Marine Mammal Observation Report
USGS Research Cruise 2015-617-FA
Central California (Monterey Bay); February 24-March 4, 2015

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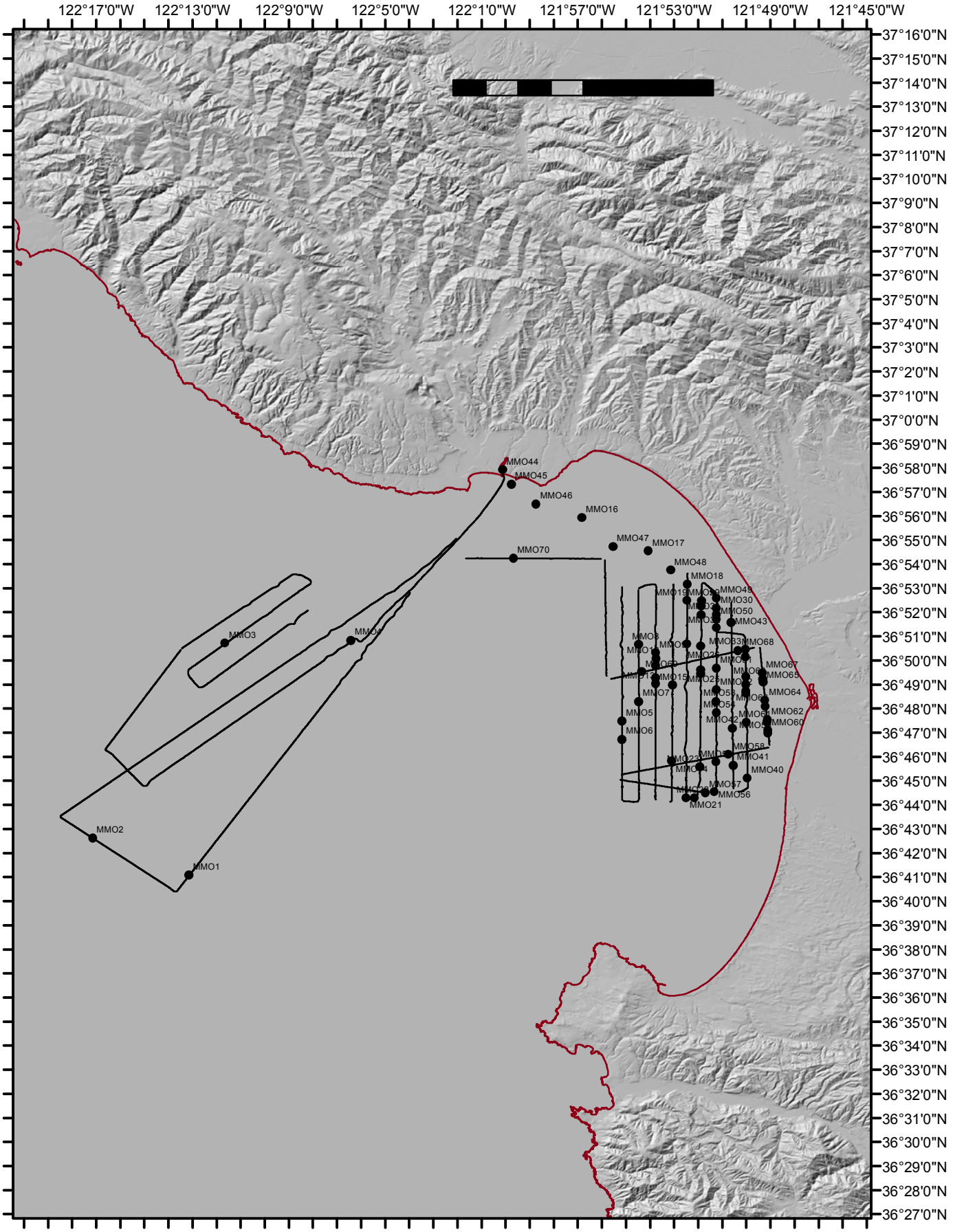
Between February 24 and March 4, 2015, the Pacific Coastal and Marine Science Center of the U.S. Geological Survey (USGS) conducted five days of geophysical research collecting high-resolution seismic-reflection data in the Monterey Bay region. The purpose of these studies was to image the uppermost few hundred meters of sub-bottom sediments in order to accurately locate offshore geologic structures, such as earthquake faults, in the northern Monterey Bay region, and to map the distribution and internal structure of geologic formations around the head of Monterey Canyon. The work occurred as part of the USGS Coastal and Marine Earthquake, Tsunami, and Landslide Active Margins Field Studies Project. The seismic-reflection data acquisition technique utilizes sound sources towed behind the research vessel, generating discreet sound impulses that travel through the water column and reflect off the seafloor and sub-bottom geologic layers. The reflected sound energy is recorded by a towed array of hydrophones and these records are digitally processed to produce image profiles.

The survey occurred in state waters (see map), and USGS obtained a permit from the California State Lands Commission. The survey did not extend into Marine Protected Areas. A primary requirement of the permits is that trained marine mammal observers (MMOs) be on board the research vessel during data acquisition operations to record all marine mammal sightings and ensure that the seismic reflection sound source is shut down whenever a marine mammal enters within a specified radius (135 m) around the sound source. The USGS sound source used for this survey was a 700 joule minisparker, fired at mostly >1 second shot intervals. The source signal frequency bandwith for this system ranges from about 200 to 1600 Hz. Boat speed during acquisition of seismic data was typically in the range of 4 to 5 nautical miles per hour.

The research cruise (USGS cruise ID 2015-617-FA) took place aboard the *R/V Parke Snavely*, owned and operated by the USGS, between February 24 and March 4, 2015. During the cruise, the boat refueled in Santa Cruz Harbor on February 27 and returned to the Santa Cruz Harbor each day before sunset. Participating trained marine mammal observors (MMO's) included Sam Johnson, Stephen Hartwell, Katherine Coble, and Daniel Brothers. The sign-in sheet for MMO's, which includes descriptions of weather and other marine environmental variables, is included in this report as Table 1. During the survey, 72 observations of marine mammals were made and recorded (see spreadsheet Table 2). Observations included California sea lions, otters, dolphins, and whales. Details and locations of individual observations are listed on the spreadsheet (Table 2) and shown on the attached map, as are the ship locations at the time of observations (not the position of the mammal in the water). All of the observations were made in State Waters. Nine of the observations were made while the boat was in transit and not collecting data. During the survey, our seismic-reflection acquisition system was shut down 31 times due to proximity to marine mammals.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MMO1

Table 1. Marine Mammal Observer Sign-in and Marine Environmental Variables

MM Observer	Date	Time	Location		Vessel Activity	Weather	Cloud Cover	Glare	Visibility	Wind Speed	Sea State	Swell Height	Comments
S.Y. Johnson	2/24/15	6:26	Santa Cruz Harbor		Leaving Harbor	clear, cool	none	none	good	N/A	calm	1-3'	
		6:52	36°56.70'N	122°08.44'W	Deploying gear	clear, cool	none	none	several miles	N/A	calm	1-2'	start minisparker
		9:30	36°46.89'N	122°08.55'W	acquiring data	clear	none	mild	good-several	~5 kts	calm	103;	no mammals observed
		15:00	36°52.94'N	122°04.54'W	end survey day								
K.L. Coble	2/25/15	7:00	Santa Cruz Harbor		Leaving Harbor	clear, cool	minimal	none	good	N/A	calm	N/A	
		7:40	36°52.55'N	122°07.58'W	Deploying gear	cool, clear	minimal	none	good	~5 kts	swell	1-3'	
		15:50	Santa Cruz Harbor		end survey day								
S.Y. Johnson	2/26/15	6:35	Santa Cruz Harbor		Start transit	clear	light haze	none	good	~3 kts	calm	1-3'	Begin deploy gear at 06:54
		15:36	36° 53.15225' N	121° 53.03272' W	end survey day								
S. Hartwell	3/3/15	6:15	Santa Cruz Harbor		start survey day	clear	none	none	good	~3 kts	calm	2-3'	
		15:24	36° 52.38398' N	121° 50.63347' W	end survey day	clear	none	none	good	~20-30 kts	chop		
S. Hartwell	3/4/15	6:15	Santa Cruz Harbor		Survey begins	clear	none	moderate	good	~1-2 kts	calm	2-3'	
		15:09	36°54.33'N	122°01.60'W	end of survey da	clear	none	moderate	good	~10-12 kts	chop	2-3'	

Table 2. Marine Mammal Observations (MMO) for USGS cruise ID 2015-617-FA

Log Entry	Date (JD)	Date (Calendar)	Time (GMT)	Latitude	Longitude	State (S) or Fed (F) waters	Heading	Course	Speed (kt/hr)	Species	Number	Distance (m)	Direction	Behavior	Comment
MMO1	55	2/24/00	19:06:29	36.68443133	-122.21896517	S	213.6	219	4.5	whale	1	500	90°	spouting	remained out of shutdown radius
MMO2	55	2/24/15	20:04:42	36.71010333	-122.28554967	S	312.1	308	4.8	CA sea lion	1	125	20°	swimming, curious	shutdown
MMO3	56	2/25/15	22:14:00	36.84500000	-122.19400000	S	250	250	4.5	whale	2	160-500	45°	spouting	remained out of shutdown radius
MMO4	56	2/25/15	23:00:00	36.84700000	-122.10700000	S	45	45	4.5	dolphin	2	100	90°	swimming next to boat and surfacing by waves	shutdown - end of line - end of day
MMO5	57	2/26/15	16:24:04	36.79124283	-121.91928417	S	178.2	0	4.8	whale	2 (to 5)	300-400	0°	spouting	remained out of shutdown radius
MMO6	57	2/26/15	16:34:05	36.77851883	-121.91923350	S	179.1	0	4.7	dolphins	4+	300	10°	swimming off the bow	remained out of shutdown radius
MMO7	57	2/26/15	18:09:12	36.80469067	-121.90781283	S	1.5	0	4.9	dolphins	~10-50	150	90°	swimming towards the boat from the east; playing around the tail bouy	shutdown
MMO8	57	2/26/15	18:47:10	36.84401467	-121.90793033	S	14.3	0	4.7	otter	1	135	70°	swimming, diving	shutdown
MMO9	57	2/26/15	20:00:38	36.83836300	-121.89603117	S	178.6	0	4.5	whale	1	2000	0°	breaching, jumping	remained over 1 mile away from ship
MMO10	57	2/26/15	20:03:28	36.83455100	-121.89564133	S	180.8	0	5	whale (humpback)	2	1500	300°	spouting	remained at least several hundred meters away from ship
MMO11	57	2/26/15	20:07:05	36.82961150	-121.89603467	S	186.3	0	5.1	dolphins	~10	500	0-270°	swimming, feeding (?)	shutdown as dolphins became closer to ship
MMO12	57	2/26/15	20:13:47	36.82098917	-121.89601000	S	169.3	0	4.7	whale	2	500	270°	spouting	remained hundreds of meters from ship
MMO13	57	2/26/15	20:16:47	36.81697233	-121.89596000	S	186	0	3.4	CA sea lion	1	100	180°	swimming	shutdown
MMO14	57	2/26/15	21:49:34	36.76332100	-121.88485500	S	353.6	0	4.1	CA sea lion	1	80	270°	swimming	shutdown
MMO15	57	2/26/15	22:35:34	36.81614633	-121.88441233	S	350.9	0	4.2	whale	1	~750-1500	340°	breaching	remained several hundred meters away from ship
MMO16	62	3/3/15	14:00:00	36.93200000	-121.94700000	S	120	118	20	otter	1	50	90°	foraging	in transit; not collecting data, no shutdown
MMO17	62	3/3/15	14:30:00	36.90900000	-121.90100000	S	118	118	20	CA sea lion	1	50	270°	swimming	in transit; not collecting data, no shutdown
MMO18	62	3/3/15	15:15:00	36.88600000	-121.87400000	S	175	180	4.5	dolphin	many	1000	30°	swimming	remained out of shutdown radius
MMO19	62	3/3/15	15:30:28	36.87452983	-121.87430283	S	173.9	178.5	4.7	otter	1	30	0°	foraging	shutdown
MMO20	62	3/3/15	15:53:38	36.84447917	-121.87439933	S	175.1	176.6	4.4	dolphins	many	130	0°	swimming	shutdown
MMO21	62	3/3/15	17:25:00	36.73800000	-121.87500000	S	135	90	4.5	CA sea lion	1	40	0°	transit	not shooting source, no shutdown
MMO22	62	3/3/15	17:35:00	36.73800000	-121.86900000	S	30	0	4.5	whale	2	200	0°	spouting, transit	remained out of shutdown radius
MMO23	62	3/3/15	17:38:50	36.75941850	-121.86533400	S	3.7	1	4.8	otter	1	40	330°	foraging	shutdown
MMO24	62	3/3/15	18:28:07	36.82378900	-121.86481850	S	351.5	354.3	4.6	whale	1	250	330°	spouting	remained out of shutdown radius
MMO25	62	3/3/15	18:30:19	36.82659017	-121.86490133	S	9.2	4.2	4.7	dolphin	many	200	300°	transit	remained out of shutdown radius
MMO26	62	3/3/15	18:42:28	36.84300283	-121.86496917	S	346.1	347.3	4.9	CA sea lion	1	30	90°	diving	shutdown
MMO27	62	3/3/15	18:59:53	36.86452583	-121.86445967	S	4.7	3.5	4.7	CA sea lion	1	150	90°	transit	remained out of shutdown radius
MMO28	62	3/3/15	19:04:33	36.87057417	-121.86443483	S	1.9	3	4.7	whale (grey)	1	30	0°	diving	shutdown
MMO29	62	3/3/15	19:08:26	36.87441317	-121.86438833	S	359.3	356.8	3.3	otter	1	40	0°	foraging	shutdown
MMO30	62	3/3/15	19:37:27	36.86920367	-121.85375717	S	179.1	178.7	4.6	otter	2	130	330°	laying on back	shutdown
MMO31	62	3/3/15	19:41:33	36.86495833	-121.85374750	S	183.1	178.7	4.2	otter	1	130	0°	laying on back	shutdown
MMO32	62	3/3/15	19:49:27	36.85576883	-121.85374383	S	182.6	181.8	4.7	otter	1	50	60°	foraging	shutdown
MMO33	62	3/3/15	20:10:40	36.84081250	-121.83391400	S	177.8	176.1	5	otter	1	140	300°	foraging	remained out of radius
MMO34	62	3/3/15	20:14:25	36.83557950	-121.83383950	S	181	176.9	4.9	otter	1	100	0°	foraging	shutdown
MMO35	62	3/3/15	20:25:43	36.82191183	-121.83362950	S	182.9	181	4.7	CA sea lion	2	160	300°	foraging	remained out of shutdown radius
MMO36	62	3/3/15	20:29:54	36.81642767	-121.83353600	S	183	181.7	4.8	otter	1	130	300°	laying in floating kelp	shutdown
MMO37	62	3/3/15	20:33:16	36.81195433	-121.83344383	S	183.2	179.9	4.7	otter	1	160	60°	swimming away from ship	remained out of shutdown radius
MMO38	62	3/3/15	20:34:13	36.81070583	-121.83342750	S	167.4	171.8	4.8	CA sea lion	1	80	30°	transit	shutdown
MMO39	62	3/3/15	20:50:24	36.79022100	-121.83309183	S	183.5	179.1	4.6	whale	1	1000	60°	transit	remained out of shutdown radius
MMO40	62	3/3/15	21:21:20	36.75153317	-121.83245950	S	180.5	180.8	4.4	otter	2	120	330°	laying at surface	shutdown
MMO41	62	3/3/15	21:48:15	36.76054717	-121.84245883	S	353.8	1.1	4.3	CA sea lion	1	150	60°	transit	remained out of shutdown radius
MMO42	62	3/3/15	22:09:15	36.78603800	-121.84279500	S	353	357.6	4.5	CA sea lion	1	<20	270°	diving	shutdown
MMO43	62	3/3/15	23:10:44	36.85924850	-121.84374267	S	352.3	358.4	4.4	CA sea lion	2	30	0°	playing, foraging	shutdown
MMO44	63	3/4/15	14:30:00	36.96500000	-122.00200000	S	180	160	2	otter	2	20	45°	foraging	leaving harbor; not collecting data, no shutdown
MMO45	63	3/4/15	14:42:05	36.95515367	-121.99582217	S	131.2	134	21.8	CA sea lion	1	>150	~0°	swimming	in transit; not collecting data, no shutdown
MMO46	63	3/4/15	14:45:14	36.94137750	-121.97862350	S	136	134.7	22.6	dolphin, CA sea lion	many	50	0°	foraging	in transit; not collecting data, no shutdown
MMO47	63	3/4/15	14:53:36	36.91191850	-121.92549017	S	119.6	117.9	22.4	porpoise	5	15	0-60°	transit	in transit; not collecting data, no shutdown
MMO48	63	3/4/15	14:59:23	36.89568117	-121.88566267	S	115.1	116.1	21.5	otter	2	50	330°	foraging	in transit; not collecting data, no shutdown
MMO49	63	3/4/15	15:23:16	36.87625867	-121.85391667	S	168.2	167.5	4.8	whale	1	2400	0°	breaching	remained over 2 miles to the south of ship
MMO50	63	3/4/15	15:34:19	36.86152550	-121.85376433	S	178.3	182.1	4.7	otter	1	>135	90°	resting on surface	remained out of shutdown radius
MMO51	63	3/4/15	16:00:09	36.82764700	-121.85394517	S	178.6	180.1	4.9	whale	1	160	330°	spouting	remained out of shutdown radius
MMO52	63	3/4/15	16:11:36	36.81281617	-121.85394817	S	168.5	172.8	4.7	whale	2	3000	300-330°	spouting	remained ~3km to the SE of ship
MMO53	63	3/4/15	16:17:53	36.80464533	-121.85407500	S	180.3	183	4.8	dolphin	many	2000	300°	jumping	pod of dolphins remained ~1 km to the east
MMO54	63	3/4/15	16:23:51	36.79680550	-121.85403217	S	180.6	179.7	4.8	dolphin	many	1km	90°	jumping	remained outside shutdown radius
MMO55	63	3/4/15	16:49:26	36.76280333	-121.85407667	S	176.5	182	4.8	dolphin	1	200	30°	swimming	remained outside shutdown radius
MMO56	63	3/4/15	17:05:14	36.74205450	-121.85529300	S	242.9	251.3	5.2	otter	1	100	90°	foraging	no source, no shutdown
MMO57	63	3/4/15	17:09:06	36.74164900	-121.86157583	S	284.7	282.6	4.8	dolphin, CA sea lion	many	150	90°	feeding frenzy	remained outside shutdown radius
MMO58	63	3/4/15	18:37:12	36.76796400	-121.84559200	S	79.6	81.8	4.7	otter, CA sea lion	2, 1	140	0°	swimming	remained outside shutdown radius
MMO59	63	3/4/15	19:01:48	36.78262400	-121.81810567	S	359	357.8	4.5	otter	2	100	60°	laying at surface	shutdown
MMO60	63	3/4/15	19:03:28	36.78471283	-121.81827467	S	359.7	356	4.5	CA sea lion	1	100	0°	swimming	shutdown
MMO61	63	3/4/15	19:08:03	36.79050817	-121.81878967	S	13.6	5.7	4.5	CA sea lion	2	136	330°	diving	remained outside shutdown radius
MMO62	63	3/4/15	19:09:12	36.79195067	-121.81870117	S	347.6	343.9	4.7	CA sea lion	1	80	0°	foraging	shutdown
MMO63	63	3/4/15	19:16:32	36.80129283	-121.81994717	S	353.2	349	4.7	CA sea lion	1	50	30-60°	jumping, diving	shutdown
MMO64	63	3/4/15	19:19:43	36.80548933	-121.82033900	S	352.4	356.6	4.7	otter	1	90	0°	laying at surface	shutdown
MMO65	63	3/4/15	19:29:03	36.81785300	-121.82157583	S	357.3	355.4	4.8	otter	1	140	300°	laying at surface	shutdown as ship came within 135 m
MMO66	63	3/4/15	19:30:43	36.82009367	-121.82178367	S	356.6	358.2	4.8	otter	2	60	30°	foraging	shutdown
MMO67	63	3/4/15	19:33:54	36.82435917	-121.82221400	S	352.4	354.7	4.9	otter	1	140	60°	laying on surface	remained outside shutdown radius
MMO68	63	3/4/15	20:00:00	36.84000000	-121.83900000	S	260	260	4.5	whale	1	1600	330°	fluke (diving)	remained outside shutdown radius
MMO69	63	3/4/15	20:45:34	36.82514667	-121.90563383	S	258.7	256.7	4.4	CA sea lion	1	80	0°	diving	shutdown
MMO70	63	3/4/15	22:48:23	36.90380783	-121.99435633	S	270.2	0	4.3	CA sea lion	1	150	90°	swimming	remained outside shutdown radius
MMO71	63	3/4/15	23:05:36	36.90384983	-121.02131350	S	273.5	0	4.9	dolphin	3 to 5	50	0°	swimming	shutdown
MMO72	63	3/4/15	23:08:50	36.90389950	-121.02648650	S	272.8	0	4.1	dolphin	2 to 5	140	30°	swimming	remained outside shutdown radius

Line No.	SOL		EOL	
	LAT	LON	LAT	LON
2/24/15				
Shakedown1	36.881	-122.006	36.674	-122.227
Shakedown2	36.674	-122.227	36.725	-122.308
Shakedown3	36.725	-122.308	36.918	-122.035
2/25/15				
Shakedown4	36.868	-122.136	36.815	-122.221
Shakedown5	36.815	-122.221	36.829	-122.216
Shakedown 6	36.830	-122.215	36.886	-122.135
Shakedown7	36.887	-122.134	36.893	-122.147
Shakedown8	36.893	-122.147	36.842	-122.223
Shakedown9	36.841	-122.225	36.769	-122.272
Shakedown10	36.768	-122.272	36.747	-122.251
Shakedown11	36.746	-122.251	36.847	-122.107
2/26/15				
MC-01	36.884	-121.919	36.737	-121.919
MC-01T	36.736	-121.918	36.736	-121.908
MC-02	36.737	-121.908	36.882	-121.908
MC-02T	36.883	-121.908	36.885	-121.896
MC-03	36.884	-121.896	36.737	-121.896
MC-04	36.735	-121.886	36.886	-121.884
3/3/15				
MC-05	36.893	-121.874	36.739	-121.875
MC-05T	36.737	-121.874	36.742	-121.867
MC-06	36.745	-121.867	36.886	-121.864
MC-06T	36.887	-121.864	36.879	-121.855
MC-07	36.875	-121.854	36.852	-121.846
MC-07T	36.852	-121.846	36.849	-121.834
MC-08	36.745	-121.842	36.873	-121.844
MC-09	36.849	-121.834	36.745	-121.832
MC-09T	36.745	-121.832	36.744	-121.842
3/4/15				
MC-07C	36.881	-121.858	36.743	-121.854
MC-10	36.775	-121.817	36.842	-121.824
MC-11	36.842	-121.828	36.821	-121.927
MC-12	36.754	-121.920	36.773	-121.818
MC-13	36.742	-121.860	36.751	-121.921
MC-14	36.823	-121.930	36.903	-121.931
MC-15	36.904	-121.934	36.904	-122.028

Appendix A: Montery Canyon Study Weather Observation Forms

2015-617-FA
Marine Environmental Variables Form

Date: 2/24/15

Monitor: Sam Johnson

MMO Sign-in	Time	Latitude	Longitude	Vessel Activity	Weather	Cloud Cover	Glare	Visibility	Wind Speed	Sea State	Swell Height	Comments
SJ	0626	Santa Cruz Harbor		Leaving Harbor	Clear, Cool	None	None	Good	—	Calm	1-3'	
	0652	36°56.70	122°08.44	Deploy gear	"	"	"	Several miles	"	Calm	1-2'	Start minisparker
	0930	36°46.89	122°08.55	Acquiring data	Clear	None	Mild	Good - several miles	~5 km	Calm	1-3'	Have not seen marine mammals
	1530	36°52.94	122°04.54	END SURVEY								MMO
KLM	0700	Santa Cruz Harbor		Leaving Harbor	clear, cool	minimal	NONE	good	-	-	-	
	0740	36°57.55	122°07.58	Deploy streamer	cool, clear	minimal	"	good	~5	swell	1-3'	
	1414	36°48.30	122°09.96	acquiring	13 kt, clear	"	mild		13	"	3-4'	Whales MMO, 100 m port
	1500	36°50.7	122°06.50	acquiring	clear	mod	mild	good	15	swell	4'	dolphins
2/26	1500	Santa Cruz Harbor		End Day	clear	mod	mild	good	15	"	4'	end and return after dolphins
SJ	0635	Leave Sc Harbor		Start Transit	clear	Light haze	None	good	3	calm	1-3'	Begin deploy at 0654 - First shots at
	1536	36°53.1525'	121°53.0372'	End Survey	Clear	None	mild	V. good	~10	choppy	4-6'	Ended Survey Day - 11 mammals
3/03 SH	6:15	SC Harbor		Start Survey	Clear	No	None	Good	3	Calm	2-3	
SH	1524	36°52.38398'	121°50.63347'	End Survey	"	"	"	"	20-30	chop		

Page 1 of 2

Marine Environmental Variables Form

Date: 3/4/15

Monitor: Steve Hartwell

MMO Sign-in	Time	Latitude	Longitude	Vessel Activity	Weather	Cloud Cover	Glare	Visibility	Wind Speed	Sea State	Swell Height	Comments
SH	6:15	Santa Cruz	Harbor	Survey begin	Clear	No	Moderate	Good	1-2	Calm	2-3	
SH	15:09	36°54.33	122°01.6	Seismic	Clear	NO	mod	Good	10-12	Chop	2-3	End of survey

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Appendix B: Monterey Canyon Study Marine Wildlife Observation Forms

CRUISE: 2015-617-FA JD 055 (2/24/15) - 057 (2/26/15) MARINE MAMMAL LOG

	GMT	SPECIES	NUMBER	DISTANCE	DIRECTION	BEHAVIOR	COMMENTS
2/24	1907	whale	1	500 m	90°	spouting	mmo #1 - never closer than ~300-400m
	2005	CA Sea Lion	1	125m	20°	swimming, curious	mmo #2 - shutdown
							END DAY 2330
2/25	(1414)	whale	2	1100-500 m	45°	spouting	see also sighting sheet mmo #3
	(1500)	dolphin	2	<100m	90°	swimming next to boat & surfacing by waves	SHUTDOWN - end day mmo #4
2/26	1626	whale	2-5	300-400m	0°	spouting	mmo #5
	1630	dolphin	4+	300	10°	swimming off bow	mmo #6
	1810	dolphins	10-50	150	90°	swimming - feeding near buoy	mmo #7 - shutdown
	1848	otter	1	135	70°	swimming, diving	mmo #8 - shutdown
	2001	whale	1	2,000	0°	jumping, breach	mmo #9
	2004	humpback whale	2	1,500	300°	spouting	mmo #10
	2057	dolphins	10?	500	0°-270°	swimming, feeding?	mmo #11 - shutdown
	2008	whales	1	500	270°	[illegible]	shutdown as dolphins approached
	2009	whales	2	500	270°	spouting	mmo #12
	2017	CA Sea Lion	1	100	180°	swimming	mmo #13 - shutdown
	2150	CA Sea Lion	1	80	270°	swimming	mmo #14 - shutdown
	2236	whale	1	750-1500	340°	breaching	mmo #15

CRUISE: 2015-617-FA JD 62 3/03/15

MARINE MAMMAL LOG

GMT	SPECIES	NUMBER	DISTANCE (M)	DIRECTION Clock (°)	BEHAVIOR	COMMENTS
0300	Otter	1	50 m	3 (90°)	Foraging	In Transit MO 16
0307	Sea lion	1	50	9 (270°)	Swimming	in Transit MO 17
0329	Dolphin	Many	1 Km	1 (30°)	Swim	Out of Shutdown radius MO 18
0329	Otter	1	30	12 (0°)	Foraging	Shutdown MO 19
0353	Dolphins	Many	130	12 (0°)	Swim	Shutdown MO 20
0525	Sea lion	1	40	12 (0°)	Transit	Not Shooting at Sighting MO 21
0535	Whale	2	200	12 (0°)	Transit blow	out of radius MO 22
0538	Otter	1	40	11 (330°)	Foraging	Shutdown MO 23
0628	Whale	1	250	11 (330°)	Blow	out of radius MO 24
0629	Dolphins	Many	200	10 (300°)	Transit	out of radius MO 25
0642	Sea lion	1	30	3 (90°)	diving	Shutdown MO 26
0658	Sea lion	1	150	3 (90°)	Transit	out of radius MO 27
0704	Grey Whale	1	30	12 (0°)	Diving	Shutdown 28
0709	Otter	1	40	12 (0°)	foraging	already Shutdown 29
0737	Otter	2	130	11 (330°)	laying on back	Shutdown 30
0740	Otter	1	130	12 (0°)	laying on back	Shutdown 31
0750	Otter	1	50	2 (60°)	foraging	Shutdown 32
0810	Otter	1	140	10 (300°)	foraging	out of radius 33
0814	Otter	1	100	12 (0°)	foraging	Shutdown 34
0826	Sea lion	2	160	10 (300°)	foraging	Out of radius 35
0830	Otter	1	130	10 (300°)	laying in Kelp	Shutdown 36

CRUISE: 2015-617-PA JD 62 3/3/15

MARINE MAMMAL LOG

GMT	SPECIES	NUMBER	DISTANCE	DIRECTION clock (°)	BEHAVIOR	COMMENTS
0831	Otter	1	160	2 (60°)	Swimming away	Out of radius MO 37
0833	Sea lion	1	80	1 (30°)	Transit	Shutdown MO 38
0850	Whale	1	1 km	2 (60°)	Transit	Out of radius MO 39
0920	Otter	2	120	11 (330°)	Lays at surface	Shutdown MO 40
0948	Sea lion	1	150	2 (60°)	Transit	Out of radius MO 41
1009	Sea lion	1	<20	9 (270°)	dive	Shutdown MO 42
1111	Sea lion	2	30	12 (0°)	Play/forage	Shutdown MO 43
EOD						

CRUISE: 2015 617-FA JD 63 3/04/15

MARINE MAMMAL LOG

GMT	SPECIES	NUMBER	DISTANCE	DIRECTION Clock (°)	BEHAVIOR	COMMENTS	
0242	CA sealion	1	>150	12 (0°)	swimming	Leaving Harbor	MO 45
0246	Otter	2	20	1-2 (45°)	foraging	Leaving Harbor	MO 44
0246	Dolphin sea lion	Many	50	12 (0°)	foraging	Transit	46
0253	Porpoise	~~1~~ 5	15	12-2 (20°)	Transit	Transit	47
0300	Otters	2	50	11 (330°)	foraging	Transit	48
0323	Whale	1	2 miles	12 (0°)	Breeding	Out of Radius	49
0334	Otter	1	>135	3 (90°)	Resting on Surface	out of radius	50
0400	Whale	1	160	11 (330°)	Blow	Out of radius	51
0411	Whale	2	3 km	10-11 (300-330)	Blow	out of radius	52
0418	Dolphins	Many	2 km	10 (300°)	Jump	Outside	53
0424	Dolphins	Many	1 km	3 (90°)	Jump	Outside	54
0449	Dolphin	1	200	1 (30°)	swim	Outside	55
0505	Otter	1	100	3 (90°)	foraging	Not shooting	56
0509	Dolphin sea lion	Many	150	3 (90°)	feeding frenzy	outside	57
0538	Otter Sea lion	2 ; 1	140	12 (0°)	swim	Outside	58
0602	Otter	2	100	2 (60°)	laying at surface	~~Outside~~ Shutdown	59
0603	Sea lion	1	100	12 (0°)	swimming	Shutdown at restart	60
0608	Sea lions	2	136	11 (330°)	Dive	Outside	61
0608	Sea lion	1	80	12 (0°)	foraging	Shutdown	62
0617	Sea lion	1	50	1-2 (30-60°)	Jump/dive	Shutdown	63
0620	Otter	1	90	12 (0°)	laying at surface	Shutdown	64
0629	Otter	1	140	10 (300°)	laying at surface	Outside - shutdown	65

CRUISE: 2015-617-FA JD 63 3/4/15 MARINE MAMMAL LOG PAGE 5 OF 5

GMT	SPECIES	NUMBER	DISTANCE	DIRECTION clock (°)	BEHAVIOR	COMMENTS
0631	Otter	2	60	1 (30°)	foraging	Shutdown MO 66
0634	Otter	1	140	2 (60°)	on Surface	Outside 67
0823	Whale	1	1.6 km	11 (330°)	Fluke	Outside 68
0840	Sea lion	1	80	12 (0°)	Dive	Shutdown 69
1049	Sea lion	1	150	3 (90°)	Swim	Outside 70
1106	Dolphin	3-5	50	12 (0°)	Swim	Shutdown 71
1109	Dolphins	2-5	140	1 (30°)	Swim	Outside 72

Appendix C: Exhibit H

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
Air Quality and Greenhouse Gas (GHG) Emissions (MND Section 3.3.3)						
MM AIR-1: Engine Tuning, Engine Certification, and Fuels. The following measures will be required to be implemented by all Permittees under the Offshore Geophysical Permit Program (OGPP), as applicable depending on the county offshore which a survey is being conducted. Pursuant to section 93118.5 of CARB's Airborne Toxic Control Measures, the Tier 2 engine requirement applies only to diesel-fueled vessels.	All Counties: Maintain all construction equipment in proper tune according to manufacturers' specifications; fuel all off-road and portable diesel-powered equipment with California Air Resources Board (CARB)-certified motor vehicle diesel fuel limiting sulfur content to 15 parts per million or less (CARB Diesel).	Daily emissions of criteria pollutants during survey activities are minimized.	Determine engine certification of vessel engines. Review engine emissions data to assess compliance, determine if changes in tuning or fuel are required.	OGPP permit holder and contract vessel operator; California State Lands Commission (CSLC) review of Final Monitoring Report.	Prior to, during, and after survey activities. Submit Final Monitoring Report after completion of survey activities.	1/26/15
	Los Angeles and Orange Counties: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner; the survey shall be operated such that daily NO_x emissions do not exceed 100 pounds based on engine certification emission factors. This can be accomplished with Tier 2 engines if daily fuel use is 585 gallons or less, and with Tier 3 engines if daily fuel use is 935 gallons or less.		Verify that Tier 2 or cleaner engines are being used. Calculate daily NO_x emissions to verify compliance with limitations.			
	San Luis Obispo County: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner, accomplished with Tier 2 engines if daily fuel use is 585 gallons or less; all diesel equipment shall not idle for more than 5 minutes; engine use needed to maintain position in the water is not considered idling; diesel idling within 300 meters (1,000 feet) of sensitive receptors is not permitted; use alternatively fueled construction equipment on site where feasible, such as compressed natural gas, liquefied natural gas, propane or biodiesel.		Verify that Tier 2 or cleaner engines are being used. Inform vessel operator(s) of idling limitation. Investigate availability of alternative fuels.			
	Santa Barbara County: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner, accomplished with Tier 2 engines if daily fuel use is 790 gallons or less.		Verify that Tier 2 or cleaner engines are being used. Investigate availability of alternative fuels.			
	Ventura County: Use alternatively fueled construction equipment on site where feasible, such as compressed natural gas, liquefied natural gas, propane or biodiesel.		Investigate availability of alternative fuels.			

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM FISH-1: U.S. Coast Guard (USCG) and Harbormaster Notification.	All California waters; as a survey permit condition, the CSLC shall require Permittees to provide the USCG with survey details, including information on vessel types, survey locations, times, contact information, and other details of activities that may pose a hazard to mariners and fishers so that USCG can include the information in the Local Notice to Mariners, advising vessels to avoid potential hazards near survey areas. Furthermore, at least twenty-one (21) days in advance of in-water activities, Permittees shall post such notices in the harbormasters' offices of regional harbors.	No adverse effects to commercial fishing gear in place.	Notify the USCG and local harbormasters of planned survey activity. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	1/26/15
MM FISH-2: Minimize Interaction with Fishing Gear.	To minimize interaction with fishing gear that may be present within a survey area: (1) the geophysical vessel (or designated vessel) shall traverse the proposed survey corridor prior to commencing survey operations to note and record the presence, type, and location of deployed fishing gear (i.e., buoys); (2) no survey lines within 30 m (100 feet) of observed fishing gear shall be conducted. The survey crew shall not remove or relocate any fishing gear; removal or relocation shall only be accomplished by the owner of the gear upon notification by the survey operator of the potential conflict.	No adverse effects to commercial fishing gear in place.	Visually observe the survey area for commercial fishing gear. Notify the gear owner and request relocation of gear outside survey area. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Imme-diately prior to survey (prior to each survey day).	1/26/15
MM FISH-1: USCG and Harbormaster Notification.	Outlined under **Commercial and Recreational Fisheries** (above)					

Acronyms/Abbreviations: CARB = California Air Resources Board; CDFW = California Department of Fish and Wildlife; CSLC = California State Lands Commission; dB = decibels; kHz = kilohertz; MPA = Marine Protected Area; MWCP = Marine Wildlife Contingency Plan; MWM = Marine Wildlife Monitor; m= meter(s); NOAA = National Oceanic and Atmospheric Administration; NO_x = Nitrogen Oxide; OGPP = Offshore Geophysical Permit Program; OSCP = Oil Spill Contingency Plan; USCG = U.S. Coast Guard

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
			ability to respond to worst-case spill.			
MM HAZ-1: Oil Spill Contingency Plan (OSCP) Required Information.	Outlined under **Hazards and Hazardous Materials** (above)					
MM HAZ-2: Vessel fueling restrictions.	Outlined under **Hazards and Hazardous Materials** (above)					
MM HAZ-3: OSCP equipment and supplies.	Outlined under **Hazards and Hazardous Materials** (above)					
MM BIO-9: Limitations on Survey Operations in Select MPAs.	Outlined under **Biological Resources** (above)					
MM REC-1: U.S. Coast Guard (USCG), Harbormaster, and Dive Shop Operator Notification.	All California waters where recreational diving may occur; as a survey permit condition, the CSLC shall require Permittees to provide the USCG with survey details, including information on vessel types, survey locations, times, contact information, and other details of activities that may pose a hazard to divers so that USCG can include the information in the Local Notice to Mariners, advising vessels to avoid potential hazards near survey areas. Furthermore, at least twenty-one (21) days in advance of in-water activities, Permittees shall: (1) post such notices in the harbormasters' offices of regional harbors; and (2) notify operators of dive shops in coastal locations adjacent to the proposed offshore survey operations.	No adverse effects to recreational divers from survey operations.	Notify the USCG, local harbormasters, and local dive shops of planned survey activity. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	1/24/15

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-9: Limitations on Survey Operations in Select Marine Protected Areas (MPAs).	All MPAs; prior to commencing survey activities, geophysical operators shall coordinate with the CLSC, California Department of Fish and Wildlife (CDFW), and any other appropriate permitting agency regarding proposed operations within MPAs. The scope and purpose of each survey proposed within a MPA shall be defined by the permit holder, and the applicability of the survey to the allowable MPA activities shall be delineated by the permit holder. If deemed necessary by CDFW, geophysical operators will pursue a scientific collecting permit, or other appropriate authorization, to secure approval to work within a MPA, and shall provide a copy of such authorization to the CSLC as part of the required presurvey notification to CSLC. CSLC, CDFW, and/or other permitting agencies may impose further restrictions on survey activities as conditions of approval.	No adverse effects to MPA resources due to survey activities are observed.	Monitor reactions of wildlife to survey operations; report on shutdown conditions and survey restart. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder; survey permitted by CDFW.	Prior to survey.	1/26/15
MM HAZ-1: Oil Spill Contingency Plan (OSCP) Required Information.	Permittees shall develop and submit to CSLC staff for review and approval an OSCP that addresses accidental releases of petroleum and/or non-petroleum products during survey operations. Permittees' OSCPs shall include the following information for each vessel to be involved with the survey: • Specific steps to be taken in the event of a spill, including notification names, phone numbers, and locations of: (1) nearby emergency medical facilities, and (2) wildlife rescue/response organizations (e.g., Oiled Wildlife Care Network); • Description of crew training and equipment testing procedures; and • Description, quantities, and location of spill response equipment onboard the vessel.	Reduction in the potential for an accidental spill. Proper and timely response and notification of responsible parties in the event of a spill.	Documentation of proper spill training. Notification of responsible parties in the event of a spill.	OGPP permit holder and contract vessel operator.	Prior to survey.	1/26/15
MM HAZ-2: Vessel fueling restrictions.	Vessel fueling shall only occur at an approved docking facility. No cross vessel fueling shall be allowed.	Reduction in the potential for an accidental spill.	Documentation of fueling activities.	Contract vessel operator.	Following survey.	1/26/15
MM HAZ-3: OSCP equipment and supplies.	Onboard spill response equipment and supplies shall be sufficient to contain and recover the worst-case scenario spill of petroleum products as outlined in the OSCP.	Proper and timely response in the event of a spill.	Notification to CSLC of onboard spill response equipment/supplies inventory, verify	Contract vessel operator.	Prior to survey.	1/26/15

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-8: Reporting Requirements – Collision.	All State waters; if a collision with marine mammal or reptile occurs, the vessel operator shall document the conditions under which the accident occurred, including the following: • Vessel location (latitude, longitude) when the collision occurred; • Date and time of collision; • Speed and heading of the vessel at the time of collision; • Observation conditions (e.g., wind speed and direction, swell height, visibility in miles or kilometers, and presence of rain or fog) at the time of collision; • Species of marine wildlife contacted (if known); • Whether an observer was monitoring marine wildlife at the time of collision; and, • Name of vessel, vessel owner/operator, and captain officer in charge of the vessel at time of collision. After a collision, the vessel shall stop, if safe to do so; however, the vessel is not obligated to stand by and may proceed after confirming that it will not further damage the animal by doing so. The vessel will then immediately communicate by radio or telephone all details to the vessel's base of operations, and shall immediately report the incident. Consistent with Marine Mammal Protection Act requirements, the vessel's base of operations or, if an onboard telephone is available, the vessel captain him/herself, will then immediately call the National Oceanic and Atmospheric Administration (NOAA) Stranding Coordinator to report the collision and follow any subsequent instructions. From the report, the Stranding Coordinator will coordinate subsequent action, including enlisting the aid of marine mammal rescue organizations, if appropriate. From the vessel's base of operations, a telephone call will be placed to the Stranding Coordinator, NOAA National Marine Fisheries Service (NMFS), Southwest Region, Long Beach, to obtain instructions. Although NOAA has primary responsibility for marine mammals in both State and Federal waters, the California Department of Fish and Wildlife (CDFW) will also be advised that an incident has occurred in State waters affecting a protected species.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Monitoring Report following comple-tion of survey.	1/24/15

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-6: Practical Limitations on Equipment Use and Adherence to Equipment Manufacturer's Routine Maintenance Schedule.	All State waters; geophysical operators shall follow, to the maximum extent possible, the guidelines of Zykov (2013) as they pertain to the use of subbottom profilers and side-scan sonar, including: • Using the highest frequency band possible for the subbottom profiler; • Using the shortest possible pulse length; and • Lowering the pulse rate (pings per second) as much as feasible. Geophysical operators shall consider the potential applicability of these measures to other equipment types (e.g., boomer). Permit holders will conduct routine inspection and maintenance of acoustic-generating equipment to ensure that low energy geophysical equipment used during permitted survey activities remains in proper working order and within manufacturer's equipment specifications. Verification of the date and occurrence of such equipment inspection and maintenance shall be provided in the required presurvey notification to CSLC.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Document initial and during survey equipment settings. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Imme-diately prior to and during survey.	1/20/15
MM BIO-7: Avoidance of Pinniped Haul-Out Sites.	The Marine Wildlife Contingency Plan (MWCP) developed and implemented for each survey shall include identification of haul-out sites within or immediately adjacent to the proposed survey area. For surveys within 300 meters (m) of a haul-out site, the MWCP shall further require that: • The survey vessel shall not approach within 91 m of a haul-out site, consistent with National Marine Fisheries Service (NMFS) guidelines; • Survey activity close to haul-out sites shall be conducted in an expedited manner to minimize the potential for disturbance of pinnipeds on land; and • Marine Wildlife Monitors shall monitor pinniped activity onshore as the vessel approaches, observing and reporting on the number of pinnipeds potentially disturbed (e.g., via head lifting, flushing into the water). The purpose of such reporting is to provide CSLC and California Department of Fish and Wildlife (CDFW) with information regarding potential disturbance associated with OGPP surveys.	No adverse effects to pinnipeds at haul outs are observed.	Document pinniped reactions to vessel presence and equipment use. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Monitoring Report following comple-tion of survey.	1/20/15

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
	factors the CSLC will consider will include the timing, type, and location of the survey, the size of the vessel, and the availability of alternate vessels for conducting the proposed survey. CSLC authorizations under this subsection will be limited to individual surveys and under any such authorization; the Permittee shall update the MWCP to reflect how survey operations will occur under the authorization.					
MM BIO-4: Limits on Nighttime OGPP Surveys.	All State waters; nighttime survey operations are prohibited under the OGPP, except as provided below. The CSLC will consider the use of single beam echosounders and passive equipment types at night on a case-by-case basis, taking into consideration the equipment specifications, location, timing, and duration of survey activity.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Presurvey request for nighttime operations, including equipment specifications and proposed use schedule. Document equipment use. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Approval required before survey is initiated. Monitoring Report following comple-tion of survey.	1/26/15
MM BIO-5: Soft Start.	All State waters; the survey operator shall use a "soft start" technique at the beginning of survey activities each day (or following a shut down) to allow any marine mammal that may be in the immediate area to leave before the sound sources reach full energy. Surveys shall not commence at nighttime or when the safety zone cannot be effectively monitored. Operators shall initiate each piece of equipment at the lowest practical sound level, increasing output in such a manner as to increase in steps not exceeding approximately 6 decibels (dB) per 5-minute period. During ramp-up, the Marine Wildlife Monitors (MWMs) shall monitor the safety zone. If marine mammals are sighted within or about to enter the safety zone, a power-down or shut down shall be implemented as though the equipment was operating at full power. Initiation of ramp-up procedures from shut down requires that the MWMs be able to visually observe the full safety zone.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Compliance with permit requirements (observers); compliance with safe start procedures. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Imme-diately prior to survey.	1/26/15

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
						1/24/15

Equipment Type	Safety Zone (radius, m)
Single Beam Echosounder	50
Multibeam Echosounder	500
Side-Scan Sonar	600
Subbottom Profiler	100
Boomer System	100

If the geophysical survey equipment is operated at or above a frequency of 200 kilohertz (kHz), safety zone monitoring and enforcement is not required; however, if geophysical survey equipment operated at a frequency at or above 200 kHz is used simultaneously with geophysical survey equipment less than 200 kHz, then the safety zone for the equipment less than 200 kHz must be monitored. The onboard MWMs shall have authority to stop operations if a mammal or turtle is observed within the specified safety zone and may be negatively affected by survey activities. The MWMs shall also have authority to recommend continuation (or cessation) of operations during periods of limited visibility (i.e., fog, rain) based on the observed abundance of marine wildlife. Periodic reevaluation of weather conditions and reassessment of the continuation/cessation recommendation shall be completed by the onboard MWMs. During operations, if an animal's actions are observed to be irregular, the monitor shall have authority to recommend that equipment be shut down until the animal moves further away from the sound source. If irregular behavior is observed, the equipment shall be shut-off and will be restarted and ramped-up to full power, as applicable, or will not be started until the animal(s) is/are outside of the safety zone or have not been observed for 15 minutes.

For nearshore survey operations utilizing vessels that lack the personnel capacity to hold two (2) MWMs aboard during survey operations, at least twenty-one (21) days prior to the commencement of survey activities, the Permittee may petition the CSLC to conduct survey operations with one (1) MWM aboard. The CSLC will consider such authorization on a case-by-case basis and

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-1: Marine Mammal and Sea Turtle Presence – Current Information.	All State waters; prior to commencement of survey operations, the geophysical operator shall: (1) contact the National Oceanic and Atmospheric Administration Long Beach office staff and local whale-watching operations and shall acquire information on the current composition and relative abundance of marine wildlife offshore, and (2) convey sightings data to the vessel operator and crew, survey party chief, and onboard Marine Wildlife Monitors (MWMs) prior to departure. This information will aid the MWMs by providing data on the approximate number and types of organisms that may be in the area.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Document contact with appropriate sources. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder; Inquiry to NOAA and local whale watching operators.	Prior to survey.	1/24/15
MM BIO-2: Marine Wildlife Monitors (MWMs).	Except as provided in section 7(h) of the General Permit, a minimum of two (2) qualified MWMs who are experienced in marine wildlife observations shall be onboard the survey vessel throughout both transit and data collection activities. The specific monitoring, observation, and data collection responsibilities shall be identified in the Marine Wildlife Contingency Plan required as part of all Offshore Geophysical Permit Program permits. Qualifications of proposed MWMs shall be submitted to the National Oceanic and Atmospheric Administration (NOAA) and CSLC at least twenty-one (21) days in advance of the survey for their approval by the agencies. Survey operations shall not commence until the CSLC approves the MWMs.	Competent and professional monitoring or marine mammals and sea turtles; compliance with established monitoring policies.	Document contact with and approval by appropriate agencies. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	1/24/15
MM BIO-3: Safety Zone Monitoring.	Onboard Marine Wildlife Monitors (MWMs) responsible for observations during vessel transit shall be responsible for monitoring during the survey equipment operations. All visual monitoring shall occur from the highest practical vantage point aboard the survey vessel; binoculars shall be used to observe the surrounding area, as appropriate. The MWMs will survey an area (i.e., safety or exclusion zone) based on the equipment used, centered on the sound source (i.e., vessel, towfish), throughout time that the survey equipment is operating. Safety zone radial distances, by equipment type, include:	No adverse effects to marine mammals or sea turtles due to survey activities are observed; compliance with established safety zones.	Compliance with permit requirements (observers); compliance with established safety zones. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	1/24/15