ATTACHMENT 1

Technical Memorandum

Rebuttal to Technical Issues Raised in Submittal by No More South Bay Power Plant Coalition

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Introduction

Tenera Environmental is providing this rebuttal to the unfounded and irrelevant statements made by the "No More South Bay Power Plant Coalition" (Coalition) in their evidentiary submittal. Tenera has reviewed such documents provided by the Coalition and submits the following:

The results from field surveys of the SBPP discharge have provided information on the abundance and distribution of species comprising the receiving water's bottom-dwelling communities. While the results for a few species suggested patterns of abundance related to the location of the SBPP discharge, most species exhibited no discharge-related patterns of abundance. Patterns of abundance from field studies of benthic communities are commonly used to infer the occurrence of environmental changes, such as those caused by a cooling water discharge. Such observances may suggest the need for further investigation but do not, by themselves, demonstrate cause and effect. Actual cause and effect must be established through experimental testing of the observation, which is merely a hypothesis of cause and effect.

The Coalition filing repeats an earlier error of untested observation contained in an RWQCB staff finding[1] that, "The absence of these species from the discharge channel demonstrates that these species cannot survive warm thermal regimes of the discharge channel and were being

[1] Finding 14. NPDES Order 2004-0154.

adversely impacted." This finding is contradicted by a further finding that determined, "The adverse impacts are due to the individual and combined effects of the elevated temperature and the volume and velocity of the discharge."[2] There is no evidence in any of the many SBPP discharge studies that separates discharge effects of temperature, volume, or velocity on SBPP receiving water benthic communities, or the relative importance of any of these three factors. The finding concludes that, "It is evident that impacts on Beneficial Uses due to the discharge of once-through-cooling water cannot be completely eliminated except through termination the discharge." If the standard for issuance of an NPDES permit were complete elimination of discharge effects, regardless of significance, the Board would be unable to issue NPDES permits of any kind. The balanced indigenous community (BIC) standard for thermal discharges, which is to assure the protection of the receiving water balanced indigenous community, recognizes that change will occur as a result of the discharge and allows for change in a zone of initial dilution, the nature and extent of which does not jeopardize the receiving water BIC.

The Coalition filing consistently ignores the now diminished nature and extent of the SBPP discharge resulting from the termination of Units 3 and 4 discharge. In the Board's present consideration of the SBPP discharge, volume of the SBPP discharge, one of the key factors attributed by the Board as the cause of effects on the receiving water benthic community, has been reduced by 63 percent with the shutdown of Units 3 and 4. Temperature and areal extent of velocity have also been significantly reduced. The dramatic diminution of discharge volume, temperature, and velocity has undoubtedly been accompanied by significant reductions in the degree and areal extent of any receiving water biological conditions. Even if the full nature and extent of the beneficial discharge reduction is not known, there is no uncertainty in the fact that the discharge effects referred to by the Coalition from the past are no longer relevant to a Board finding of significant adverse intake and discharge effect today.

Rebuttal to Specific Statements

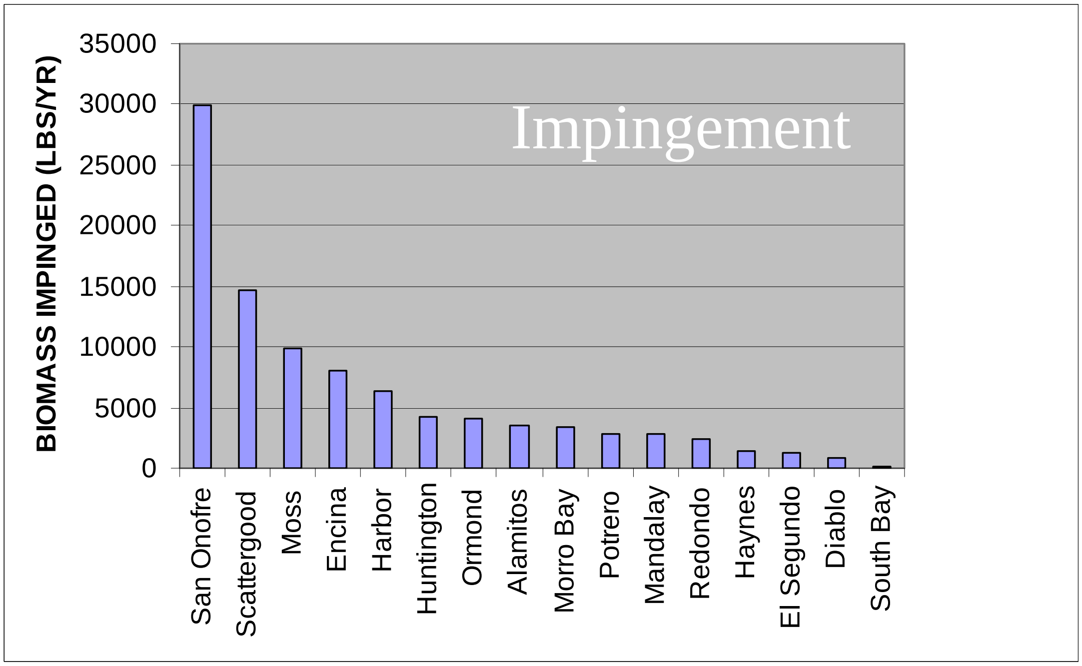
Item c). (page 5). *The Coalition filing states,[3] referring to a 2005 California Energy Commission Report,[4] "We now know that the impacts are not negligible and that beneficial uses are, and will continue to be, significantly impacted by the discharge to bay water by the SBPP whether it is from one, two or four units."*

Response: The California Energy Commission (CEC) 2005 report referred to by the Coalition addresses the impingement and entrainment effects of once-through cooling (OTC). The CEC report has been superceded by the more recent California State Water Resources Control Board (SWRCB) research, analysis, and reporting on the State's OTC facilities, as

[2] Finding 15. NPDES Order 2004-0154.
[3] At page 5.
[4] At page 5. "In their 2005 analysis, Issues and Environmental Impacts Associated with Once-Through Cooling at California's Coastal Power Plant, the California Energy Commission acknowledged the poor state of our understanding of impacts in the past."

recently as 2008 and 2009. SWRCB data compiled for the State's analysis and reports are illustrated graphically in **Figure 1**. The figure compares the reported entrainment and impingement at California's OTC power plants. The SWRCB data for SBPP entrainment and impingement have been adjusted to reflect termination of Units 3 and 4 OTC flow reduction of 63 percent and impingement reduction of 86 percent resulting from the retirement of Units 3 and 4. The Coalition's assertion that this reduction in flow is irrelevant to an assessment of these effects—essentially, that it doesn't matter whether one, two, or four units are operating—cannot be supported by logic or fact. A 63 percent reduction in cooling water flow and entrainment losses resulting from the termination of Units 3 and 4 is a significant, positive reduction in cooling water intake effects.[5] An 86 percent reduction in SBPP impingement effects is a significant, positive reduction in cooling water intake effects, making impingement at SBPP the lowest of all the State's reported OTC annual impingement. A 63 percent reduction in the volume of discharge that results in a cooler and thinner thermal plume is a significant reduction in the areal extent of the plume and its contact with receiving water communities. The Coalition's submittal not only ignores the significance of these reductions in intake and discharge effects, but continues to refer throughout the submittal to studies and findings of effects based on past SBPP cooling water flows at nearly three times present flows.[6]

[5] EPA 316(b) Phase II.
[6] page 10.



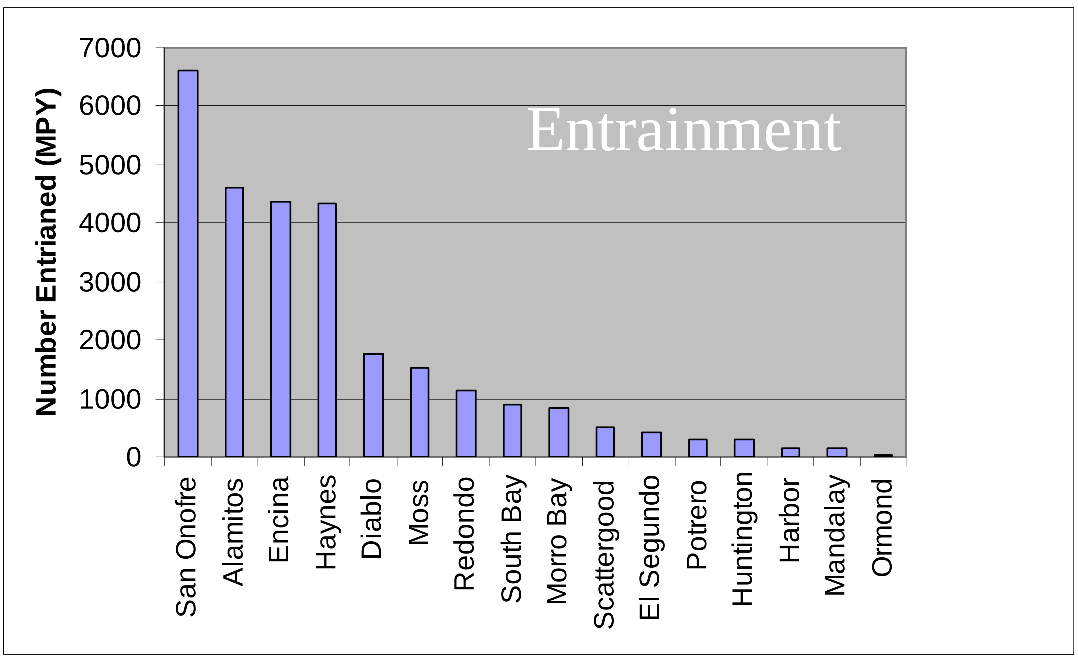


Figure 1. Comparison of South Bay Power Plant Units 1 and 2 impingement and entrainment to all other California OTC power plants.

Data Source: Foster and Steinbeck for California State Water Resources Control Board, adjusted for the decommissioning of SBPP Units 3 and 4.

Item 1) (page 2). *"There has been no valid assessment of the true background (pre-discharge) conditions in South San Diego Bay; therefore the baseline of all subsequent studies is flawed and unrepresentative."*

Item 1a) (page 2). *"All environmental studies began years after the power plant began discharges…a full eight years after the power plant was already in operation."*

Response: The SBPP facility consists of four units, the first of which, Unit 1, came online and began discharging heated water in 1960, with Units 2, 3, and 4 subsequently added to the facility in 1962, 1964, and 1971, respectively. While it is true that the first comprehensive ecological studies were done in July and August 1968 after operation of the facility was well underway, full operation had not yet been established at that time.

Item 1b) (page 3). *"Previous findings of 'no impact' are flawed due to lack of representative baseline of the ecological conditions of the Bay prior to the power plant cooling system commencement."*

Response: Although the most rigorous type of impact sampling design is of the Before-After Control-Impact Paired Series (BACIPS) type,[7] the lack of pre-operational baseline data does not invalidate Control-Impact studies by making them "flawed and unrepresentative." For example, virtually all CWA 301(h) discharge permits for POTWs nationwide are based on environmental monitoring programs that employ spatial gradient sampling designs with control sites. Near-field impact zones have rarely been sampled prior to any discharges whatsoever, yet given an adequate spatial configuration of sampling sites and adequate within-site replication, trends in population responses can be measured. Multi-year time series also serve to reveal long-term trends compared to short-term fluctuations. In the case of the SBPP studies, control sites established in the far-field area beyond the effects of the discharge have served as valid comparisons for the purpose of describing the nature and extent of changes attributed to thermal discharges. Although natural spatial variation in species' distributions can complicate the interpretation of designs that use direct comparisons of control to impact areas, analysis of density gradients can delineate the spatial extent of effects on populations of the more abundant species.

Item 1c) (page 4). *"Biodiversity and Ecosystem Health and Alteration were never adequately assessed due to lack of baseline."*

Response: This statement implies that pre-operational conditions in the water body segment where SBPP discharges occur were pristine prior to plant construction. However, San

[7] Stewart-Oaten, A., W. M. Murdoch, and K. R. Parker. 1986. Environmental impact assessment: "pseudoreplication" in time? Ecology 67: 929–940.

Diego Bay has a long history of multiple environmental stressors including dredging, diking, sewage discharges, contaminant input from shipyards, non-point source runoff from surrounding urbanized land uses and, more recently, non-indigenous invasive species.[8] Over the operational life of the SBPP, water quality has improved in some respects within the Bay due to improved sewage disposal and more attention to curtailing contaminants. The assertion that biodiversity in the South Bay was greater in 1960 and that SBPP alone is responsible for widespread degradation of habitat is unfounded. It is true that benthic invertebrate diversity in the nearfield SBPP discharge channel has been found to decline seasonally with the onset of warmer ambient temperatures in summer, but the effects are much less obvious in winter and spring when temperatures are lower.[9] Marine invasive species are a problem throughout San Diego Bay. For example, the introduced mussel (*Musculista senhousia*) was measured in high abundance near the SBPP discharge at densities near 15,000 individuals per square meter,[10] but it has also been found at similar densities near Harbor Island in north San Diego Bay, 17 km (10.5 mi) northwest of SBPP, and many other locations throughout the Bay.[11]

To the point that the "dominant fish species near the plant is now the round stingray (*Urolophus halleri*)"[12], it should be noted that round stingray is also a major component of the biomass in all regions of San Diego Bay, constituting almost 25% of the total biomass.[13] Of all four ecoregions in the Bay sampled from 1994–1999, *H'* diversity of fishes in the south region, where SBPP is located, was higher than in the north or north-central regions, and second only in diversity to the south-central region. Data also showed that in the south region,

"…slough anchovy, topsmelt, arrow goby, round stingray, northern anchovy, and shiner surfperch were the most abundant species while round stingrays, spotted sand bass, barred sand bass, and bat rays dominated in biomass."[14]

[8] Fairey, R. et al. 1996. Chemistry, toxicity and benthic community conditions in sediments of the San Diego Bay region. Final Report. California State Water Resources Control Board. September 1996.
[9] Ford, R. F., R. L. Chambers, and J. Merino. 1974. Ecological effects of thermal effluent from the South Bay Power Plant during September 1972 – July 1973. Environmental Engineering Laboratory Tech. Report. p. 74.
[10] Duke Energy South Bay. 2004. SBPP cooling water system effects on San Diego Bay. Vol. 1: Compliance with Section 316(a) of the Clean Water Act for the South Bay Power Plant. page 3.3-33.
[11] Reusch, T. B. H. and S. L. Williams. 1998. Variable responses of native eelgrass *Zostera marina* to a non-indigenous bivalve *Musculista senhousia*. Oecologia 113: 428–441.
[12] The correct scientific name for round stingray is *Urobatis halleri* (see Love et al. 2005).
[13] Allan, L. G. 1999. Fisheries Inventory and Utilization of San Diego Bay, San Diego, California. Final Report: Sampling Period July 1994 to April 1999. Prepared for the U.S. Navy and the San Diego Unified Port District. p. 3.
[14] Ibid, p. 4.

Allen (1999) concluded that,

> "The extensive shallow water habitat and eelgrass beds of the bay also support very high standing stocks of both fisheries species and of midwater, schooling fishes, such as northern anchovies, slough anchovies and topsmelt which, in turn, serve as an important forage resource for predatory fish and avian species. In addition, the generally warm and hypersaline waters of south San Diego Bay offer a warm-water refuge for a number of southern, "Panamic" province fish species making it unique among all other southern California embayments."[15]

The discharge channel itself supports a high diversity of fish species. Surveys conducted quarterly from 1997 through 1999 recorded 38 species of fishes, sharks, and rays in the discharge channel during the 12 quarterly sampling periods.[16] Slough anchovy numerically dominated most catches (91 percent overall) and most were juveniles. Although sharks and rays accounted for a majority of the total biomass captured at both stations, an overall conclusion of the study was that the discharge channel supported a high density of fishes, particularly anchovies, that was greater than San Diego Bay as a whole, and that these fishes comprised the principal forage base for piscivorous birds, such as terns and skimmers, feeding within the channel.

Item 1d) (page 6). *"Previous findings on protection of beneficial uses were based on compromised data and cannot be relied on."*

Response: The assertion presented in Item 1b, that any studies done after the Plant was already in operation are "compromised" due to a lack of pre-operational baseline data, is false and has already been addressed.

Secondly, the notion that because studies were funded by the discharger means that the quality of the collected data are suspect, is unfounded. Many of these studies were designed, conducted, and authored by respected experts, such as Dr. Richard Ford, Professor Emeritus of Biology, San Diego State University, who after studying the benthic communities in the vicinity of the Plant stated that,

> "The results of this seasonal monitoring study in 1972-1973 have shown that thermal effluent from the South Bay Power Plant had some adverse effects on benthic organisms in the area, but that these were restricted primarily to the cooling channel area and to warmer periods of the year. Some effects of the thermal plume that could be interpreted as beneficial to the benthic community also were demonstrated. It is our opinion that thermal effluent from this power plant had no major adverse effects

[15] Ibid, p. 9.
[16] Merkel & Associates, Inc. 2000. South Bay Power Plant cooling water discharge channel fish community characterization study: April 1997 through January 2000 – Final Report. Prepared for Duke Energy North America. 55 p.

> on the benthic community beyond the end of the cooling channel, and that its operation was, on balance, not detrimental to these communities during September 1972 – April 1973."[17]

All data that have been collected in the various studies since 1968 and reported to regulatory agencies such as the San Diego Regional Water Quality Control Board are available for inspection and analysis, whether or not every interested party agrees with the summary conclusions stated in the reports.

Item 4b ii) (sic) (page 16): *"Heat Impacts to Juvenile Halibut Nursery"*

Response: There is little doubt that, at the immediate point of the SBPP discharge, warmer water temperatures under certain operating conditions can be unsuitable for the settlement of fishes with pelagic larval phases. However, the statement (page 17, para. 1) that "settlement of halibut has been found to decrease rapidly above 22 degrees C (72 degrees F)" cited from an unpublished source (MBC 1991b as cited in MBC 1992) is contrary to published research that states,

> "As halibut developed from eggs to juveniles, highest survival occurred at increasingly higher temperature ranges. Growth and development rates of all early-life-history stages were proportional to temperature. …Survival of 3-month-old juvenile halibut was significantly greater at 20, 24, and 28 degree C (57-76%) than at 16 degree C (31%). …High densities of newly-settled halibut larvae and juveniles are found in shallow areas of bays where temperatures are often higher than the open ocean inhabited by young larvae. These warmer inshore nursery grounds could enhance growth and survival of halibut juveniles."[18]

Furthermore, an extensive study on the abundance and distribution of fishes in San Diego Bay from 1994–1999 found that California halibut, 99 percent of which were juveniles, were more abundant and had greater biomass in the south ecoregion of the Bay (where SBPP is located) than either the north-central or south-central ecoregions.[19] The study also provided estimated stock sizes for the Bay based on sampled densities from the most effective sampling methods for each species. The estimated stock size of California halibut for San Diego Bay, as a whole, from July 1994 to April 1999 was 78,725.[20] This is nearly six times the estimated standing stock of juvenile California halibut that was referenced by the Coalition (page 17, para. 2) in an unpublished dissertation (Cramer 1990, p. 61[21]) in order to suggest that significantly fewer halibut settle in San Diego Bay as compared to

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[17] Ibid, Ford et al. 1974. pg. 74.

[18] Gadomski, D. M. and S. M. Caddell. 1991. Effects of temperature on early-life-history stages of California halibut *Paralichthys californicus*. Fishery Bulletin. 89(4): 567–576. abstract.

[19] Allen, L. G., A. M. Findlay, and C. M. Phalen. 2002. Structure and standing stock of the fish assemblages of San Diego Bay, California from 1994 to 1999. Bull. So. Cal. Acad. Sci. 101(2): 49–85. Tables 3 and 4.

[20] Ibid, Allen et al., Table 11.

[21] Cramer, S.H. 1990. Habitat specificity and ontogenetic movement of juvenile California halibut, *Paralichthys californicus*, and other flatfishes in shallow waters of southern California. Ph.D. Dissertation, University of California, San Diego.

Mission Bay because of the operation of SBPP. Juvenile California halibut regularly occur in the SBPP discharge channel,[22] and contrary to the Coalition's assertions, there is no convincing evidence that discharges from SBPP adversely affect the settlement and standing stock of California halibut in San Diego Bay as a whole.

Item 4d) (page 19). *"Impacts of entrainment and impingement."*

Response: Entrainment from once-through cooling increases daily mortality rates on local populations of planktonic organisms above the mortality rates that they experience naturally. Estimated impingement rates based on periodic sampling also provide direct evidence for some additional mortality of juveniles and adults of certain species. However, statements such as, *"Systematic sterilization of the high percentage of sea water habitat has a significant impact on the ability of the South Bay to perform its ecological function"* (page 20, para. 3) may sound convincing from an intuitive standpoint, but such effects are not actually measureable in the field, cannot be verified, and can only be approximated using modeling approaches that include many assumptions about physical and biological processes in the ecosystem. This has been done on the more abundant fish species in the SBPP source water using *ETM* analysis. Analysis results for the two taxa (CIQ goby complex and anchovy complex) that comprised almost 97 percent of the larvae entrained showed that average proportional entrainment was 16.0 percent in 2001 and 17.3 percent in 2003.[23]

To visualize the effects that entrainment can have on source populations, if one were to assume that 1) the source water body for the CWIS was a closed system, 2) that the ratio of cooling water exchange to that of the source water was a significant fraction, and 3) that the duration at risk of entrainment for an organism was greater than the time required for circulation of the entire source water body through the CWIS, then, over time, the mortality of source populations would approach 100 percent. Of course, this does not happen because 1) South Bay is an open system with daily tidal exchange, 2) the ratio of cooling water exchange to that of the total source water is small, and 3) the duration at risk of entrainment for most planktonic populations is short relative to the time necessary for the entire source water body to theoretically circulate through the CWIS. This is why, despite variable levels of incremental mortality caused by the SBPP to certain populations, and after many years of continuous operation, those populations of fishes and invertebrates continue to propagate and flourish in south San Diego Bay.

An analysis of long-term trends in invertebrate populations near the SBPP found that the assemblage attributes (numbers of individuals and numbers of taxa) varied considerably

[22] Ibid, Merkel and Associates, Inc., pg. 12.
[23] Tenera Environmental, Inc. 2004a. SBPP Cooling Water System Effects on San Diego Bay. Volume II: Compliance with Section 316(b) of the Clean Water Act for the South Bay Power Plant. pg. E-5.

both among and between years and that, for the most part, there were lower values at the near-field sites and higher values at the far-field sites.[24] Correlations with sediment temperature suggested that the thermal discharge was primarily responsible for differences between the near and far-field sites. In general, the study documented a complex infaunal community throughout the study area with relatively stable biomass through time.[25] These observations are consistent with the conclusion that effects of the discharge are localized and have not resulted in a continued long-term degradation of marine habitat.

There are also strong similarities in abundance and composition of assemblages in south San Diego Bay as compared to other southern California bays with no cooling water intakes. As stated by Dr. Ford:

> "South San Diego Bay supports assemblages of marine organisms that are characteristic of the inner portions of relatively undisturbed bays and estuaries in California and Baja California. Ecologically similar forms inhabit bays and estuaries in other temperate areas of the world (Hedgepeth, 1957). In general, the forms found in the South Bay are tolerant of moderately wide ranges of temperature, salinity, and dissolved oxygen content and thus are able to survive seasonal and short term changes in these factors that occur there."[26]

Comprehensive sampling of larval fish populations in San Diego Bay in 2001 and 2003 showed that each species had a unique distribution that was strongly correlated with the preferred spawning habitats of the adults.[27] For example, the longjaw mudsucker (*Gillichthys mirabilis*) consistently had highest larval concentrations at the sampling station closest to the intake (SB1), which is adjacent to the mudflat habitat preferred by this species, while combtooth blennies (*Hypsoblennius* spp.) had highest concentrations at stations along the northeastern margin of the Bay (SB9 and SB7) where extensive wharfs and pilings support biofouling communities that provide habitat for adult blennies. Because there is no spatial relationship between plankton densities and proximity to the SBPP, there is no empirical evidence to support the contention that *"…[entrainment] is devastating to the biologically rich water 'habitat' of the South Bay"* (page 20, para. 1).

The Coalition incorrectly concludes that under a 225 mgd operating regime that "…23% of the South Bay water will be heated, denuded of marine life through impingement and entrainment, and sterilized with chlorine compounds prior to discharge" (page 20, para. 4). With respect to entrainment, this is incorrect because it is based on overly simplistic assumptions of the source water dynamics, as will be explained in the following analysis. Furthermore, there is no meaningful way to calculate proportional impingement because

[24] Ogden Environmental and Energy Services Co., Inc. 1994. Review of the long-term receiving water monitoring done for the South Bay San Diego Bay Power Plant. Prepared for San Diego Gas & Electric. pg. 28.
[25] Ibid, Ogden Environmental, pg. 29.
[26] Ford, R. F. and R. L. Chambers. 1968. Marine organisms of South San Diego Bay and the ecological effects of power station cooling water discharge. Environmental Engineering Laboratory, Inc. San Diego, CA. pg. 21.
[27] Ibid, Tenera Environmental, Inc. 2004a.

there is no relationship between the abundance of highly motile fish species in the source water and their abundance in impingement samples. Impingement mortality occurs at a much reduced rate because most larger organisms have the ability to negotiate currents.

To explain further, a 40-day water residence time is not appropriate for the whole of South San Diego Bay. Tenera stated that "*Residence times in summer 1993 were estimated at greater than 40 days for South Bay*."[28] The quote refers to information developed by Largier et al. (2006) who referenced this particular residence time to the portion of South Bay near the head of the Bay, based on a model of tidal exchange ratios for various bay segments with differing distances from the entrance (see following **Figure 2**).[29] However, the analysis of mortality in the 2004 SBPP 316(b) used a volume of water spanning a distance of approximately 11.25 km from the Coronado Narrows to the head of the Bay, not just the very southern segment of the Bay (see following **Figure 3**).

[28] Tenera Environmental, Inc. 2004b. SBPP Cooling Water System Effects on San Diego Bay. Volume I: Compliance with Section 316(a) of the Clean Water Act for the South Bay Power Plant. pg 2.5-1.

[29] Largier, J. L., C. J. Hearn, and D. B. Chadwick. 2006. Density structures in "low inflow estuaries". Chap. 16 in Buoyancy Effects on Coastal and Estuarine Dynamics. Coastal and Estuarine Studies 53: 227–241.

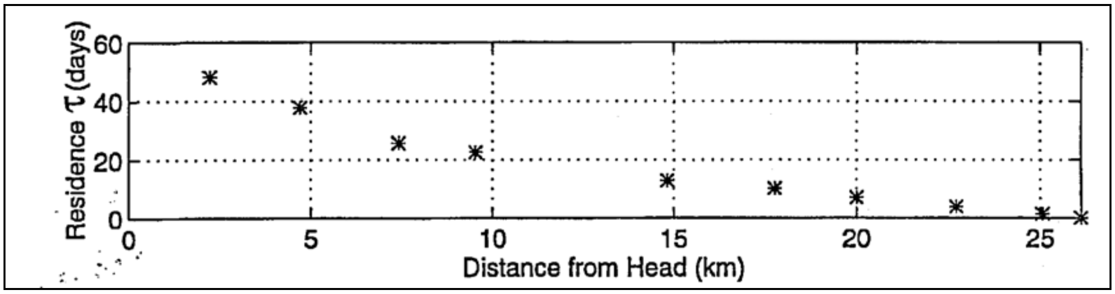

Figure 2. Residence time of water in San Diego Bay from Largier et al. (1996, Figure 6).

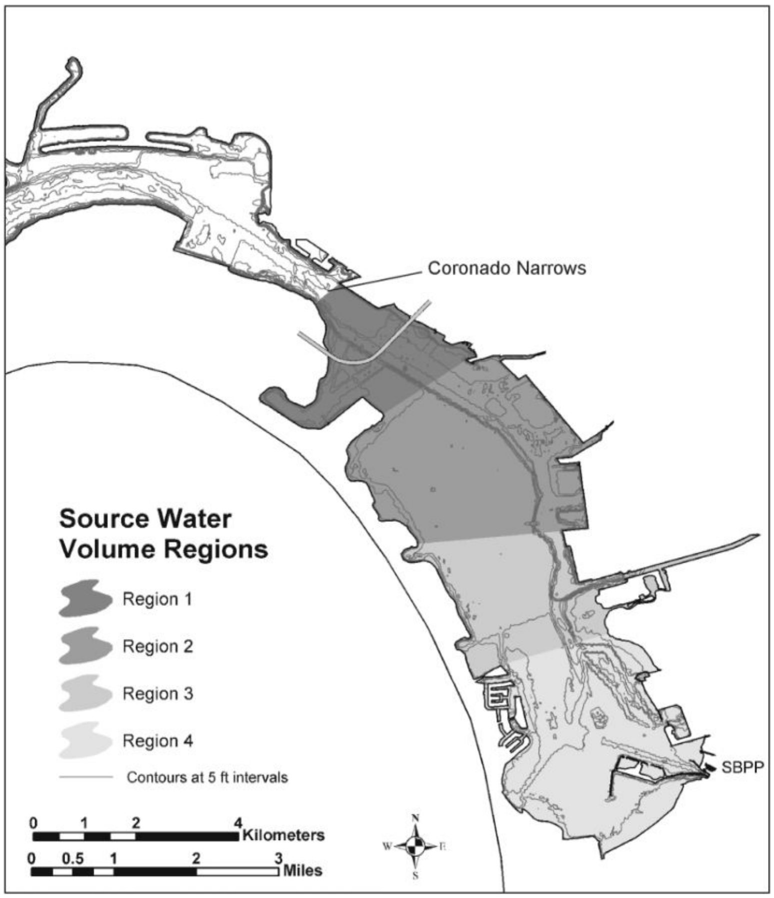

Figure 3. Source water volume regions of south San Diego Bay used to calculate total source water volumes for SBPP. From Jay and Largier (2003).

Table 1 presents residence times digitized from Largier et al. (1996) with volumes in four regions described by Jay and Largier (2003)[30] and presented in Tenera (2004b). The appropriate water residence time for the total volume of 149,612,092 m^3 is the volume-weighted average. The residence time using a volume weighted average is therefore 29.7 days.

Table 1. Residence times (Largier 1996) and corresponding regional volumes from Jay and Largier (2003).

Region	Distance from Head of Bay (km)	Residence Time (d)	Region Volume (m^3)
1	9.47	22.4	33,754,018
2	7.40	25.1	70,387,388
3	4.68	37.4	25,060,179
4	2.20	48.0	20,410,508

The appropriate mortality estimation is one minus survival. A few organisms with long larval periods could be susceptible during the residence time (RT) of 29.7. Others will settle before that time. For those that are susceptible during the RT, survival can be calculated given a SBPP daily withdrawal of either 2,275,032 m^3 (601 mgd) for all units or 851,718 m^3 (225 mgd) for Units 1 and 2. Daily proportional entrainment (*PE*) for 601 mgd is 0.0152 and for 225 mgd is 0.00569.

$$Mortality = 1 \quad Survival = 1 \quad e^{(-RT \times PE)},$$ or alternatively,

$$Mortality = 1 - Survival = 1 - (1 - PE)^{RT}.$$

Entrainment mortality for a residence time and susceptibility duration of 29.7 days in South San Diego Bay can be calculated as 36.3at full power plant operations or 15.5 percent at the current operations of Units 1 and 2, not the 23 percent calculated by the Coalition.

[30] Jay, D. A. and J. L. Largier. Definition of a source volume for the South Bay Power Plant, San Diego Bay, California. Appendix A *in* Tenera Environmental, Inc. 2004. SBPP Cooling Water System Effects on San Diego Bay. Volume II: Compliance with Section 316(b) of the Clean Water Act for the South Bay Power Plant.