Estimated Cumulative Effects of scwd^2 Desalination Plant Intake on Fish Populations

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Introduction

CEQA requires that, in addition to project impacts, an EIR must discuss cumulative impacts. Cumulative impacts can occur when two or more individual effects result in compounding or increasing other environmental impacts. In the case of ocean intake, cumulative effects could occur if high losses due to entrainment exceeded some threshold level that would significantly impact the population.

The approach used in this analysis is similar to an earlier investigation required by the California Energy Commission on cumulative impacts of ocean intakes from 12 of the 13 southern California power plants that was part of a 2004 study on the effects of the Huntington Beach Generating Station cooling water intake system (MBC and Tenera 2005). That study, conducted by Tenera, used permitted flows at all of the coastal power plants located in the Southern California Bight (SCB) (the area from Point Conception south to Baja California) to assess the cumulative impacts of ocean water for power plant cooling. A refinement to the original modeling approach incorporated coastal currents into the model to estimate the coastal zone from which eggs and larvae of fish and invertebrates could originate and be subject to entrainment by individual power plant cooling water intakes (Tenera 2009). The approach used in this report is similar to the cumulative impacts modeling approach used for southern California, but does not incorporate coastal currents due to the small area of coastline being considered from Point Año Nuevo to Cypress Point relative to the entire coast of California south of Point Conception.

Methods

The coastal area used in the analysis of potential cumulative impacts due to the **scwd^2** intake included all of Monterey Bay and coastal waters up to Point Año Nuevo (**Figure 1**). This area of coastline was selected based on analyses of data on coastal currents for the **scwd^2** project, and also for an ocean intake for a desalination plant near Moss Landing in Monterey Bay proposed

by Deepwater Desal LLC. The analysis of coastal currents for the **scwd^2** project showed that currents in the vicinity of the proposed **scwd^2** intake were predominantly upcoast out of Monterey Bay, but could also run downcoast from the north, as they did from December 2009 through February 2010 (**Figure 2**). Currents inside Monterey Bay generally follow a gyre that likely contributes to the upcoast currents near Santa Cruz (**Figure 3**). More recent analysis of CODAR data for the proposed Moss Landing desalination plant showed that the sources of larvae for the proposed intake location were generally restricted to the coastal areas inside Monterey Bay (Tenera 2012). The information on coastal currents from these studies was only used to define a fixed body of water that included the coastal area inside Monterey Bay and north to Point Año Nuevo as the area potentially affected by the SCWD^2 intake and other intakes in the area, and not used to determine the areas within this fixed body of water potentially affected by the individual intakes.

The potential effects of the **scwd^2** intake were evaluated by combining the volume for that facility with the volumes of the other existing and proposed open-ocean intakes in the area. The volume of water in the coastal area potentially affected that is shown in **Figure 1** was determined using a spatial analysis of uniform 50 m x 50 m (164 ft x 164 ft) cells derived from 5 m (16.5 ft) bathymetry contour line data for the Monterey Bay coastal region using ESRI ArcGIS software. The source of the 5 m (16.5 ft) contour lines was data from the California Department of Fish and Wildlife, Marine Region GIS Lab. A region was selected from the gridded bathymetry of Monterey Bay that ranged from 0–100 m (0–328 ft) in depth. The northernmost boundary was Point Año Nuevo and the southernmost boundary was Cypress Point at the southern edge of Monterey Bay. Area and depth values were selected for two depth ranges, 0–30 m (0–98 ft) and 0–100 m (0–328 ft). The volumes were calculated on a cell area by depth basis and summarized (**Table 1**) for each depth range shown in **Figure 1**.

The coastal open-ocean intakes considered in the analysis are shown in **Table 2**. The largest volume intake in the area at 4.63 million m^3 per day (1,224 million gallons per day [mgd]) is the Moss Landing Power Plant located inside Moss Landing Harbor. The volume of the current and proposed open-ocean intakes in the area total 4.80 million m^3 per day (1,269 mgd) with the full build out of the **scwd^2**project and 4.79 million m^3 per day (1,265 mgd) without the project.

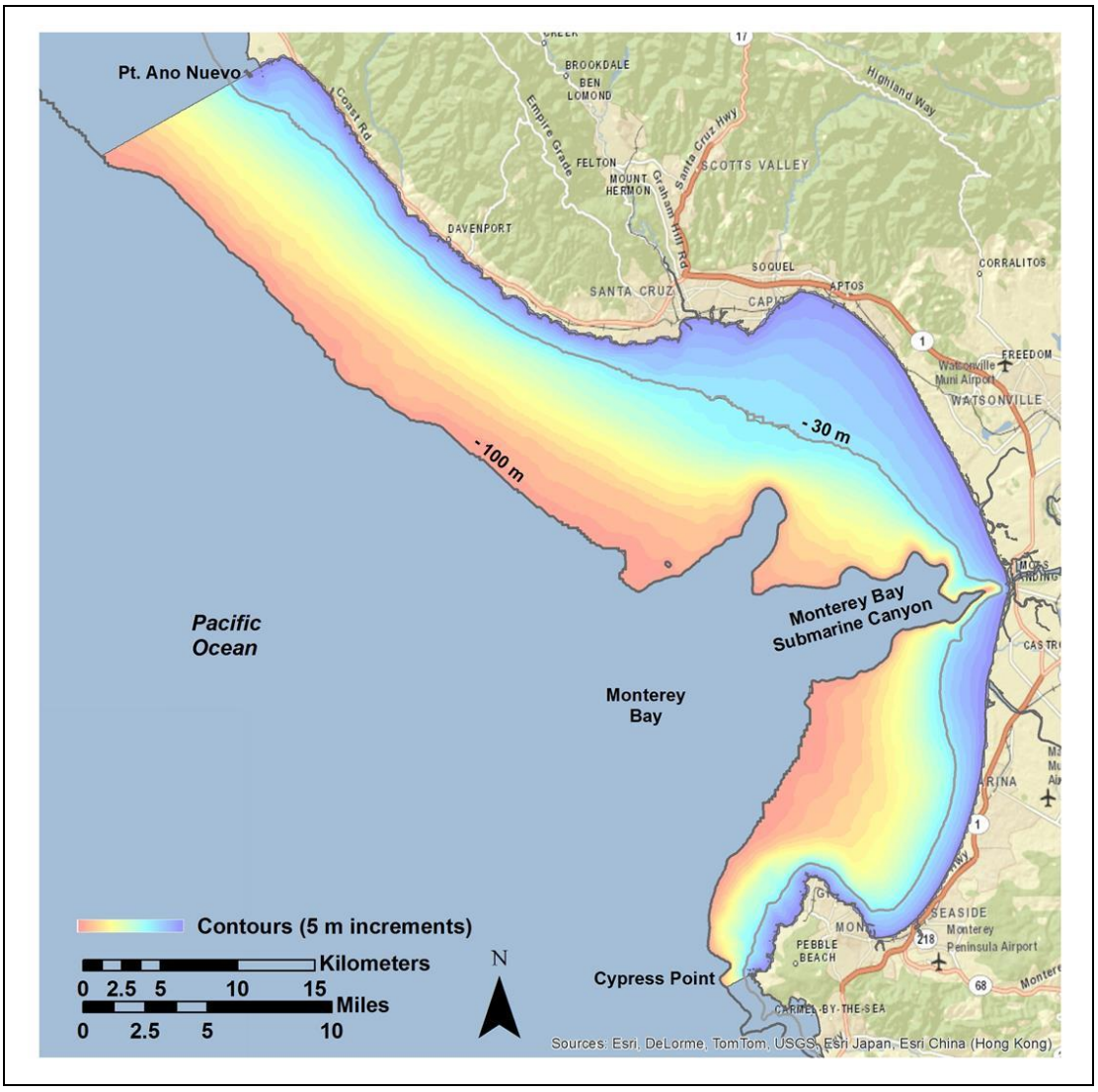

Figure 1. Area of coastline included in cumulative impacts analysis with depth contours in 5 m (16 ft) depth increments.

The intake volumes with and without the **scwd²** project were analyzed using the same empirical transport modeling (ETM) approach used in the analysis of the entrainment data for the proposed **scwd²** intake. The ETM for the **scwd²** intake assessment was based on an estimate of mortality due to entrainment, termed proportional entrainment (*PE*) that was expressed as the estimated number of larvae entrained to the estimated number in the source water. The estimate of *PE* in this analysis was calculated as follows:

$$PE = \frac{volume\ of\ ocean\ intakes}{volume\ of\ coastal\ source\ water},$$

and assumed that larval densities were constant throughout the coastal volume and that the coastal volume adequately described the source population. The coastal source water volumes corresponded to the estimates in **Table 1** for depths out to 30 m (98 ft) and 100 m (328 ft).

Larval fish and invertebrate survival over time was calculated following MacCall et al. (1983) as:

$$S = e^{-PE\,t},$$

where t is the number of days that the larvae are exposed to entrainment. The estimate of S was converted to the usual ETM estimate of proportional mortality as $P_M = (1 - S)$. The ETM estimate of P_M was calculated over periods of 5, 10, 15, 30, 40, and 60 days, which corresponded to the range of larval durations used in the ETM analysis for the **scwd²** intake assessment.

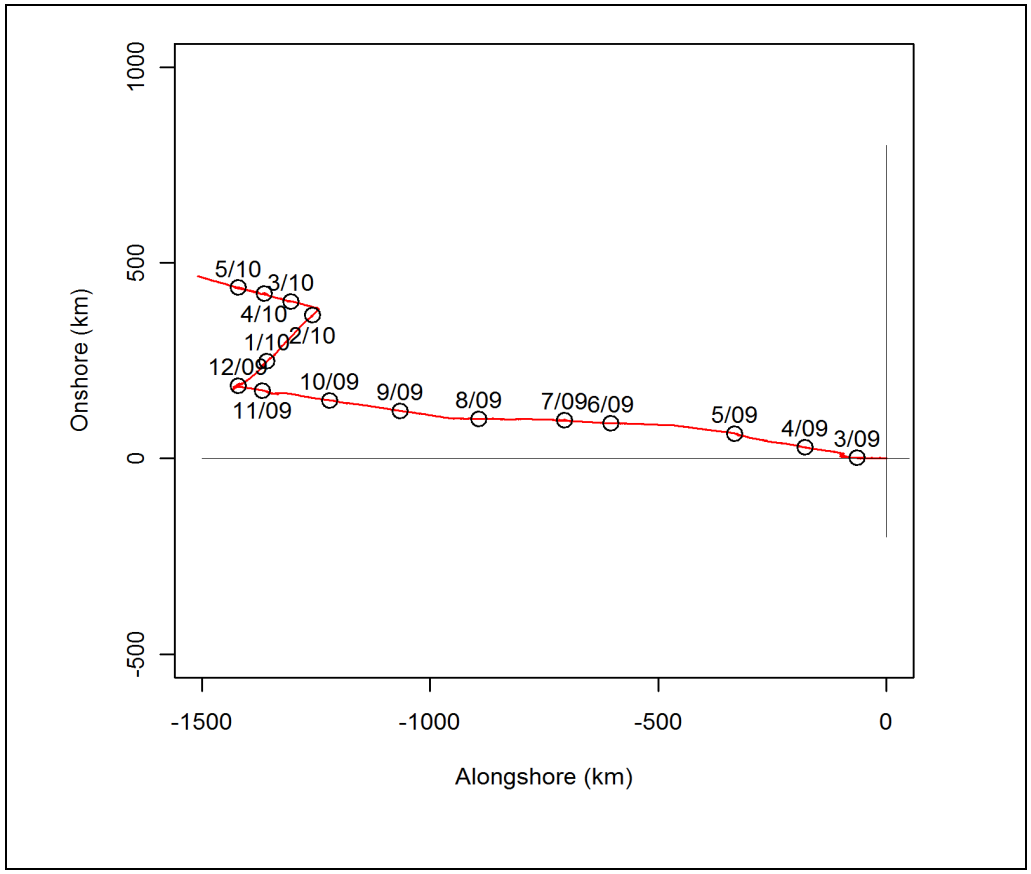

Figure 2. Coast-aligned water column average currents measured from 2/13/2009 to 5/13/2010 at a current meter located at Terrace Point maintained by the University of California, Santa Cruz, showing current displacement in a progressive vector. Movement was generally upcoast in the alongshore direction. From Tenera (2010).

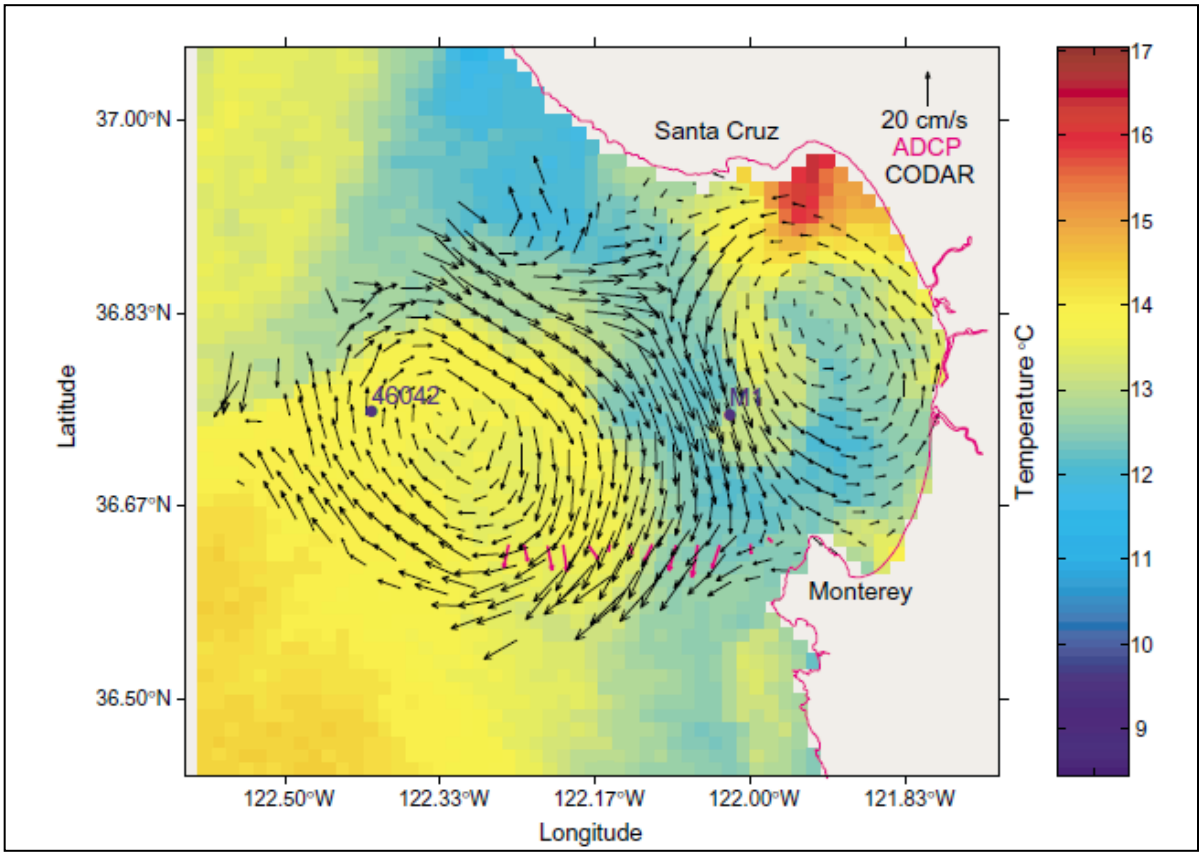

Figure 3. Surface currents and sea surface temperatures in Monterey Bay during upwelling in August 1994. (Source: Paduan and Rosenfeld 1996). Position of NOAA buoy 46042 is also indicated. From Tenera (2010).

Table 1. Coastal area and volumes for coastal areas shown in Figure 1 from Point Año Nuevo to Cypress Point at the southern edge of Monterey Bay.

Coastal Volumes	Area (m^2)	Area (acres)	Volume (m^3)	Volume (10^6 gal)
Depths to 30 m (98 ft)	283,220,000	69,985	4,442,556,538	1,173,599
Depths to 100 m (328 ft)	695,240,000	171,798	47,827,143,183	12,634,592

Table 2. Coastal open-ocean intakes included in cumulative impacts analysis. Volumes presented in millions gallons per day (mgd).

Project	Location	Maximum Intake Volume	Open-Ocean Intake Source	Status
Existing Desalination Facilities				
Monterey Bay Aquarium	Monterey	0.04 mgd	Pre-existing exhibit water pipeline from ocean	Operational
Proposed Desalination Facilities				
scwd² Regional Seawater Desalination Project	Santa Cruz	2.5 mgd with expandability up to 4.5 mgd	Screened open-ocean intake associated with 2.5-mgd project	Proposed
DeepWater Desalination Project	Moss Landing	25 mgd	New screened, passive open-ocean intake and existing pipeline	Proposed
People's Moss Landing Water Desalination Project	Moss Landing	10 mgd	New screened, passive open-ocean intake and existing intake pipe and pump station	Proposed
Other Ocean Intakes				
Dynegy Moss Landing Power Plant	Moss Landing	1,224 mgd	Intake structure inside Moss Landing Harbor	Operational
Monterey Bay Aquarium	Monterey	2.9 mgd	Pre-existing exhibit water pipeline from ocean	Operational
UCSC Long Marine Lab	Santa Cruz	2.9 mgd	Pre-existing exhibit water pipeline from ocean	Operational
Total w/ 4.5 mgd **scwd²**		4,804,976 m^3 (1,269 mgd)		
Total w/o **scwd²**		4,787,941 m^3 (1,265 mgd)		

Results and Conclusions

The results of the ETM cumulative impacts analysis showed that the cumulative effects of all the intake sources in the nearshore coastal waters (0–30 m [0–98 ft]) of Santa Cruz and Monterey Bay represents an increase to natural and other sources of mortality of 0.5 percent for larvae that are exposed to entrainment for 5 days, to 6.0 percent for exposure periods of 60 days (**Table 3**). As the fish larvae for most species are only exposed to entrainment for periods of less than 30 days, the total mortality from all intakes should be 3.0 percent or less. These estimates are very small relative to the very high natural mortality rates for the planktonic egg and larval stages of most fishes (Carr and Syms 2006). For example, the daily mortality rate from all intake sources is 0.1 percent and 0.0004 percent from just the **scwd²** intake. For comparison, the daily natural mortality for early larvae for northern anchovy, gobies, and rockfish are 31, 7, and 11 percent, respectively (Brothers 1975, Butler et al. 1993, Yoklavich et al, 1996). The cumulative and daily mortalities would be even less for fishes that occupy deeper waters out to depths of 100 m (328 ft) along the coast (**Table 3**). These levels of additional mortality due to entrainment from all

sources would not represent a significant impact to the larval populations in the coastal areas of Santa Cruz and Monterey Bay.

Table 3. ETM estimates of proportional mortality (P_M) based on volumetric ratio estimates of proportional entrainment (*PE*) for larval durations of 5 to 60 days.

Source Water Volume	*PE* Estimates (daily mortality)		ETM Estimates of P_M for Periods of Larval Duration					
			5 days	10 days	15 days	30 days	40 days	60 days
30 m (98 ft) Depth	Total w/ 4.5 mgd **scwd²**	0.00108158	0.005393	0.010758	0.016093	0.031927	0.042341	0.062834
	Total w/o 4.5 mgd **scwd²**	0.00107774	0.005374	0.010720	0.016036	0.031815	0.042194	0.062618
	Total contribution from 4.5 mgd **scwd²**	0.00000383	0.000019	0.000038	0.000058	0.000115	0.000153	0.000230
100 m (328 ft) Depth	Total w/ 4.5 mgd **scwd²**	0.00010047	0.000502	0.001004	0.001506	0.003009	0.004011	0.006010
	Total w/o 4.5 mgd **scwd²**	0.00010011	0.000500	0.001001	0.001501	0.002999	0.003996	0.005989
	Total contribution from 4.5 mgd **scwd²**	0.00000036	0.000002	0.000004	0.000005	0.000011	0.000014	0.000021

The contribution to the cumulative mortality due to the operation of the **scwd²** intake will be proportional to the total volume of the intakes and represents an increase in the daily and total mortality of approximately 3.5 percent to the already very low levels shown in Table 3. The actual mortality levels due to the volume for the **scwd²** intake represent a very small fraction of a percent (0.002 to 0.023 percent) if considering fishes that only occupy the nearshore coastal waters, such as rockfishes and sculpins, and much less (0.0002 to 0.0021 percent) for fishes such as anchovies and croakers that occur over a broader depth range. The project would represent 3.5 percent of the impacts associated with cumulative projects. The fraction would decrease if the planned expansion of the intake for the UCSC Long Marine Lab from 2.9 to 8.6 mgd occurs. Even with the expansion of the UCSC intake, neither the cumulative impacts, nor the project's contribution to the cumulative effects related to entrainment would be significant and most likely could never be detected relative to levels of natural mortality. Therefore, cumulative entrainment impacts would be less than significant.

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