picture of what may occur when oil is spilled. Both data sets have been used in this analysis.

APPENDIX EXHIBIT 5.2-2: SURFACE DRIFTER ANALYSIS FOR THE CAVERN POINT UNIT PROJECT OIL SPILL RISK ASSESSMENT

David R. Browne, MMS

ABSTRACT

Eighty-five drifters were launched from the Cavern Point Unit Project area during a 6-year deployment period. Eighty-two percent of these drifters made contact with, or were near to, a shoreline. Drifter data is presented in a number of different categories in order to give an intuitive sense of where spilled oil would possibly travel and make shoreline contact. Likely areas of high and low impact from a large spill occurring in the Cavern Point Unit Project are discussed. A comparison of this drifter analysis and the MMS Oil Spill Risk Analysis Model results is made.

INTRODUCTION

This surface drifter analysis is presented along with the MMS Oil Spill Risk Analysis (OSRA) Model results as part of the best available information regarding oil spill risk analysis for the Cavern Point Unit Project. A comparison between the two analyses will be made in the discussion section.

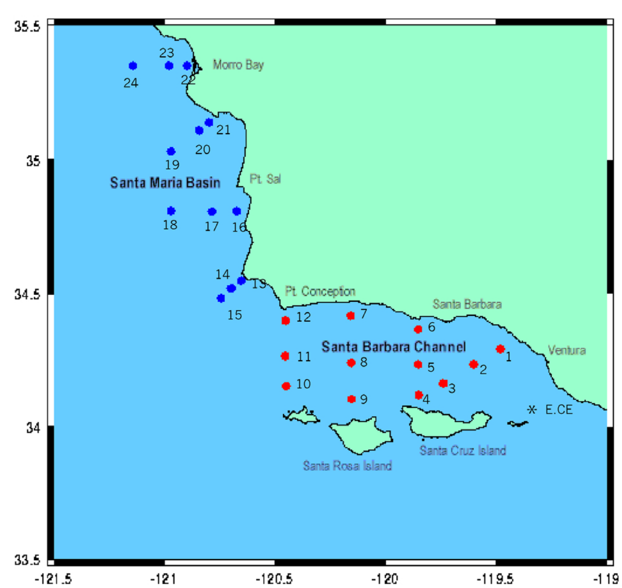
As part of the Santa Barbara Channel-Santa Maria Basin Circulation (SBC-SMBC) Study conducted by the Scripps Institution of Oceanography, 29 drifter deployments were conducted over a 6-year period. A “drifter” is a free floating drifting buoy drogued to follow the top 1-meter of the water column. It “consists of a submerged vertical tube, which houses the electronics and battery. An antenna protrudes from the top of the tube and extends upward through the surface of the water. Four cloth vanes of total area: 1.8 square meters are supported on rods that extend radially from the top and bottom of the tube. Four flotation elements are attached at the end of each rod by short lengths of nylon line. The electronics consists of a controller with temperature circuit and transmitter. The transmitter allows the drifters to be located by orbiting satellites using the Argos system. This system locates the drifters several times each day, with positional accuracy varying between 150 m and 1000 m. The temperature circuit measures hourly averages of sea surface temperature accurate to 0.01 deg C. The drifters are programmed to run for 40 days after deployment" (Scripps website: www-ccs.ucsd.edu).

Most deployments consisted of launching drifters at 12 locations within the Santa Barbara Channel (SBC) or 12 locations in the Santa Maria Basin (SMB). There were also deployments where drifters were launched at all 24 locations.

The drifter data and analysis below provide a measure of the likelihood that a drifter and, therefore, possibly an oil spill, will be transported in a certain direction. Because of the small number of drifter observations, the calculated percentage (probability) that a drifter will move in a certain direction, or make contact with a shoreline, should be viewed with caution.

Trajectories of drifters launched from four locations in the proximity of the Cavern Point area (Deployment Sites 1, 2, 3, and E.CE, Figure 1) were examined, described (Table 1), and categorized according to dominant/effective direction, dominant/effective direction by season, final direction, shoreline contact in major areas, final location, final location by season, and whether shoreline contact was made. Examination of all drifter tracks advecting through the Cavern Point area, regardless of their origin, is deferred for later analysis. If no trajectory data existed for a launch point during a particular deployment, no attempt was made to fill that data break with trajectory data from another drifter launch point. There were a total of 85 successful drifter launches from all four locations during the 6 years of deployments. There were 31 successful launches at one location, 26 successful launches at another, 24 launches at another and 4 at the eastern Channel entrance (E.CE).

Appendix Figure 5.2-27. Figure 1 of Appendix Exhibit 5.2-2.



Appendix Table 5.2-11. Table 1 for drifter location 1 of Appendix Exhibit 5.2-2.

Table 1. Cavern Point Drifter Analysis Trajectory Descriptions For Launch Point 1

DDN**	Flow Regime	Month/Year	Direction/Path Description	DDIR*	Land Strike	Where
549	Cyclonic/Upwelling	Nov. 1999	SE, OEC, eddies, W	SE	Yes	South Santa Cruz Island
no	Relaxation/ ?	Sep. 1999	NO DATA	ND	ND	
527	Cyclonic/Upwelling	Mar. 1999	N to Carpenteria	N	Yes	Carpenteria
no	Cyclonic/Upwelling	Oct. 1998	NO DATA	ND	ND	
480	Cyclonic	Jul. 1998	W, Cycles, OWC, S	W	Near	Santa Barbara
no	Upwelling - Flow East	Apr. 1998	NO DATA	ND	ND	
444	Relaxation	Nov. 1997	Cycling, NE, Mainland	NE	Yes	Punta Gorda, Pitas Pt., Ventura
410	Cyclonic/Relaxation	Jul. 1997	S, Cycles, Chinese Harbor, San Pedro Pt.	S	Yes	C Harbor & S Pedro Pt. of SCI
389	Upwelling	Mar. 1997	SE, OEC, SE, cycles in S. Monica Bay	SE	Yes	Redondo Beach, LA
353	Relaxation	Dec. 1996	CyclesSouth, W along & near mainland	W	Yes	Pt. Conception
320	Relaxation/Cyclonic	Sep. 1996	S then W near mainland shoreline	W	Yes	Coal Oil Pt., El Capitan, Gaviota
296	Cyclonic	Aug. 1996	NO DATA	ND	ND	
287	Cyclonic	May. 1996	NW to mainland	N	Yes	Loon Pt. - Santa Barbara
254	Relaxation - Upwelling Transition	Jan. 1996	W, NE	NE	Yes	Carpenteria
249	Cyclonic/Relaxation	Oct. 1995	W, S, Strikes entire N.SCI, N, W, OWC,S	S	Yes	N. SCI
225	Cyclonic/Upwelling	Aug. 1995	SE, OEC, strikes Redondo Beach	SE	Yes	Redondo Beach, LA
215	Cyclonic OWC	July. 1995	NO DATA	ND	ND	
204	Upwelling	May. 1995	NW - tight cycle, near Santa Barbara	NW	Yes	Santa Barbara
182	Upwelling	Mar. 1995	SE,Near Pt. Hueneme,SE alng M'nland C	SE	No	
175	Upwelling then Relaxation	Jan. 1995	S-OEC, Cycles, N, Strikes near Pt. Dume	SE	Yes	Near Pt. Dume
155	Cyclonic	Nov. 1994	W, OWC, S	W	No	
141	Cyclonic	Sep. 1994	WNW	N	Yes	Santa Barbara Pt.
129	Cyclonic then Upwelling	Jun. 1994	N, E	N, E*	Yes	Carpenteria, Ventura
113	Upwelling	Apr. 1994	N	N	Yes	Punta Gorda
102	Upwelling	Feb. 1994	SE, OEC	SE	Yes	Laguna Pt.
88	Relaxation	Dec. 1993	NE,alng mnlnd,S,crclng AI&SCI,W,OWC	NE*,S	Near	Carpenteria to Pt. Hu'me, NSCI
73	Relaxation	Oct. 1993	W, OWC, Near Goleta&Arguello,NW	W,NW*	Yes	Area South of Purisma Pt.
59	Cyclonic-Relaxation	July. 1993	SE, OEC, cycles SE/NW - SMSP Basins	SE	Near	Laguna Pt.,Pt. Dume,E. S Cat I
34	Upwelling	May. 1993	SE, OEC, SE,SW, SE alng Mainland	SE	Near	E. SNI

* "*" or "DDIR" means Dominant Direction **Drifter Deployment Number

Appendix Table 5.2-12. Table 1 for drifter location 2 of Appendix Exhibit 5.2-2.

Table 1 Cavern Point Drifter Analysis Trajectory Descriptions for Launch Point 2

DDN**	Flow Regime	Month/Year	Direction/Path Description	DDIR*	land Strike	Where
550	Cyclonic/Upwelling	Nov. 1999	SE, OEC, W, S in W.SCB	SE	No	
no	Relaxation/ ?	Sep. 1999	No Data	ND	ND	
526	Cyclonic/Upwelling	Mar. 1999	W, OWC, NW, S	W	No	
no	Cyclonic/Upwelling	Oct. 1998	No Data	ND	ND	
479	Cyclonic	Jul. 1998	W, Cycles, OWC, W, S	W	No	
no	Upwelling - Flow East	Apr. 1998	No Data	ND	ND	
443	Relaxation	Nov. 1997	W,OWC,NW alng Central California Coast	W*/NW	Near	Pt. Conception
407	Cyclonic/Relaxation	Jul. 1997	Cycles, S, NE coast SCI	S	Yes	NE coast SCI
388	Upwelling	Mar. 1997	W, S.WCE, SMI, E, N.SRI, S	W	Near	W.SMI & E.SRI
350	Relaxation	Dec. 1996	Cycles around LP, E, Strikes mainland	E	Yes	Ventura
321	Relaxation/Cyclonic	Sep. 1996	W, OWC, S	W	No	
297	Cyclonic	Aug. 1996	W, S, E-near SRI, NE, SE-OEC, S, SE	W*/SE	Near	SRI
286	Cyclonic	May. 1996	NE to mainland	NE	Yes	Carpenteria
255/256	Relaxation - Upwelling Transition	Jan. 1996	W,Cycles,E,SE,OEC,cycles SM-SP Bsns	SE	Near	Pt.Vicente-Redondo Bch(255 only)
248	Cyclonic/Relaxation	Oct. 1995	S, N cycle, W, OWC, SW, SE	W	Yes	NW. SMI
224	Cyclonic/Upwelling	Aug. 1995	E, OEC, SE	SE	No	
214	Cyclonic OWC	July. 1995	N,Eddies,SW,SE,near NE. SCI,E-OEC,W	SE*/W	Near	NW.SCI, S.SCI, E.Anacapa
202	Upwelling	May. 1995	NE - tight cycling	NE	Yes	Pitas Pt. to Ventura
183	Upwelling	Mar. 1995	N, near mainland, W, SE, OEC	N	Near	Loon Pt,S.Barbara,Goleta,S.Diego
172/173	Upwelling then Relaxation	Jan. 1995	Both-SE,cycling,OEC,173,near Anacapa	SE*/S	Near	Anacapa Island (173 only)
154	Cyclonic	Nov. 1994	S, cycle, W	S*/W	Near	N.SCI, Goleta Pt., Gaviota
139/140	Cyclonic	Sep. 1994	W,OWC,Eddies,S//W,OWC,S	W	No	
127	Cyclonic then Upwelling	Jun. 1994	SW, SE	S	Near	N. SCI
112	Upwelling	Apr. 1994	SE then NE to Mainland	E*/NE	Yes	Pitas Pt. to Punta Gorda
100	Upwelling	Feb. 1994	SE, OEC	SE	Near	Ventura
85/86	Relaxation	Dec. 1993	W,NW,OWC,N along Central CA Coast	W,NW*	Near	Pt.Cncept&Pt.Arguello (86 only)
71	Relaxation	Oct. 1993	W, OWC, N along Central CA Coast	W/NW*	Near	Goleta, Pt. Arguello
56/55	Cyclonic-Relaxation	July. 1993	56-W,OWC,S//55-W,O SMI/SRI Pass, S	W	Near	W. San Miguel, near E. S.Miguel
35	Upwelling	May. 1993	SE, OEC, W near S.Cruz, SE	SE	Near	S. SCI

* "*" or "DDIR" means Dominant Direction **Drifter Deployment Number

Shoreline contact will be part of the discussion. Actual shoreline contact is many times subject to small scale local environmental events. However, the fact that a free floating drifter has moved to a certain coastal region indicates the associated onshore and offshore resources in that area are in jeopardy should a real spill occur.

NON-SEASONAL ANALYSIS

The dominant/effective direction of a drifter trajectory is defined as the direction the drifter traveled in the proximity of the SBC and SMB area, or its direction prior to its contact (or near contact) with a shoreline. When looking at the totals over all deployments (Table 2), irrespective of season or flow regime, we see that the tendency is greatest (35.3% of all 85

Appendix Table 5.2-13. Table 1 for drifter location 3 of Appendix Exhibit 5.2-2.

Table 1 **Cavern Point Drifter Analysis Trajectory Descriptions For Launch Point 3**

DDN**	Flow Regime	Month/Year	Direction/Path Description	DDIR*	land Strike	Where
551	Cyclonic/Upwelling	Nov. 1999	SE,nearNE SCI,circlesSCI,reenters CviaW.SCI pass	SE*,W	Yes	near NE SCI & SW. SCI
no	Relaxation/ ?	Sep. 1999	No Data	ND	ND	
525	Cyclonic/Upwelling	Mar. 1999	W,OWC,NW,S	W	no	
no	Cyclonic/Upwelling	Oct. 1998	No Data	ND	ND	
478	Cyclonic	Jul. 1998	Cycle,W,cycles,S,San Miguel I	W	Yes	N. SMI
no	Upwelling - Flow East	Apr. 1998	No Data	ND	ND	
442	Relaxation	Nov. 1997	W, eddies-tightly,OWC,NW along central CA coast	W/NW*	no	
405	Cyclonic/Relaxation	Jul. 1997	S to N. SCI	S	Yes	N. SCI
387	Upwelling	Mar. 1997	W, cycles near Pt.C, SW, OWC,S	W	Yes	Pt. Conception
348	Relaxation	Dec. 1996	W, cycles, W to Pt.C, OWC, NW	W/NW*	Yes	Pt.C,Pismo Bch to Pt.Sal
no	Relaxation/Cyclonic	Sep. 1996	No Data	ND	ND	
298	Cyclonic	Aug. 1996	SE,near Anacapa I,OEC,SW,S	SE	near	Anacapa I
283	Cyclonic	May. 1996	Cycles, E, N,W-Strikes Goleta Pt.	N	Yes	GoletaPt&SantaBarbaraPt
no	Relax - Upwell Transition	Jan. 1996	No Data	ND	ND	
249	Cyclonic/Relaxation	Oct. 1995	S,cycles in Chinese Harbor - SCI, N, W, OWC,S	S	Yes	N. SCI
221	Cyclonic/Upwelling	Aug. 1995	SE, near NE. SCI, SE-OEC,S,W,S.SCI,S.SRI	SE*,W	near	N.SCI, S.SCI, S.SRI
212	Cyclonic OWC	July. 1995	NE, SE-OEC, S, near San Clemente I	SE	near	N. San Clemente I
201	Upwelling	May. 1995	SE-OEC, S, near San Nicolas I	SE	near	San Nicolas I
184	Upwelling	Mar. 1995	E,nearW.Anacapa,OEC,WthenS,nearSan Clemente	SE	near	SE San Clemente I
167	Upwelling then Relaxation	Jan. 1995	Cycles @LP,W,W eddy,OWC,NW, eddy,NW	NW	near	Purisma Pt. - Pt. Sal
153	Cyclonic	Nov. 1994	SE, near NE. SCI, N to Goleta Pt.	SE*,N	yes	NE. SCI & Goleta Pt.
138	Cyclonic	Sep. 1994	cycles N & S	S	Yes	N. SCI
126	Cyclonic then Upwelling	Jun. 1994	SE, OEC, W(S.SCI), S	SE*,W	near	Anacapa I, S. SCI
109	Upwelling	Apr. 1994	SE,OEC,near AnacapaI & N. SCI, Pt. Vicente	SE	Yes	Anacapa,S.SCI,Pt.Vicente
99	Upwelling	Feb. 1994	SE, OEC, W, SE	SE	near	N. SCI
84	Relaxation	Dec. 1993	W,eddy,S,very near E.SRI,W.SMI,S	S	near	E.SRI, near SMI
69	Relaxation	Oct. 1993	Eddies, W, OWC, forms W eddy	W	no	
53	Cyclonic-Relaxation	July. 1993	SE	SE	yes	near Anacapa, yes E.SCI
38	Upwelling	May. 1993	S, eddies, impacts SCI	S	Yes	Chinese Harbor, SCI

* "*" or "DDIR" means Dominant Direction **Drifter Deployment Number

Appendix Table 5.2-14. Table 1 for drifter pairs at locations 1 and E.CE of Appendix Exhibit 5.2-2.

Table 1 **Cavern Point Drifter Analysis Trajectory Descriptions - Special Launched Pairs**

Launch Point	Estimated Flow Regime	Month/Year	Direction/Path Description	DDIR*	land Strike	Where
LP1,393	Cyclonic	May-97	W to mainland	W	Yes	Goleta to Coal Oil Pt.
LP1,394	Cyclonic	May-97	W to mainland	W	Yes	Goleta to Coal Oil Pt.
117	N/A	May-94	Not Pertinent to Cavern Point			
118	N/A	May-94	Not Pertinent to Cavern Point			
ECE, 32	Upwelling	Mar-93	SE to North San Diego County coastline	SE	Yes	North San Diego County coastline
ECE,33	Upwelling	Mar-93	SE to North San Diego County coastline	SE	Yes	North San Diego County coastline
ECE, 31	Relaxation	Jan-93	W to NW to OWCE, N to San Luis Obispo Bay	W, NW*	Yes	San Luis Obispo Bay
ECE, 30	Relaxation	Jan-93	W to S of SCI to ESRI, NW to OWC, N to Morro Bay	W, NW*	Yes	E. S. Rosa Island and Morro Bay

drifters) to travel southeast toward, and out, the eastern Channel entrance. The westerly direction is second at 24.7%, north is third at 14.1%, south is fourth at 11.8%, and northwest along the central California coast is fifth at 10.6% . The easterly direction accounts for only 3.5%. A startling statistic is that over 82% of all drifters launched in the Cavern Point area made landfall or came near a shoreline.

In looking at drifter contact with the shoreline, a drifter can contact the shore without necessarily beaching there. A drifter can, and usually does, travel offshore after making contact with land to yet a new fate. This analysis limits the definition of shoreline contact of a drifter to first contact with a beach. First contact means the first location at which a drifter made actual contact with the shoreline or was close enough that, if it were oil, oil spill response experts and the public alike would consider it a land strike. Table 7 does present the degree of multiple shoreline contacts in different areas during a single drifter trajectory.

Appendix Table 5.2-15. Tables 2 and 3 of Appendix Exhibit 5.2-2.

Non-Seasonal Analysis

Table 2 **Cavern Point Drifter Analysis - Dominant/Effective Direction**
(number in "()" indicates number of land strikes)

Launch Pts.	North	South	West	East	South East	NW,CCACoast	Trajectories(Hits)
E.CE	0	0	0	0	2(2)	2(2)	4(4)
1	8(8)	2(2)	6(5)	1(1)	8(7)	1(1)	26(24)
2	3(3)	3(3)	11(6)	2(2)	9(5)	3(2)	31(21)
3	1(1)	5(5)	4(2)	0	11(11)	3(2)	24(21)
Totals	12(12)	10(10)	21(13)	3(3)	30(25)	9(7)	85(70)
Ratio	12//85	10//85	21/85	3//85	30/85	9//85	70/85
Percentage	**14.12%**	**11.76%**	**24.71%**	**3.53%**	**35.29%**	**10.59%**	**82.35%**

Table 3 **Cavern Point Drifter Analysis - Final Directions**

Launch Pts.	North	South	West	East	South East	NW,CCACoast	Trajectories
E.CE	0	0	0	0	2	2	4
1	6	4	7	1	7	1	26
2	3	11	3	1	9	4	31
3	2	10	2	0	7	3	24
Totals	11	25	12	2	25	10	85
Ratio	11//85	25/85	13/85	2//85	25/85	10//85	
Percentage	**12.94%**	**29.41%**	**15.29%**	**2.35%**	**29.41%**	**11.76%**	

Appendix Table 5.2-16. Tables 4 and 5 of Appendix Exhibit 5.2-2.

Non-Seasonal Analysis

Table 4. **Cavern Point Drifter Analysis - Shoreline Contact CCAC, CM, and CI&S**

Launch Pts.	CCACoast	CM*	CI&S*	Total Hits	SBC*	Trajectories
E.CE	2	0	2	4	1	4
1	1	14	9	24	16	26
2	2	7	12	21	19	31
3	2	2	17	21	16	24
Total	7	23	40	70	52	85
Comp Ratio	7//85	23//85	40/85	70/85	52/85	
Percentage	**8.24%**	**27.06%**	**47.06%**	**82.35%**	**61.18%**	

*CM = Channel Mainland; CI&S = Channel Islands and Shorlines further south; SBC = CM + CI contacts

Table 5. **Cavern Point Drifter Analysis - Final Location**

Launch Pts.	CCACoast	SCBWest	SBC	SCBCoastal	S.SBC I*	Trajectories
E.CE	2	0	0	2	0	4
1	1	4	14	6	1	26
2	4	12	7	7	1	31
3	3	9	7	4	1	24
Totals	10	25	28	19	3	85
Ratio	10//85	25/85	28/85	19/85	3//85	
Percentage	**11.76%**	**29.41%**	**35.29%**	**23.53%**	**3.53%**	

*S.SBC I = Southern Santa Barbara Channel Islands Shorelines

In Table 4 a comparison of the number of drifter shoreline contacts in each of three main areas is made. Over 47% of all launches made land strike at the Channel Islands, or at shorelines immediately south in the Southern California Bight. Over 27% of launches struck the Channel mainland, and 8.2% of all drifters launched in the Cavern Point area made land strike along the central California coast.

When looking at the final direction of all drifter trajectories (Table 3), again irrespective of season or flow regime, the south toward the Channel Islands and the southeast out the eastern Channel entrance dominated at 29.4% for each direction or a composite of 58.8% of all drifters. West was the final direction for 15.3% of all drifters, north toward the mainland was the final direction for 12.9% of all of the drifters, northwest along the central California coast was the final direction for 11.8% of all of the drifters launched, and the east was the final direction for 2.4% of all the drifters launched from the Cavern Point area. Since all trajectories represent 40 days of transmitting data, the category of "final direction" of free floating surface drifters is probably the least important to oil spill trajectory. The effect of weathering on oil makes the first 10 days of the oil spill trajectory the most important in a risk analysis.

Final distribution of the 85 drifters launched from the Cavern Point area (Table 5) consists of 35.3% remaining in the SBC, 29.4% exiting the Channel and finishing their reported trajectory in the western region of the Southern California Bight, 23.5% end their journey in the coastal region of the Southern California Bight, 11.8% travelled northwest along the central California coast before striking its shoreline or stop reporting, and 3.6% exit out of the eastern Channel entrance and then go west striking the southern shorelines of the Channel Islands.

SEASONAL ANALYSIS

The seasonal organization of months matches the seasonal synoptic current maps provided to the MMS from the SBC-SMBC Study as input to MMS's OSRA Model. These seasonal current maps are statistical representations of both drifter current data and current data obtained from moorings that were deployed as part of the study's field program. Thus, to provide consistency, the 6 years of drifter deployments are grouped according to their months of deployment into the same seasons as defined for the OSRA Model.

There are two major non-local forcing mechanisms affecting the oceanic flows in the SBC-SMB area. They are the upwelling favorable macroscopic wind regime (from the northwest along the western United States coastline) and the poleward alongshore pressure gradient in the Southern California Bight. There are also some local forcing mechanisms that modify the larger flow regime that is set in place by the relative balance of these two larger scale oceanic forcing mechanisms. While the dominant flow regime for each season is discussed, the other flow regimes characteristic to the SBC-SMB area can occur during that same season which, in that instance, would dictate the trajectory of spilled oil.

Spring Season (March – May): The dominant flow regime during the spring season is the upwelling flow regime. Upwelling favorable winds (from the northwest) dominate over the poleward alongshore pressure gradient in the Southern California Bight causing upwelling along the central California coast and south and southeastward current flows through the greater western half of the Channel. Channel waters flow south through the Channel Island passes and southeast through the eastern Channel entrance. There typically remains a remnant of a western current in the northern part of the Channel along the mainland shoreline.

There were 25 drifters successfully launched from the four launch points in the proximity of Cavern Point during the spring seasons (Table 6). Drifters tended to go southeast 36.0% of the time in the spring, with 88.9% of those drifters making shoreline contact. The second most dominant direction was north claiming 32.0% of the trajectories with a 100% shoreline contact rate. Drifters moved toward the west 24.0% of the time, with 66.6% of those drifters making contact with a beach. Drifters moved to the south or east only 4.0% of the time for each direction, but with a 100% shoreline contact rate. There were no drifters that moved northwest along the central California coast during this time period.

Final locations (Table 7) of the free floating drifters consisted of 44.0% in the Santa Barbara Channel with a 100% shoreline strike rate, 32.0% in the coastal region of the Southern California Bight with an 87.5% shoreline strike rate, and 24.0% in the western region of the Southern California Bight with a 0.0% shoreline strike rate.

Summer Season (June – August): The dominant flow regime during the summer season is the cyclonic flow regime. The poleward alongshore pressure gradient in the Southern California Bight and the upwelling favorable winds (from the northwest) are in balance which causes a cyclonic eddy to be formed which is at least the size of the western half of the Santa Barbara Channel.

There were 20 drifters successfully launched from the proximity of Cavern Point during the summer (Table 6). The southeast is the most dominant direction for drifter trajectory in the summer, accounting for 45.0% of the total, with 88.9% shoreline contact. The second most frequent direction for drifter movement was west, with 30.0% of drifter trajectory

Appendix Table 5.2-17. Tables 6 (Spring and Summer) of Appendix Exhibit 5.2-2.

Table 6 **Seasonal Analysis:** **Cavern Point - Dominant Direction and Shoreline Contact in Spring and Summer Seasons**

Spring Season

Launch Pts.	N	N Strike	S	S Strike	W	W Strike	E	E Strike	SE	SE Strike	NW	NW Strike	Launches
E.CE	0	0	0	0	0	0	0	0	2	2	0	0	2(2)
1	4	4	0	0	2	2	0	0	3	2	0	0	9(8)
2	3	3	0	0	2	1	1	1	1	1	0	0	7(6)
3	1	1	1	1	2	1	0	0	3	3	0	0	7(6)
Total	8	8	1	1	6	4	1	1	9	8	0	0	25(22)
Ratio	8//25		1//25		6//25		1//25		9//25		0//25		
Percentage	**32.00%**		**4.00%**		**24.00%**		**4.00%**		**36.00%**		**0.00%**		

Summer Season

Launch Pts.	N	N Strike	S	S Strike	W	W Strike	E	E Strike	SE	SE Strike	NW	NW Strike	Launches
E.CE	0	0	0	0	0	0	0	0	0	0	0	0	0(0)
1	0	0	1	1	1	1	1	1	2	2	0	0	5(5)
2	0	0	2	2	4	3	0	0	2	1	0	0	8(6)
3	0	0	1	1	1	1	0	0	5	5	0	0	7(7)
Total	0	0	4	4	6	5	1	1	9	8	0	0	20(18)
Ratio	0//20		4//20		6//20		1//20		9//20		0		
Percentage	**0.00%**		**20.00%**		**30.00%**		**5.00%**		**45.00%**		**0.00%**		

Appendix Table 5.2-18. Tables 6 (Fall and Winter) of Appendix Exhibit 5.2-2.

Table 6 **Seasonal Analysis:** **Cavern Point - Dominant Direction and Shoreline Contact in Fall and Winter Seasons**

Fall Season

Launch Pts.	N	N Strike	S	S Strike	W	W Strike	E	E Strike	SE	SE Strike	NW	NW Strike	Launches
E.CE	0	0	0	0	0	0	0	0	0	0	0	0	0(0)
1	2	2	1	1	2	1	0	0	1	1	1	1	7(6)
2	0	0	1	1	5	2	0	0	1	0	1	1	8(4)
3	0	0	2	2	1	0	0	0	2	2	1	0	6(4)
Total	2	2	4	4	8	3	0	0	4	3	3	2	21(14)
Ratio	2//21		4//21		8//21		0		4//21		3//21		
Percentage	**9.52%**		**19.05%**		**38.10%**		**0.00%**		**19.05%**		**14.25%**		

Winter Season

Launch Pts.	N	N Strike	S	S Strike	W	W Strike	E	E Strike	SE	SE Strike	NW	NW Strike	Launches
E.CE	0	0	0	0	0	0	0	0	0	0	2	2	2(2)
1	2	2	0	0	1	1	0	0	2	2	0	0	5(5)
2	0	0	0	0	0	0	1	1	5	3	2	1	8(5)
3	0	0	1	1	0	0	0	0	1	1	2	2	4(4)
Total	2	2	1	1	1	1	1	1	8	6	6	5	19(16)
Ratio	2//19		1//19		1//19		1//19		8//19		6//19		
Percentage	**10.53%**		**5.26%**		**5.26%**		**5.26%**		**42.11%**		**31.58%**		

and a shoreline contact rate of 83.3%. Drifters advected to the south 20.0% and the east 5.0% of the time both with a 100% shoreline contact rate. No drifters moved to the north during the summer.

Final locations (Table 7) of the free floating drifters consisted of 35.0% in the Santa Barbara Channel with a 100% contact rate, 35.0% in the western region of the Southern California Bight with a 0.0% contact rate, 25.0% in the coastal region of the Southern California Bight with a 60.0% contact rate, and 5.0% in the region near the southern shorelines of the Channel Islands with a 100% contact rate. No drifters moved north to the mainland or northwest along the central California coastline during the summer seasons.

Fall Season (September – November): The dominant flow regimes for the fall are the relaxation

Appendix Table 5.2-19. Tables 7 (Spring and Summer) of Appendix Exhibit 5.2-2.

Table 7 **Seasonal Analysis**: **Cavern Point - Final Location and Shoreline Contact in Spring and Summer Seasons**

X(Y)(Z) = Trajectories in Final Location(strikes in final location)(strikes enroute to final location)

Spring Season

Launch Pts.	CCACoast	CCACoast Strike	SCBWest	SCBWest Strike	SBChannel	SBChannel Strike	SCBCoastal	SCBCoastal Strike	S.SBCI	S.SBCI Strike	Launches
E.CE	0	0	0	0	0	0	2	2	0	0	2(2)
1	0	0	0	0	6	6(2)	3	2	0	0	9(8)(2)
2	0	0	3	0	3	3(2)	1	1	0	0(1)	7(4)(3)
3	0	0	3	0	2	2(2)	2	2(1)	0	0	7(4)(3)
Total	0	0	6	0	11	11(6)	8	7(1)	0	0(1)	25(18)(8)
Ratio	0/25		6//25		11///25		8//25		0/25		
Percentage	**0.00%**		**24.00%**		**44.00%**		**32.00%**		**0.00%**		

Summer Season

Launch Pts.	CCACoast	CCACoast Strike	SCBWest	SCBWest Strike	SBChannel	SBChannel Strike	SCBCoastal	SCBCoastal Strike	S.SBCI	S.SBCI Strike	Launches
E.CE	0	0	0	0	0	0	0	0	0	0	0(0)
1	0	0	1	0	2	2(1)	2	2	1	0	5(4)(1)
2	0	0	3	0	2	2(4)	2	0	0	1	8(3)(4)
3	0	0	3	0	3	3(2)	1	1	0	0(2)	7(4)(4)
Total	0	0	7	0	7	7(7)	5	3	1	1(2)	20(11)(9)
Ratio	0/25		7//20		7//20		5//20		1//20		
Percentage	**0.00%**		**35.00%**		**35.00%**		**25.00%**		**5.00%**		

Appendix Table 5.2-20. Tables 7 (Fall and Winter) of Appendix Exhibit 5.2-2. SMB-A.

Table 7 **Seasonal Analysis**: **Cavern Point - Final Location and Shoreline Contact in Fall and Winter Seasons**

X(Y)(Z) = Trajectories in Final Location(strikes in final location)(strikes enroute to final location)

Fall Season

Launch Pts.	CCACoast	CCACoast Strike	SCBWest	SCBWest Strike	SBChannel	SBChannel Strike	SCBCoastal	SCBCoastal Strike	S.SBCI	S.SBCI Strike	Launches
E.CE											
1	1	1	2	0	3	3(1)	0	0	1	1	7(5)(1)
2	2	1	5	0	1	1(3)	0	0	0	0	8(2)(3)
3	1	0	2	0	2	2(1)	0	0	1	1	6(3)(1)
Total	4	2	9	0	6	6(5)	0	0	2	2	21(10)(5)
Ratio	4//21		9//21		6//21		0/21		2//21		
Percentage	**19.05%**		**42.86%**		**28.57%**		**0.00%**		**9.52%**		

Winter Season

Launch Pts.	CCACoast	CCACoast Strike	SCBWest	SCBWest Strike	SBChannel	SBChannel Strike	SCBCoastal	SCBCoastal Strike	S.SBCI	S.SBCI Strike	Launches
E.CE	2	2	0	0	0	0(1)	0	0	0	0	2(2)(1)
1	0	0	1	0	2	2(1)	2	2	0	0	5(4)(1)
2	2	1	0	0	1	1(2)	5	2	0	0	8(4)(2)
3	2	2	1	0	0	0(3)	1	0	0	0	4(2)(3)
Total	6	5	2	0	3	3(7)	7	4	0	0	19(12)(7)
Ratio	6//19		2//19		3//19		7//19		0/19		
Percentage	**31.58%**		**10.53%**		**15.79%**		**36.84%**		**0.00%**		

and cyclonic flow regimes with reasonable representation of the upwelling flow regime. The latter two have already been described. The relaxation flow regime occurs when there is a "relaxation" of the northwest, upwelling favorable macroscopic winds allowing the poleward alongshore pressure gradient, that exists in and to the south of the Southern California Bight, to dominate. The western current flow along the mainland shoreline in the Santa Barbara Channel and the poleward current along the central California coastline reach their peak magnitudes during a full relaxation event. There typically exists an eastward flowing current of lesser magnitude along the northern shorelines of the Channel Islands.

There were 21 drifters successfully launched from the four launch points in the proximity of Cavern Point during the fall (Table 6). Drifters tended to go to the west 38.1% of the time, with 37.5% of them making contact with the shoreline. The second two most dominant directions of drifter trajectory were south and southeast with 19.5% each, with 100% of the drifters going south making contact with the shoreline and 75.0% of those moving in the southeast direction making landfall. Drifter trajectories toward the northwest along the central California coastline accounted for 14.3% of the total number of launches, with 66.7% making shoreline contact. Two drifters of the 21 launched (9.5%) during the fall season moved to the east, with both (100%) making shoreline contact. No drifters moved to the east during the fall seasons that were sampled.

Final locations (Table 7) of the free floating drifters during the fall season consisted of 42.9% in the western region of the Southern California Bight with no shoreline contact occurring, 28.6% in the Santa Barbara Channel with 83.3% making shoreline contact, 19.1% along the central California coastline with 50.0% making shoreline contact, and 9.52% in the nearshore region of the southern coastlines of the Channel Islands with 100% making landfall.

Winter Season (December – February): The dominant oceanic flow regimes for the winter are the relaxation flow regime, and to a slightly lesser extent, the upwelling flow regime.

There were 19 drifters successfully launched from the proximity of Cavern Point during the winter seasons (Table 6). Drifters tended to go southeast 42.1% of the time with 75.0% of those launches making shoreline contact. Drifters advected northwest along the central California coastline 31.6% of the time with 83.3% of them making shoreline contact. North was the third most prominent direction for drifter movement during the winter season at 10.5% of the drifters launched, with 100% making shoreline contact. One drifter (5.3% of the winter season launches) travels south, one travels west, and one travels east. All three made shoreline contact.

Final locations (Table 7) of the free floating drifters during the winter season consisted of 36.8% in the coastal region of the Southern California Bight with 57.1% of those drifters making shoreline contact, 31.6% along the central California coastline with 83.3% making shoreline contact, 15.8% in the Santa Barbara Channel with 100% making shoreline contact, and 10.5% in the western region of the Southern California Bight with none making landfall.

DISCUSSION

It is apparent by the high shoreline contact statistics (82.4% of the 85 drifters launched from the Cavern Point area) that if an oil spill of significant size occurred at Cavern Point there would almost certainly be shoreline contact unless there was effective intervention. The drifter data represented in all of the tables, but specifically Tables 4 and 5, indicate there is virtually no particular region in the SBC-SMB area that is not vulnerable to a large spill occurring at Cavern Point. Certainly the Channel Islands and the coastal area of the Southern California Bight are the most vulnerable to oil contact with 47.1% of all drifter launches making shoreline contact in this region. The mainland coastline of the Channel suffered shoreline contact from 27.1% of all the launches from Cavern Point. Free floating drifters launched from Cavern Point reached the central California coastline at an 8.2% rate. This latter phenomenon is not represented in the MMS Pacific Region OSRA Model results.

The most important non-seasonal statistics when considering resources at risk from an oil spill are those concerning the dominant/effective direction of the drifter trajectory. Table 2 indicates that the environmental resources southeast of Cavern Point, the majority of which are outside the eastern Channel entrance, are vulnerable 35.3% of the time. Environmental resources located along the central California coastline are vulnerable 10.6% of the time from a large oil spill (over 500 barrels) occurring in the Cavern Point area. The remaining 50% of the time onshore and offshore environmental resources within the Santa Barbara Channel would be impacted by a large oil spill occurring in the Cavern Point area.

The seasonal drifter data results are consistent with the known oceanography in the SBC-SMB area. In the spring and summer seasons, the upwelling and cyclonic flow regimes, respectively, dominate the oceanic circulation in the SBC-SMB area. During these seasons, no drifters ever entered the central California coastal region which is what would be expected since no poleward current is generated during these regimes. The dominate directions during these two seasons respectively were the southeast (36.0% and 45.0%), west (24.0% and 30.0%), north (32.0% and 0.0%), and south (4.0% and 20.0%).

In the fall and winter seasons the relaxation, cyclonic, and upwelling flow regimes, in that order, dominate the oceanic circulation in the SBC-SMB area. The dominant directions for the drifters launched during the fall seasons are west (38.1%), southeast (19.1%), south (19.1%), northwest (14.3%), and north (9.5%). Unlike the spring and summer seasons, in the fall a significant number of drifter trajectories travel northwest along the central California coast.

The dominant directions for the drifters launched during the winter seasons are the southeast (42.1%), northwest along the central California coast (31.6%), north (10.5%), south (5.3%), west (5.3%), and east (5.3%). In the winter a third of the drifter trajectories travel northwest along the central California coast.

So, in a nutshell, what are the areas most vulnerable to an oil spill occurring at Cavern Point, and by what degree? Table 4 indicates that 61.2% of all drifter strikes launched from the Cavern Point area occur within the SBC. From the Cavern Point area it takes from less than a day to up to 4 days to strike anywhere in the Channel. The remaining 38.8% of drifter strikes occur southeast of the SBC at the Southern California Bight shorelines, or at Pt. Arguello and north along the southern central California coastline. While it is possible that oil could hit the regions beyond the SBC, it would have to be unabated by organized response measures and weathering. The regions southeast of the SBC are the next most vulnerable since the southeast is a high percentage dominant direction with shoreline availability for drifters during all 4 seasons. It would take 5 to 10 days for a spill travelling southeast out of the eastern Channel entrance to strike Redondo Beach.

Drifters, and therefore oil, are only carried in the direction along the central California coastline during a relaxation event, which typically occurs during the fall and winter seasons. Drifter data also indicates that it would take 5 to 20 days for oil spilling from the Cavern Point area to make landfall somewhere along the central California coastline. So, while it is significant that 11.8% of all drifters launched from the Cavern Point area make their final location along the central California coastline, it would require a catastrophic event at Cavern Point to jeopardize resources in the shoreline areas north of Pt. Arguello.

The surface drifter trajectories emanating from the Cavern Point Unit Project area vary at times with the trajectories calculated for that area by the MMS OSRA Model. MMS OSRA Model trajectories make very few shoreline contacts north of Pt. Arguello throughout the entire year. One of the reasons for this is the OSRA Model is heavily dependent on wind fields in performing its trajectory calculations and, therefore, its probabilities of shoreline contact. It calculates numerous trajectories from the same launch point by varying the wind over a seasonally averaged ocean current field and applying the deep ocean 3.5-percent wind effect estimator to project the assumed movement of oil over the surface layer of the water. The prevailing wind characteristic of the SBC-SMB area is from the northwest.

Another reason for OSRA Model trajectories not proceeding to the northwest along the central California coast during the fall and winter seasons is that the currents that were provided as input to the OSRA Model were seasonally averaged. Any transition of current flow from the westerly to northwesterly directions in the vicinity west of Pt. Arguello was smoothed out in the synoptic current fields by the averaging process. Because of this and other circumstances resulting from seasonally averaging currrent synoptic data fields, it has been argued that truer representations of actual synoptic currents in the SBC area could be obtained by averaging the synoptic data by current flow regime. This way the characteristics of one distinct flow regime would not act to modify the characteristics of another flow regime occurring in the same season. As it is now, only establishing a strong wind forcing from the south will override this particular result of seasonally averaging the synoptic current data sets.

Therefore, the probabilities computed from this present OSRA Model run are based on oil spill trajectories more prominently directed toward the south and southeast relative to the drifter trajectories. Other oil spill trajectory analysis tools provide oil spill trajectories where wind is seen to exert far less influence than theoretical estimators such as the 3.5-percent rule would indicate. However, even the proponents of the 3.5-percent rule would have to agree that in the circumstane where drifters do move northwestward along the central California coast, their trajectories most likely will give a reasonaably good estimate of what oil will do. This is because drifters launched from the Santa Barbara Channel only move poleward along the central California coastline during a relaxation flow regime event. The winds "relax" in intensity and allow the poleward alongshore pressure gradient to dominate the circulation forcing in the area. The theoretical wind estimator becomes negligible, even for discussion, in this instance.

Experimental time varying synoptic current fields representing conditions in the SBC-SMB area have been developed from both observations and dynamic modeling techniques. Preliminary runs using these new current fields have produced OSRA model trajectories more in line with those of the surface drifters. However, the drifter data and the present OSRA Model calculations both provide important insights. The drifter analysis is based on actual field observations and provides information on actual surface current flow variability to be considered with the computer-generated results calculated for the SBC-SMB area by the OSRA Model. Together, the two analyses present a more complete picture of what may occur when oil is spilled.

Gnome Model Analysis Results Tables
Appendix Tables 5.2-21 to 5.2-38

Appendix Table 5.2-21. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at launch point SMB-A

				GNOME Oil Spill Trajectory Run Results								
					Launch Point:SMB-A							
					Spill Volume: 200 BBL							
Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SMB	N			1	Pt Sal		79	117	3	4mpsNW
							Pismo Bch				N SMB	
Relaxation	10	SMB	N			3	Pt Sal	Purisima Pt	88	3	106	4mpsNW
							Pismo Bch				N SMB	
Relaxation	3	SMB	N			0			79	49	72	0mps
											N SMB	
Relaxation	10	SMB	N			0			80	0	120	0mps
											N SMB	
Relaxation	3	SMB	N			0			77	23	100	4mpsSW
											N SMB	
Relaxation	10	SMB	N			0			77	0	123	4mpsSW
											N SMB	
Convergent	3	SMB	S			6	Surf	Purisima Pt	79	114	0	7mpsNW
							Pt Arguello					
Convergent	10	SMB	S			12	Surf	Purisima Pt	96	19	74	7mpsNW
							Pt Arguello				W SMB	
Upwelling	3	SBC	SE			1	Surf		79	120	0	8mpsNW
							Pt Arguello					
Upwelling	10	SBC	SE			50	S Miguel I		95	12	43	8mpsNW
							S Rosa I				S WCE	

Appendix Table 5.2-22. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at launch point SMB-A.

GNOME Oil Spill Trajectory Run Results
Launch Point:SMB-A
Spill Volume: 2000 BBL

Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SMB	N			12	Pt Sal		786	1174	28	4mpsNW
							Pismo Bch				N SMB	
Relaxation	10	SMB	N			26	Pt Sal	Purisima Pt	880	30	1064	4mpsNW
							Pismo Bch				N SMB	
Relaxation	3	SMB	N			0			788	494	718	0mps
											N SMB	
Relaxation	10	SMB	N			0			796	0	1204	0mps
											N SMB	
Relaxation	3	SMB	N			0			768	230	1002	4mpsSW
											N SMB	
Relaxation	10	SMB	N			0			774	0	1226	4mpsSW
											N SMB	
Convergent	3	SMB	S			62	Surf	Purisima Pt	794	1144	0	7mpsNW
							Pt Arguello					
Convergent	10	SMB	S			118	Surf	Purisima Pt	958	186	738	7mpsNW
							Pt Arguello				W SMB	
Upwelling	3	SBC	SE			8	Surf		794	1198	0	8mpsNW
							Pt Arguello					
Upwelling	10	SBC	SE			496	S Miguel I		950	122	432	8mpsNW
							S Rosa I				S WCE	

Appendix Table 5.2-23. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Hidalgo.

GNOME Oil Spill Trajectory Run Results
Launch Point: Hidalgo
Spill Volume: 200 BBL

Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SMB	N			2	Purisima Pt	Surf	79	119	0	4mpsNW
Relaxation	10	SMB	N			35	Purisima Pt	Surf	96	33	36	4mpsNW
							Pt. Sal	Pismo Bch			N SMB	
Relaxation	3	SMB	N			0			79	121	0	0mps
Relaxation	10	SMB	N			1	Purisima Pt		93	6	100	0mps
											N SMB	
Relaxation	3	SMB	N			8	Purisima Pt	Surf	79	113	0	4mpsSW
							Pt. Sal					
Relaxation	10	SMB	N			30	Purisima Pt	Pismo Bch	94	24	52	4mpsSW
							Pt. Sal	Pt. San Luis			N SMB	
Convergent	3	SMB	NW	SMB	NE	1	Pt. Arguelo		79	120	0	7mpsNW
Convergent	10	SMB	W	SMB	NE	1	Pt. Arguelo		95	43	61	7mpsNW
											W SMB	
Upwelling	3	SBC	SE	S of SBC	S	32	S Miguel I	S Rosa I	79	88	1	8mpsNW
											S WCE	
Upwelling	10	SBC	SE	S of SBC	S	57	S Miguel I		95	14	33	8mpsNW
							S Rosa I				S WCE	

Appendix Table 5.2-24. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Hidalgo.

GNOME Oil Spill Trajectory Run Results Launch Point: Hidalgo Spill Volume: 2000 BBL												
Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SMB	N			20	Purisima Pt	Surf	794	1186	0	4mpsNW
Relaxation	10	SMB	N			358	Purisima Pt	Surf	950	318	374	4mpsNW
							Pt. Sal	Pismo Bch			N SMB	
Relaxation	3	SMB	N			2	Surf		794	1204	0	0mps
Relaxation	10	SMB	N			2	Pt. Sal		920	52	1026	0mps
											N SMB	
Relaxation	3	SMB	N			86	Purisima Pt	Surf	794	1120	0	4mpsSW
							Pt. Sal					
Relaxation	10	SMB	N			296	Purisima Pt	Pismo Bch	942	220	542	4mpsSW
							Pt. Sal	Pt. San Luis			N SMB	
Convergent	3	SMB	NW	SMB	NE	6	Pt. Arguelo		794	1200	0	7mpsNW
Convergent	10	SMB	W	SMB	NE	4	Pt. Arguelo		950	432	614	7mpsNW
											W SMB	
Upwelling	3	SBC	SE	S of SBC	S	324	S Miguel I	S Rosa I	792	880	4	8mpsNW
											S WCE	
Upwelling	10	SBC	SE	S of SBC	S	572	S Miguel I		950	144	334	8mpsNW
							S Rosa I				S WCE	

Appendix Table 5.2-25. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Harvest.

GNOME Oil Spill Trajectory Run Results

Launch Point: Harvest

Spill Volume: 200 BBL

Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SMB	N			1	Surf		79	120	0	4mpsNW
Relaxation	10	SMB	N			26	Purisima Pt	Surf	97	31	46	4mpsNW
							Pt Sal				N SMB	
							Pismo Bch					
Relaxation	3	SMB	N			1	Purisima Pt		79	120	0	0mps
Relaxation	10	SMB	N			1	Purisima Pt	Pt Sal	93	6	101	0mps
											N SMB	
Relaxation	3	SMB	N			4	Purisima Pt	Surf	79	116	0	4mpsSW
Relaxation	10	SMB	N			22	Purisima Pt	Pismo Bch	93	17	67	4mpsSW
							Pt Sal	Pt. San Luis			N SMB	
Convergent	3	SMB	W			0			79	121	0	7mpsNW
Convergent	10	SMB	W			0			96	60	44	7mpsNW
											W SMB	
Upwelling	3	SBC	SE			45	S Miguel I	S Rosa I	79	74	2	8mpsNW
											S WCE	
Upwelling	10	SBC	SE			58	S Miguel I		95	10	36	8mpsNW
							S Rosa I				S WCE	

Appendix Table 5.2-26. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Harvest.

GNOME Oil Spill Trajectory Run Results
Launch Point: Harvest
Spill Volume: 2000 BBL

Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SMB	N			4	Surf		794	1202	0	4mpsNW
Relaxation	10	SMB	N			280	Purisima Pt	Surf	972	290	458	4mpsNW
							Pt Sal				N SMB	
							Pismo Bch					
Relaxation	3	SMB	N			2	Purisima Pt		794	1204	0	0mps
Relaxation	10	SMB	N			4	Purisima Pt	Pt Sal	930	56	1010	0mps
											N SMB	
Relaxation	3	SMB	N			42	Purisima Pt	Surf	794	1164	0	4mpsSW
Relaxation	10	SMB	N			220	Purisima Pt	Pismo Bch	934	174	672	4mpsSW
							Pt Sal	Pt. San Luis			N SMB	
Convergent	3	SMB	W			0			794	1206	0	7mpsNW
Convergent	10	SMB	W			0			960	600	440	7mpsNW
											W SMB	
Upwelling	3	SBC	SE			452	S Miguel I	S Rosa I	792	736	20	8mpsNW
											S WCE	
Upwelling	10	SBC	SE			580	S Miguel I		954	104	362	8mpsNW
							S Rosa I				S WCE	

Appendix Table 5.2-27. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Hermosa.

				GNOME Oil Spill Trajectory Run Results								
					Launch Point: Hermosa							
					Spill Volume: 200 BBL							
Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SMB	N			1	Surf	Purisima Pt	79	120	0	4mpsNW
Relaxation	10	SMB	N			28	Purisima Pt	Pismo Bch	97	32	43	4mpsNW
							Pt Sal	Surf			N SMB	
Relaxation	3	SMB	N			0			79	121	0	0mps
Relaxation	10	SMB	N			1	Purisima Pt	Pt Sal	93	8	98	0mps
											N SMB	
Relaxation	3	SMB	N			8	Purisima Pt	Pt Sal	79	112	0	4mpsSW
Relaxation	10	SMB	N			27	Purisima Pt	Pismo Bch	93	24	56	4mpsSW
							Pt Sal	Pt San Luis			N SMB	
Convergent	3	SMB	W			0			79	121	0	7mpsNW
Convergent	10	SMB	W			0			96	72	32	7mpsNW
											SW SMB	
Upwelling	3	SBC	SE			57	S Miguel I	S Rosa I	79	63	1	8mpsNW
											S WCE	
Upwelling	10	SBC	SE			60	S Miguel I	S Rosa I	96	13	31	8mpsNW
											S WCE	

Appendix Table 5.2-28. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Hermosa.

GNOME Oil Spill Trajectory Run Results

Launch Point: Hermosa

Spill Volume: 2000 BBL

Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SMB	N			6	Surf	Purisima Pt	794	1200	0	4mpsNW
Relaxation	10	SMB	N			282	Purisima Pt	Pismo Bch	970	322	426	4mpsNW
							Pt Sal				N SMB	
Relaxation	3	SMB	N			0			794	1206	0	0mps
Relaxation	10	SMB	N			8	Purisima Pt	Pt Sal	934	78	980	0mps
											N SMB	
Relaxation	3	SMB	N			82	Purisima Pt	Pt Sal	794	1124	0	4mpsSW
Relaxation	10	SMB	N			268	Purisima Pt	Pismo Bch	934	242	556	4mpsSW
							Pt Sal	Pt San Luis			N SMB	
Convergent	3	SMB	W			0			794	1202	0	7mpsNW
Convergent	10	SMB	W			0			962	716	322	7mpsNW
											W SMB	
Upwelling	3	SBC	SE			566	S Miguel I	S Rosa I	792	630	12	8mpsNW
											S WCE	
Upwelling	10	SBC	SE			598	S Miguel I	S Rosa I	964	130	308	8mpsNW
											S WCE	

Appendix Table 5.2-29. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Heritage.

GNOME Oil Spill Trajectory Run Results Launch Point: Heritage Spill Volume: 200 BBL												
Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SBC	SW	SMB	W & N	0			79	121	0	4mpsNW
Relaxation	10	SBC	S & SE	SMB	N &W	33	S Miguel I	S Cruz I	98	47	22	4mpsNW
							S Rosa I				S SBC	
											S WCE	
Relaxation	3	SBC	W	SMB	N & W	0			79	121	0	0mps
Relaxation	10	SBC	S	SMB	W & N	3	S Miguel I	S Rosa I	96	81	20	0mps
											S WCE	
											W SMB	
Relaxation	3	SBC	W	SMB	N & W	0			79	121	0	4mpsSW
Relaxation	10	SMB	N	SBC	S	1	Purisima Pt	Pt Sal	96	30	73	4mpsSW
							Pt San Luis	Pismo Bch			N SMB	
Convergent	3	SBC	S & SE			24	S Miguel I	S Cruz I	79	96	1	7mpsNW
							S Rosa I				S SBC	
Convergent	10	SBC	S & SE			48	S Miguel I		95	15	41	7mpsNW
							S Rosa I				S SBC	
							S Cruz I					
Upwelling	3	SBC	SE			20	S Cruz I	S Rosa I	79	101	0	8mpsNW
											S SBC	
Upwelling	10	SBC	SE			11	S Cruz I	Ventura	88	5	95	8mpsNW
											SE ECE	
											S SBC	

Appendix Table 5.2-30. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Heritage.

				GNOME Oil Spill Trajectory Run Results								
					Launch Point: Heritage							
					Spill Volume: 2000 BBL							
Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SBC	SW	SMB	W & N	0			794	1206	0	4mpsNW
Relaxation	10	SBC	S	SMB	N &W	324	S Miguel I	S Cruz I	972	460	244	4mpsNW
							S Rosa I				S SBC	
											S WCE	
Relaxation	3	SBC	W	SMB	N & W	0			794	1206	0	0mps
Relaxation	10	SBC	S	SMB	W & N	40	S Miguel I	S Rosa I	964	782	214	0mps
											S WCE	
											W SMB	
Relaxation	3	SBC	W	SMB	N & W	0			794	1206	0	4mpsSW
Relaxation	10	SMB	N	SBC	S	20	Purisima Pt	Pt Sal	954	302	724	4mpsSW
							Pt San Luis	Pismo Bch			N SMB	
Convergent	3	SBC	S & SE			244	S Miguel I	S Cruz I	786	956	14	7mpsNW
							S Rosa I				S SBC	
Convergent	10	SBC	S & SE			482	S Miguel I		954	154	410	7mpsNW
							S Rosa I				S SBC	
							S Cruz I					
Upwelling	3	SBC	SE			198	S Cruz I	S Rosa I	790	1008	4	8mpsNW
											S SBC	
Upwelling	10	SBC	SE			112	S Cruz I	Ventura	882	52	954	8mpsNW
											SE ECE	
											S SBC	

Appendix Table 5.2-31. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Harmony.

GNOME Oil Spill Trajectory Run Results

Launch Point: Harmony

Spill Volume: 200 BBL

Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SBC	SW	SMB	W & N	0			79	121	0	4mpsNW
Relaxation	10	SBC	S & SE	SMB	W & N	25	S Miguel I	S Cruz I	97	58	21	4mpsNW
							S Rosa I				S WCE	
											S SBC	
											N SMB	
Relaxation	3	SBC	W	SMB	W & N	0			79	121	0	0mps
Relaxation	10	SBC	W & SW	SMB	W & N	1	S Miguel I	S Rosa I	97	63	39	0mps
								Pismo Bch			S WCE	
											W SMB	
											N SMB	
Relaxation	3	SBC	W	SMB	N	1	Pt Arguello	Surf		119	0	4mpsSW
Relaxation	10	SBC	W	SMB	N & W	8	Purisima Pt	Surf	96	18	79	4mpsSW
							Pt Sal	Pismo Bch			N SMB	
Convergent	3	SBC	S			11	S Miguel I		79	109	0	7mpsNW
							S Rosa I					
Convergent	10	SBC	S & SE			52	S Miguel I		96	15	37	7mpsNW
							S Rosa I				S SBC	
							S Cruz I					
Upwelling	3	SBC	SE			3	S Cruz I		79	117	0	8mpsNW
Upwelling	10	SBC	SE			2	S Cruz I	Ventura	90	5	103	8mpsNW
											SE ECE	

Appendix Table 5.2-32. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Harmony.

				GNOME Oil Spill Trajectory Run Results								
					Launch Point: Harmony							
					Spill Volume: 2000 BBL							
Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SBC	SW	SMB	W & N	0			794	1206	0	4mpsNW
Relaxation	10	SBC	S & SE	SMB	W & N	250	S Miguel I	S Cruz I	968	576	206	4mpsNW
							S Rosa I				S WCE	
											S SBC	
											N SMB	
Relaxation	3	SBC	W	SMB	W & N	0			794	1206	0	0mps
Relaxation	10	SBC	W & SW	SMB	W & N	8	S Miguel I	S Rosa I	970	628	394	0mps
								Pismo Bch			S WCE	
											W SMB	
											N SMB	
Relaxation	3	SBC	W	SMB	N	14	Pt Arguello	Surf	794	1192	0	4mpsSW
Relaxation	10	SBC	W	SMB	N & W	78	Purisima Pt	Surf	956	180	786	4mpsSW
							Pt Sal	Pismo Bch			N SMB	
Convergent	3	SBC	S			112	S Miguel I		792	1094	2	7mpsNW
							S Rosa I				S SBC	
Convergent	10	SBC	S & SE			524	S Miguel I		958	152	366	7mpsNW
							S Rosa I				S SBC	
							S Cruz I					
Upwelling	3	SBC	SE			34	S Cruz I		794	1172	0	8mpsNW
Upwelling	10	SBC	SE			22	S Cruz I		898	50	1030	8mpsNW
											SE ECE	

Appendix Table 5.2-33. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Hondo.

GNOME Oil Spill Trajectory Run Results
Launch Point: Hondo
Spill Volume: 200 BBL

Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SMB	W			0			79	121	0	4mpsNW
Relaxation	10	SBC	S	SMB	N & W	16	S Miguel I	Purisima Pt	97	73	14	4mpsNW
							S Rosa I	Pismo Bch			N SMB	
							S Cruz I	Pt. Sal			S WCE	
Relaxation	3	SMB	W & N			0			79	121	0	0mps
Relaxation	10	SMB	W & N			1	Purisima Pt	S Miguel I	97	46	57	0mps
											N SMB	
											W SMB	
Relaxation	3	SMB	N	SMB	W	5	Pt Arguello		79	116	0	4mpsSW
							Surf					
Relaxation	10	SMB	N			20	Purisima Pt	Pismo Bch	97	20	63	4mpsSW
							Pt. Sal				N SMB	
Convergent	3	SBC	S	SMB	W	6	S Miguel I	S Rosa I	79	115	0	7mpsNW
Convergent	10	SBC	S			53	S Miguel I	S Cruz I	96	18	33	7mpsNW
							S Rosa I				SBC	
Upwelling	3	SBC	SE			1	S Cruz I		79	120	0	8mpsNW
Upwelling	10	SE ECE	SE	SBC	SE	2	S Cruz I		89	6	103	8mpsNW
											ECE	

Appendix Table 5.2-34. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Hondo.

				GNOME Oil Spill Trajectory Run Results								
					Launch Point: Hondo							
					Spill Volume: 2000 BBL							
Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SMB	W			0			794	1206	0	4mpsNW
Relaxation	10	SBC	S	SMB	N & W	146	S Miguel I	Purisima Pt	968	742	144	4mpsNW
							S Rosa I	Pismo Bch			N SMB	
							S Cruz I	Pt. Sal			S WCE	
Relaxation	3	SMB	W & N			0			794	1206	0	0mps
Relaxation	10	SMB	W & N			8	Purisima Pt	S Miguel I	976	480	536	0mps
							Pt. Sal				N SMB	
											W SMB	
Relaxation	3	SMB	N	SMB	W	50	Purisima P	Pt. Sal	794	1156	0	4mpsSW
							Surf					
Relaxation	10	SMB	N			196	Purisima Pt	Pismo Bch	950	218	636	4mpsSW
							Pt. Sal	Pt. San Luis			N SMB	
Convergent	3	SBC	S	SMB	W	56	S Miguel I	S Rosa I	794	1150	0	7mpsNW
Convergent	10	SBC	S			532	S Miguel I	S Cruz I	964	176	614	7mpsNW
							S Rosa I				SBC	
Upwelling	3	SBC	SE			8	S Cruz I		794	1198	0	8mpsNW
Upwelling	10	SBC EE	SE	SBC	SE	18	S Cruz I		890	60	1032	8mpsNW
											SBC EE	

Appendix Table 5.2-35. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Hillhouse.

				GNOME Oil Spill Trajectory Run Results								
					Launch Point: Hillhouse							
					Spill Volume: 200 BBL							
Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SBC	W			71	Goleta Pt	S Barbara	79	50	0	0 mps
							Gaviota					
Relaxation	10	SBC	W	SMB	N	19	Goleta Pt	Pt Arguello	97	83	0	4mpsNW
							Gaviota	Purisima Pt				
								Pt Sal				
Relaxation	3	SBC	W			71	Goleta Pt	S Barbara	79	50	0	0mps
							Gaviota					
Relaxation	10	SBC	W			22	Goleta Pt	Pt Arguello	97	78	3	0mps
							Gaviota	Purisima Pt			N SMB	
Relaxation	3	SBC	W			71	Goleta Pt	S Barbara	79	50	0	0 mps
							Gaviota					
Relaxation	10	SBC	W	SMB	N	52	Goleta Pt	Pt Arguello	97	44	7	4mpsSW
							Gaviota	to Pt Sal			N SMB	
Convergent	3	SBC	W			24	Goleta Pt		79	97	0	0mpsNW
							Gaviota					
Convergent	10	SBC	W	SMB	W	20	S Miguel I	Capitan	97	30	53	7mpsNW
							S Rosa I				S WCE	
Upwelling	3	SBC	W			16	S Barbara		79	105	0	0mpsNW
							Gaviota					
Upwelling	10	SBC	SE			8	S Cruz I	S Rosa I	97	15	80	8mpsNW
											SE ECE	

Appendix Table 5.2-36. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Hillhouse.

				GNOME Oil Spill Trajectory Run Results								
					Launch Point: Hillhouse							
					Spill Volume: 2000 BBL							
Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SBC	W			698	Goleta Pt	S Barbara	794	508	0	0 mps
							Gaviota					
Relaxation	10	SBC	W	SMB	N	164	Goleta Pt	S Barbara	972	864	0	4mpsNW
							Capitan	Purisima Pt				
							Gaviota	Pt Sal				
Relaxation	3	SBC	W			698	Goleta Pt	S Barbara	794	508	0	0mps
							Gaviota					
Relaxation	10	SBC	W			236	Goleta Pt	P Conception	974	764	26	0mps
							Gaviota	P Arguello			N SMB	
Relaxation	3	SBC	W			698	Goleta Pt	S Barbara	794	508	0	0 mps
							Gaviota					
Relaxation	10	SBC	W	SMB	N	570	Goleta Pt	Pt Arguello	972	404	54	4mpsSW
							Gaviota	to Pt Sal			N SMB	
Convergent	3	SBC	W			240	Goleta Pt		794	966	0	0mpsNW
							Gaviota					
Convergent	10	SBC	W	SMB	W	202	S Miguel I	Capitan	966	302	530	7mpsNW
							S Rosa I				S WCE	
Upwelling	3	SBC	W			156	S Barbara		794	1050	0	0mpsNW
							Gaviota					
Upwelling	10	SBC	SE			84	S Cruz I	S Rosa I	970	150	796	8mpsNW
											SE ECE	

Appendix Table 5.2-37. GNOME oil spill trajectory results for hypothetical 200 bbl oil spill at Platform Gail.

GNOME Oil Spill Trajectory Run Results

Launch Point: Gail

Spill Volume: 200 BBL

Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SBC	W			21	S Barbara		79	99	0	0 mps
							Gaviota					
Relaxation	10	SBC	W			8	Coal Oil Pt	Pt Arguello	97	93	1	4mpsNW
							Gaviota	Purisima Pt			S WCE	
							S Miguel I	S Rosa I				
Relaxation	3	SBC	W	Same as above for the next two Relaxation events								
Relaxation	10	SBC	W			8	Goleta pt	Pt Arguello	97	89	6	0mps
							Gaviota	Purisima Pt			N SMB	
								Pt Sal				
Relaxation	10	SBC	W			37	Naples	Goleta Pt	97	48	18	4mpsSW
							Gaviota	Pt San Luis				
							Pt Arguello					
							to Pt Sal					
Convergent	3	SBC	W			19	Carpenteria	Ventura	79	101	0	0mpsNW
							S Barbara					
							Gaviota					
Convergent	10	SBC	W			42	S Miguel I	Carpenteria	96	37	26	7mpsNW
							S Rosa I	S Cruz I			S WCE	
Upwelling	7 Hrs	SBC	SE			0			15	16	169	1.5mpsNW
											SE ECE	
Upwelling	3 & 10	SBC	SE			0			15	0	185	1.5mpsNW
											SE ECE	

Appendix Table 5.2-38. GNOME oil spill trajectory results for hypothetical 2000 bbl oil spill at Platform Gail.

					Launch Point: Gail							
					Spill Volume: 2000 BBL							
Flow Regime	No. Days Model Run	Area of Trajectory	Trajectory Direction	2nd Area of Trajectory	Trajectory Direction	BBl of Oil Beached	Primary Location	Secondary Location	BBl of Oil Weathered	BBl of Oil Floating	BBl of Oil Off Map	NDBC 54 Winds
Relaxation	3	SBC	W			212	S Barbara		794	994	0	0 mps
							Gaviota					
Relaxation	10	SBC	W			94	Coal Oil Pt	Pt Arguello	974	924	8	4mpsNW
							Gaviota	Purisima Pt			S WCE	
							S Miguel I	S Rosa I				
Relaxation	3	SBC	W	Same as above for the next two Relaxation events								
Relaxation	10	SBC	W			82	Goleta pt	Pt Arguello	974	886	58	0mps
							Gaviota	Purisima Pt			N SMB	
								Pt Sal				
Relaxation	10	SBC	W			368	Naples	Goleta Pt	970	482	180	4mpsSW
							Gaviota	Pt San Luis				
							Pt Arguello					
							to Pt Sal					
Convergent	3	SBC	W			192	Carpenteria	Ventura	794	1014	0	0mpsNW
							S Barbara					
							Gaviota					
Convergent	10	SBC	W			418	S Miguel I	Carpenteria	956	366	260	7mpsNW
							S Rosa I	S Cruz I			S WCE	
Upwelling	7 Hrs	SBC	SE			0			146	162	1692	1.5mpsNW
											SE ECE	
Upwelling	3 & 10	SBC	SE			0			148	0	1852	1.5mpsNW
											SE ECE	