California MLPA Master Plan Science Advisory Team
Water Quality Work Group
Recommendations for Considering Water Quality and Marine Protected Areas in the MLPA South Coast Study Region

Revised December 10, 2008

The Marine Life Protection Act (MLPA; Stats. 1999, Chapter 1015) mentions water quality concerns in several places [Section 2851(c), Section 2852(d), Section 2853(b)(1), Section 2855 (b)(3), Section 2857(b)(2)], but does not offer any guidance or direction on how to treat water quality issues when siting marine protected areas (MPAs).

The Marine Managed Areas Improvement Act (MMAIA; Stats. 2000, Chapter 385), which is complementary to the MLPA, does address water quality concerns with the establishment of state water quality protection areas (SWQPAs); SWQPAs include areas of special biological significance (ASBSs). SWQPAs, inclusive of ASBSs, must be designated by the State Water Resources Control Board.

This document is intended to provide guidance and additional information to assist the MLPA South Coast Regional Stakeholder Group (SCRSG) in developing alternative MPA proposals. Also provided are proposed concepts for an informative evaluation of MPA proposals with reference to water quality issues. Lastly, this document provides the water quality work group's recommendations for post implementation strategies to protect and restore water quality. Thus this document is broken into four sections:

I. SCRSG consideration of water quality in the MLPA South Coast Study Region
II. Using water quality maps and figures during MPA proposal development
III. Water quality evaluations during MPA proposal stages
IV. Post MPA designation – Strategy to protect and restore water quality

I. SCRSG Consideration of Water Quality in the MLPA South Coast Study Region

The MLPA South Coast Regional Stakeholder Group (SCRSG) may consider avoiding, where possible, locating proposed MPAs in areas of poor or threatened water quality, such as at sewage or industrial outfalls, and in areas that are significantly impacted by a variety of pollutants from large industrial or developed watersheds in the MLPA South Coast Study Region. Underlying oceanographic patterns and other abiotic factors should also be considered.

On the other hand, co-locating MPAs with ASBSs may be appropriate, when possible. Co-located MPAs and ASBSs may provide a more complete package of protection. In either case, water quality should not be used as a final determinant of MPA proposals, but rather considered to inform the process and design of MPAs. Ultimately MPAs should be proposed and established based on the requirements of the MLPA. Further protection from water quality threats, or restoration of water quality to meet standards, should be targets to be accomplished after MPA implementation using the appropriate mechanisms.

Additional information has been compiled as a set of maps and tables to assist the SCRSG in identifying areas with water quality concerns and ASBSs. The following section provides descriptions of these data and guidance on how to interpret these data.

I. Using Water Quality Maps and Figures During MPA Proposal Development

There are two sets of water quality maps that will be available to help inform the SCRSG of water quality issues during the development of MPA proposals. The first set of maps is labeled "Areas of Water Quality Concerns" the second set is labeled "Water Quality Areas of Opportunity". These two maps consist of data layers that will be described in detail below. The SCRSG should view the maps for areas of water quality concerns as potential areas to exercise caution when proposing MPAs. In examining the data sets provided to the SCRSG, consideration should be weighted towards the pollutants which cause impairment, with more attention to pollutants that have known harmful effects on marine life than to pollutants that strictly affect human interaction with the impaired water body. The set of maps labeled "water quality areas of opportunity" provide the locations of ASBSs where consideration may be given to co-locating MPAs and ASBSs in order to maximize the protections built into the designation of ASBSs.

In addition to these maps, there are data sets describing the mussel watch and other data sources data, these data will be described below.

Descriptions of Layers on the "Areas of Water Quality Concerns" Map

Industrial and Municipal Wastewater Discharge Sites

There are specific locations (point sources) where industrial pollution enters coastal waters; these are generally regulated by state or federal agencies. The origin of these industrial point sources include municipal wastewater treatment and disposal systems, desalination plants, power plants, aquaculture sites, and research marine laboratories. There are 18 publicly owned treatment works plants, three desalination plants, 12 "once-through" cooling power plants, and six other permitted pollution discharge sites which include; aquaculture wastewater, marine lab waste seawater, refinery wastewater and treated sanitary waste from oil platforms. Only the municipal wastewater sites and the power plant cooling intakes (see section on entrainment sites) are considered to have major effects on the aquatic system.

The industrial point source sites have been broken out by major and minor pollutant ratings. The major waste discharges include treated sanitary wastewater and discharges and intakes from once-through cooling water power plants. The industrial point sources with a minor pollution rating include desalination plants and the other permitted pollution discharge points mentioned above. Industrial point source sites with a major pollution rating deserve more attention and have a larger effect on the surrounding environment. This "zone of impact" will be represented on maps 1a, 2a, and 3a as a two kilometer buffer area. Numerous parameters influence the extent of impacts from industrial point source pollutants, these include; oceanographic conditions, output flow, and concentration of pollutant when dispersed at the source. Considering these parameters the SAT felt that a two kilometer zone represented a

typical or average extent of impacted area. It is important to note that this two kilometer area is an arbitrary area which represents this work group's best professional judgment. Given the best available science, time, and financial constraints, the SAT felt two kilometers would be a conservative estimate to provide the SCRSG with a basic area large enough to encompass any unforeseen issues. The actual impacts at any discharge point could be larger or smaller in reality, and two kilometers only represents a best professional judgment. The other sites on the map which will receive this two kilometer zone of impact will be the major stormwater discharge sites discussed below.

Stormwater Discharge Sites

Another type of point source pollutant within the study region includes wet weather outfalls, which are a source of untreated stormwater. River and stream systems throughout southern California have been altered and are major carriers of pollutants. For example, in the City of Los Angeles, there are 60 storm drain outfalls that release approximately 100 million gallons of untreated water each day into Santa Monica and San Pedro Bays[1]. Throughout the rest of the study region, there are numerous storm drain sites ranging from large sites such as rivers and creeks to smaller manmade sites that may be connected to a storm drain or dump directly into the ocean. As described in Bay et al. (2003) "Stormwater discharge has the potential to impair the beneficial uses of the Southern California's Coastal Waters through (1) contamination of recreational waters or seafood with disease-causing microbes, (2) aesthetic degradation from trash, odors, and reduced water clarity, and (3) ecosystem degradation from contaminants or other stormwater constituents"[2]. The later of which most directly pertains to the MLPA.

Due to the number of storm water discharge sites in the SCSR, the SAT recommends the SCRSG focus on the top ten storm sites by discharge volume per year (Table 1). Typically the annual mean is calculated as the mean value using 30 years of precipitation with orographic corrections. The top ten sites included were all major rivers or creeks, which drain into the ocean. Similar to wastewater discharge sites, stormwater discharge sites are represented on maps 1a, 2a, and 3a with a buffer of two kilometers around the stormwater discharge points.

Table 1. Top ten stormwater drainage points by volume (liters per year).

River/Stream Discharge Sites	Volume (10^9 L Per-Year)
Los Angeles River	132.22
Santa Clara River	111.28
Santa Ana River	65.50
San Gabriel River	53.14

[1] City of Los Angeles. 2008b. About the Los Angeles Storm Drain System http://www.lacity.org/SAN/wpd/Siteorg/general/lastrmdrn.htm (accessed 08/1/08).
[2] Bay, SM, Jones, BH, Schiff, KC, Washburn, L. 2003. Water quality impacts of storm water discharges to Santa Monica Bay. Marine Environmental Research 56:205-223.

Calleguas Creek	49.09
San Luis Rey River	40.32
Santa Margarita River	36.31
Domiguez Channel	33.99
Ballona Creek	33.87
San Diego River	32.27

Source: Summarized by SCCWRP in 2008 from original data source[3]. Note: The areas above dams that control more that 52 sq. km are removed. Therefore, areas in upper watersheds above dams are removed from contributing volume.

Power Plant Intake Sites

There are 12 large coastal power plants (at least 50 mega-watts of generating capacity) that use a "once-through" cooling system which draws water from a nearby open water source such as a bay, estuary, or ocean. The withdrawal and discharge of cooling water has an impact on ocean organisms and habitats which can be defined as either thermal effects, or impingement and entrainment. Thermal effects can occur at different scales; the discharge of cooling water can be warmer than the surroding water and impact marine organisms by altering the temperature of their habitat, though under current operating practices this is less of an issue than impingement of entrainment. Increased temperatures can also impact entrained larvae and eggs as described below. Impingement occurs when aquatic organisms are trapped against or within components of the cooling system, such as screens. Impingement usually affects larger organisms such as fish that are trapped within or against the cooling water system structures and either die of starvation or exhaustion[4]. Entrainment occurrs when aquatic organisms are drawn through the cooling system. Entrainment may kill smaller organisms in early life stages by exposing them to increased water temperatures beyond tehermal tolerances, mechanical damage, or toxic stress. Of the three, entrainment has the most significant effect.

Table 2 lists each of the 12 power plant sites according to the volume of larvae entrained Scale and location are just two important factors when considering the extent of impacts from larval entrainment. For instance, the San Onfre Nuclear Power Generating Station (SONGS) draws in more larvae than the other the power plants, while the Ormond Beach Generating Station draws in the least (Table 2). However, the location of the intake affects the scale and distribution of the impacts to the surrounding communities and marine populations, for this reason the location of each power plant is displayed in maps 1a, 2a, and 3a using four scales based on the range of larvae entrained.

[3] Ackerman, D. and Schiff, K. 2003. Modeling storm water mass emissions to the Southern California Bight. Journal of Environmental Engineering 129 (4): 308-317.
[4] See the California Energy Commission's webpage for more information at www.energy.ca.gov.

Table 2. Power plant entrainment estimates.

FACILITY	Entrainment (Larvae-Per-Year Entrained)
SONGS Unit 1, 2, & 3	6,230,819,601
Encina Power Plant	3,161,960,103
Alamitos Generating Station Units 1, 2, 3, 4, 5, & 6	2,954,339,708
South Bay Power Plant	1,667,044,144
Haynes Generating Station	1,159,409,807
AES Redondo Beach Generating Station 5, 6, 7 & 8	373,757,257
Scattergood Generating Station	315,565,914
El Segundo Generating Station 1, 2, 3 & 4	238,676,079
Ocean Vista Power Station at Mandalay B	129,172,964
AES Huntington Beach	104,316,376
Harbor Generating Station	85,429,045
Ormond Beach Generating Station	32,126,547

Data Source[5] contracted by the California State Water Resources Control Board.

Sediment Contamination Sample Sites

Sediment contamination data are helpful in understanding the health of the benthic environment. Anthropogenic contaminants such as heavy metals and persistent organic pollutants (POPs) can have negative affects on marine species. For example persistent organic pollutants, such as DDT and PCBs, become introduced into the marine environment, settle into the sediment and bioaccumulate throughout the food web, beginning with the benthic organisms[6]. These compounds have toxic affects on animal reproduction, immunological functions, and development[7]. Not only do the pollutants pose a threat to the marine organisms, after being integrated into the food web, they may pose a threat to humans as carcinogens or mutagens.

One local example of this is a manufacturing plant in Torrance, California, which discharged DDT into Los Angeles County Sanitation Districts' wastewater collection system. This was discharged for nearly 30 years through the wastewater outfall into the Pacific Ocean off White Point, in a submarine area known as the Palos Verdes Shelf[8]. The lingering affects of this contamination still exist today and it is the major contributor to many fish contamination zones around the Los Angeles and Long Beach harbor. A separate map of this site has been provided for your reference and is shown below (Figure 1).

[5] Foster, M., Steinbeck, J. 2008. Compilation of California coastal power plant entrainment and impingement estimates for California State Water Resources Control Board staff draft issue paper on once-through cooling. California State Water Resources Control Board.
[6] Van der Oost, R., Beyeer, J., Vermeulen, N.P.E. 2003. Fish Bioaccumulation and biomarkers in environmental risk assessment: a review. *Environmental Toxicology and Pharmacology* 13:2 57-149.
[7] Muir D, Braune B, DeMarch B, Norstrom R, Wagemann R, Lockhart L, et al. 1999. Spatial and temporal trends and effects of contaminants in the Canadian Arctic marine ecosystem: a review. *Sci Total Environ* 230 (1-3):83-144.
[8] For more information please see http://www.darrp.noaa.gov.

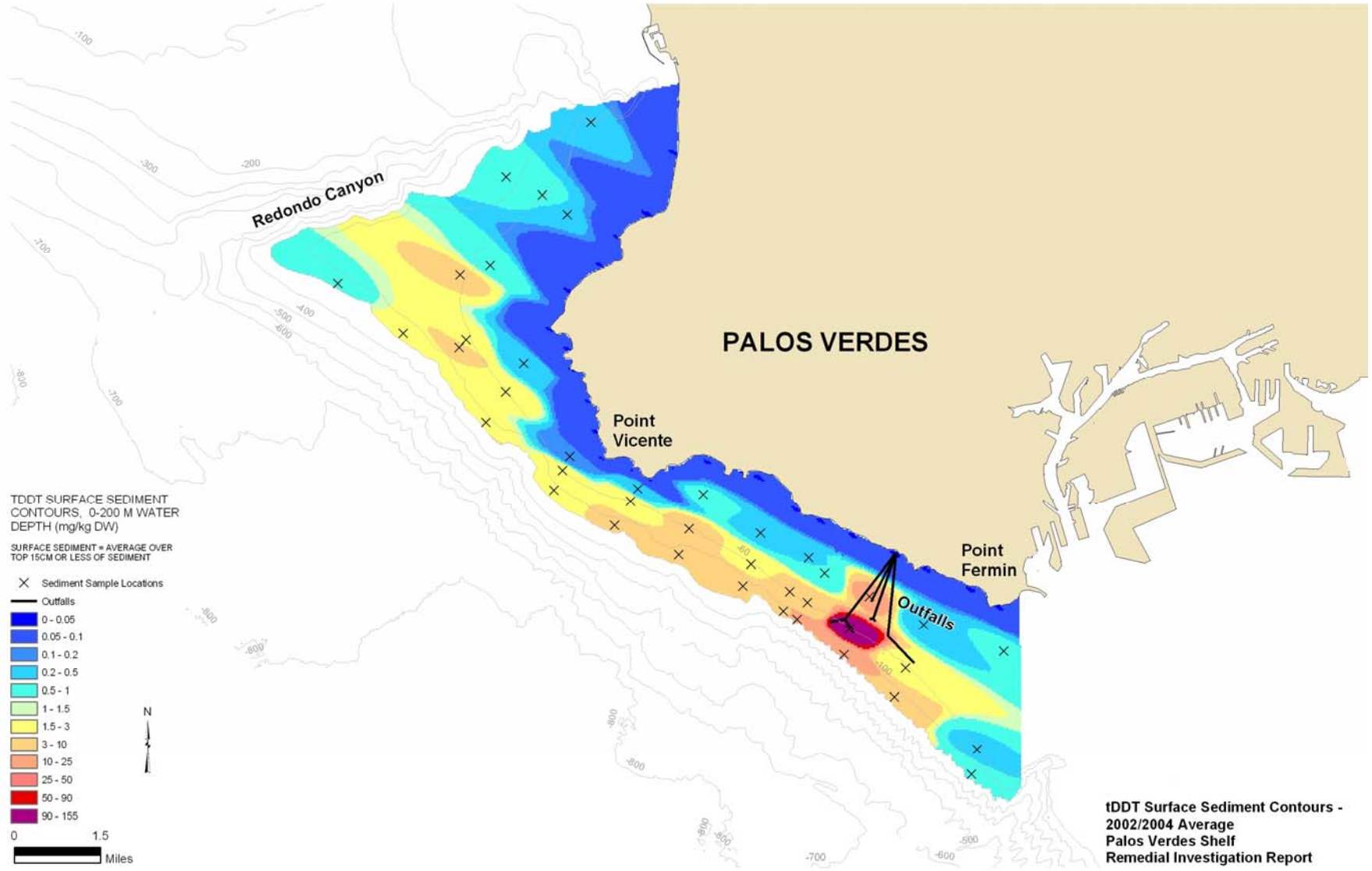

Figure 1. Figure 3 (DDT deposit map): The effluent-affected (EA) deposit per million) at the outfalls. As the deposit fans out to the northwest, concentrations less than 1 ppm closer to shore and 3 to 15 ppm over contaminant concentrations in the 100 to 200 ppm range.
Data Source: EPA 2008. http://www.epa.gov/region09/waste/sfund/pvshelf/.

Sediment samples and their pollutant levels are shown on maps 1b, 2b and 3b for both the coastal ocean areas and the bays and estuaries. Coastal ocean sites use a benthic response index (BRI) which determines the level of effect any contamination in that sediment has on the benthic community. The following table describes the BRI used in the data and presented in the maps.

Table 3. Benthic response index and the correlating descriptors for each reference level.

Benthic Response Level	Bethic Condition	Coastal Sites	BRI Description
Reference	Good	Reference	• Reference communities are expected to occur at undisturbed sites
Level 1	Good	Marginal deviation	• At Response Level 1, communities exhibit some indication of stress, but only within the measurement variability of reference condition.
Level 2	Poor	Biodiversity loss	• At Response Level 2, communities exhibit clear evidence of physical, chemical, other anthropogenic, or natural stress.
Level 3	Poor	Community function loss or defaunation	• At Response Level 3 communities exhibit a high magnitude of stress.

Data Source[9]

In bays and estuaries a more comprehensive approach is using three lines of evidence to develop sediment quality objectives. The three lines of evidence include chemistry, toxicity, and the benthic response index. These data determine how impacted the sites are and range from no impact to highly impacted.

Impaired Water Bodies

When a water body does not meet established water quality standards, it is placed on an impaired waters list mandated by §303(d) of the federal Clean Water Act. For this reason, this list is often called the 303(d) list, and waters on this list are referred to as “impaired” waters. Typically, a total maximum daily load (TMDL) is developed for each impaired water body. A TMDL determines the total amount of the pollutant/stressor (e.g., pathogens, sediment, nutrients) that the water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources[10]. Not all pollutants listed in the 303(d) list are harmful to the marine ecosystem. Bacteria and other pathogens are 303(d) listed because they may be harmful humans during recreational activities. Most of these sites occur along the beaches.

The data for impaired water bodies are presented on maps 1a, 2a, and 3a and have been divided into three categories; impaired water bodies (which include impaired rivers, streams, wetlands, enclosed bays, estuaries, harbors, and lakes), impaired beaches, and impaired coastlines. The impaired beaches and impaired rocky shores have been further segregated by the absence or presence of impairments to contact recreational users.

[9] Ranasinghe, J.A., A.M. Barnett, K.C. Schiff, D.E. Montagne, C. Brantley, C. Beegan, D.B. Cadien, C. Cash, G.B. Deets, D.R. Diener, T.K. Mikel, R.W. Smith, R.G. Velarde, S.D. Watts and S.B. Weisberg. 2007. Southern California Bight 2003 Regional Monitoring Program: III Benthic Macrofauna. Southern California Coastal Water Research Project Authority. Costa Mesa, CA.
[10] For more information on impaired water bodies please see USEPA 2008f.

Descriptions of Layers on the "Areas of Water Quality Opportunities" Map

A separate map, with only one data layer, has been created for the SCRSG's use. This map is labeled the Areas of Water Quality Opportunities. This map contains the ASBS data layer and is discussed below. SCRSG members can use this map to guide them towards the most suitable places to place an MPA in regards to water quality areas.

ASBS Data Layer

Areas of special biological significance (ASBSs), which were established through the California Ocean Plan, are considered a subset of the SWQPAs. These areas are protected from waste being discharged into them, affording them better and more natural water quality. Areas proposed for ASBS designation should have the potential to benefit from protection beyond that offered by standard waste discharge restrictions and other measures. As previously mentioned, co-locating MPAs near ASBS may offer more complete package of protection. ASBS are presented in maps 1c, 2c, and 3c.

Description of Mussel Watch Data

Mussel Watch Programs

The California Department of Fish and Game operated the California State Mussel Watch and its freshwater equivalent, the Toxic Substances Monitoring Program, under interagency agreement with the California State Water Resources Control Board since 1975. This program is a long-term water quality trends monitoring program. This program transplants mussels to evaluate coastal water quality conditions[11].

NOAA National Status and Trends Mussel Watch Program was created in 1986 and it is designed to monitor chemical contamination in coastal waters. The program is based on yearly collection and analysis which uses these bivalves to measure the contaminents in the water by measuring the level of contaminants in the bivalve's tissues. Pollutants found in the tissue is a good indicator of local contaminaiton in the environment. This program now measures nearly 140 different contaminents[12]. The NOAA mussel watch data is better at capturing particular areas of concern, because the sites are located fairly regularly and along important features along the coast and can be used to provide an overall assessment, whereas the state's program primarily targets areas with known or suspected impaired water quality and is not intended to give an overall water quality assessment.

We will examine data from the NOAA mussel watch report with a focus on the sites that had medium to high concentrations of contaminents. The medium to high range is relative to other sites throughout Caliofornia. Due to the complexity of these reports, we are only going to focus on

[11] State Water Resources Control Board. 2000. State mussel watch program 1995-1997 data report. Web Source: http://www.waterboards.ca.gov/water_issues/programs/swamp/mussel_watch_9597.shtml.
[12] Kimbrough, K. L., W. E. Johnson, G. G. Lauenstein, J. D. Christensen and D. A. Apeti. 2008. An Assessment of Two Decades of Contaminant Monitoring in the Nation's Coastal Zone. Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 74. 105 pp. Web Source: http://ccma.nos.noaa.gov/about/coast/nsandt/welcome.html.

the four contaminants; Copper, DDT, PAHs, and PCBs. For more information and finer detail on these reports, please see footnotes 8 and 9). In addition, it is important to note that these studies are only relevant to the effect these pollutants have on humans. Since very few studies exist for the the effects on wildlife, this data will be used as a surrogate to get an overall feel to the effect the contaminents may have on wildlife.

The use of DDT, a POP and an organocholorine pesticide (OCP), was banned in Europe and the U.S. in the 1970's. Documented evidence has shown the influence OCPs have on biological organisms[13,14]. Pesticides applied to land find their way into the marine sediments through rain runoff or rivers and streams. Here they settle and the degradation rates, either natural or biologically, are very low. DDT biocaccumulates in organisms which are highly sensitive to this compound. In study region there are nine sites that have levels of DDT that have medium to high concentrations when compared to sites in the rest of the state. These locations are near Harbor Island in San Diego Bay, Oceanside Beach jetty, the west jetty in Anaheim Bay, Long Beach breakwater, Cabrillo pier in the LA Harbor, the Royal Palms area of Palos Verdes, Redondo Beach jetty, south jetty in Marina Del Ray and Las Tunas Beach in Santa Monica Bay.

Industrial contributors to total POPs in environmental samples come from Polychlorinated biphenyls (PCBs). These are synthetic compounds which have up to 209 congeners which differ widely in their toxicological properties. Commercial uses for PCBs can be found as fluids in transformers and capacitors, hydrolytic fluids, lubricating oils and as additives to pesticides, paints and ink. The physiological effects these toxins have on a biological system can contribute to negative growth and reproductive efforts[15]. In the study region there are two sites that have medium to high concentrations when compared to sites in the rest of the state. These sites are located near the Coronado Bridge in San Diego Bay and Harbor Island in San Diego Bay.

The most ubiquitous pollutants among the POPs are the polycyclic aromatic hydrocarbons (PAHs) and are defined by containing two or more fused rings. PAHs have two types of anthropogenic sources; petrogenic, which are derived from natural petroleum-related sources and pyrogenic, which are the byproducts of burning fossil fuels and other hydrocarbons, such as natural brush or forest fires. PAH's stability coupled with the carcinogenic properties of some compounds have led to greater interest in understanding the affects and distribution among aquatic ecosystems[16]. In the study region there are 4 sites that have levels of PAHs which have medium to high concentrations compared to sites in the rest of the state. These sites are located near Coronado Bridge in San Diego Bay, Harbor Island in San Diego Bay, Cabrillo pier in the LA Harbor, and the south jetty in Marina Del Ray.

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[13] Pant, N., Mathur, N., Banerjee, A.K., Srivastava, S.P. Saxena, D.K. (2004). Correlation of chlorinated pesticides concentration with seminal vesicle and prostatic markers. *Reproductive Toxicology* 19: 209-214.
[14] Damstra, T (2002). Potential effects of certain organic pollutants and endocrine disrupting chemicals on the health of children. *Journal of Toxicology: Clinical toxicology* 40:4 457-465.
[15] Sauer, P.J.J., Huisman, M., Koopman-Esseboom, C., Morse, D.C., Smits-van Prooije, A.E., van de Berg, K.J., Tuinstra, L.G.M.Th., van der Paauw, C.G., Boersma, E.R., Weisglas-Kuperus, N., Lammers, J.H.C.M., Kulig, B.M., Brouwer, A. 1994. Effects of Polychlorinated Biphenyls (PCBs) and Dioxins on Growth and Development. *Human and Experimental Toxicology* 13: 900-906.
[16] Zeng, E.Y. and Vista, C.L. (1996). Organic pollutants in the coastal environment off San Diego, California. 1. Source Indentificatin and assessment by compositional indices of polycyclic aromatic hydrocarbons. *Environmental Toxicology and Chemistry* 16:2 179-188.

Trace amounts of copper are an essential nutrient for plants and animals. Anthropogenic sources of copper come from antifouling ship paint, naufacturain, wood preservative and vehicle brake pads to name a few. (For more information on copper see footnotes 17 and18). Copper can be toxic to aquatic organisms; juvenile fishes and invertebrates are much more sensitive to copper than adults fishes[12]. The three highest levels of copper in the study region occurred in Coronado Bridge in San Diego Bay, Harbor Island in San Diego Bay and near the Cabrillo pier in the LA Harbor.

III. Water Quality Evaluations During MPA Proposal Stages

The MLPA Master Plan Science Advisory Team's Water Quality Work Group will rank areas based on proximity to major pollution (large wastewater outfalls and storm drainages) or entrainment (power plant) sites in order to evaluate each proposal presented by the working groups. This evaluation will be based on the relative number of proposed MPAs that contain areas with poor water quality features; such areas will be viewed as producing conditions unfavorable to MPA performance. The evaluation will also look at proposed MPAs that contain areas with ASBSs more favorably than those that do not. Since water quality evaluations are not mandated by the MLPA, this working group's analysis of MPA proposals will be used to supplement but not override the other evaluations (i.e. size and spacing or habitat replication) used to assess each MPA proposal.

Thus, this evaluation will be an informative synopsis of how effective the MPAs might be, based on water quality conditions and features inside the proposed MPAs. The water quality evaluations presented to the RSG will not be quantitative but qualitative in nature, unlike the other evaluations (i.e. size and spacing or habitat replication).

In order to receive a favorable evaluation based on water quality features, the SCRSG should avoid, where possible, placing MPAs in areas that contain the following; power plant entrainment sites, major stormwater discharge sites and major wastewater discharge sites. The fewer of these sites found within MPAs in each proposal the better the evaluation. This working group understands that it may not be possible to completely avoid all areas with water quality concerns. The SCRSG should use its best judgment when siting MPAs near areas where water quality has been affected or disturbed by humans. Additionally, the following three sites have been designated by the SAT to be considered inappropriate for MPA siting because MPAs placed in or near these areas contain water quality conditions that will most likely compromise the ability of an MPA to meet the goals of the MLPA:

1. San Onofre Nuclear Power Generating Station (SONGS) Intake Pipe (entrainment, impingement and thermal pollution concerns)
2. Los Angeles and Long Beach harbors (large industrial harbor, stormwater discharge concerns, wastewater treatment outfall, sediment quality concerns, entrainment concerns)
3. San Diego Harbor and vicinity of South Bay Power Plant (large industrial harbor, entrainment concerns, sediment quality concerns).

[17] ATSDR (Agency for Toxic Substances and Disease Registry). 2004. Toxicological Profile for Copper. September 2004.
[18] Denier van der Gon, H.A.C., Hulskotte, J.H.J.AVisschedijk, .J.H, and Schaap, M. 2007. A revised estimate of copper emissions from road transport in UNECE Europe and its impact on predicted copper concentrations. *Atmospheric Environment* 41 (38):8697-8710.

Note: South Bay Power Plant intake may be discontinued in the future due to lease status.

IV. Post MPA Designation – Strategy to Protect and Restore Water Quality

Marine water quality will undoubtedly play a role in the success of MPAs. It is generally accepted that degraded water and sediment quality results in impacts to marine life, including undesirable changes to community structure and function[19,20,21,22]. Since the State Water Resources Control Board and regional water quality control boards have primary responsibility for regulating water quality, the water boards should be informed on new MPAs with regard to potential water quality concerns. For example, the regional water boards may recommend to the State Water Resources Control Board the designation of additional state water quality protection areas, or work on priority total maximum daily loads that could restore water quality in MPAs.

Monitoring MPAs is extremely important to track their status and effectiveness. Similarly, monitoring is also necessary to determine the status of water quality and beneficial uses, both in discharge areas (e.g., sewage outfalls and large storm drainages) and in ASBSs. In fact, biological monitoring for water quality purposes often includes fish, macrobenthos and benthic community condition (e.g., abundance and diversity) which are frequently the same measures that would inform MPA monitoring as well. MPA and water quality monitoring efforts should be coordinated and collaborative in nature in order to leverage and stretch finite monetary resources while developing the best information possible.

This work should set the stage for future collaboration between managing agencies and the water boards to restore and protect water quality in MPAs, and provide information in developing monitoring programs.

[19] Guidetti, P., Terlizzi, A., Fraschetti,S. Boero, F. 2003. Changes in Mediterranean rocky-reef fish assemblages exposed to sewage pollution. *Marine Ecology Progress Series* 253:269–278.
[20] Bay, SM, Jones, BH, Schiff, KC, Washburn, L. 2003. Water quality impacts of storm water discharges to Santa Monica Bay. *Marine Environmental Research* 56:205-223.
[21] Islam, S. and Tanaka, M. 2004. Impacts of pollution on coastal and marine ecosystems including coastal and marine fisheries and approach for management: a review and synthesis. *Marine Pollution Bulletin* 48 (2004) 624–649.
[22] Allen, M. J. 2006. Pollution. Pp. 595-610 *i*n : L.G. Allen, D.J. Pondella, and M.H. Horn (eds). The Ecology of Marine Fishes: California and Adjacent Waters. University of California Press, CA.

Areas of Water Quality Concern

Subregion 1 - Point Conception to Point Mugu

Legend

South Coast Study Region Boundary

Power Plant Entrainment

# of Larvae per Year Entrained

- 30,000,000 - 99,999,999
- 100,000,000 - 999,999,999
- 1,000,000,000 - 3,199,999,999
- 3,200,000,000 - 6,231,000,000

Impaired Water Bodies*

- Impaired Beaches[1]
- Impaired Beaches[2]
- Impaired Rocky Shores[1]
- Impaired Rocky Shores[2]
- Impaired Water Bodies

Discharge

- Major Stormwater Discharge**
- Major Wastewater Discharge**
- Minor Wastewater Discharge

* [1]Contains all 303d listed pollutants except recreational contact impairments such as bacteria and/or other pathogens.
[2]Only contains 303d listed recreational contact impairments such as bacteria and/or other pathogens.
**The area covered by the symbology used to represent stormwater discharge and major wastewater discharge represents the true area affected by this discharge. The extent of all other symbology on this map is not to scale. The area covered by this symbology represents the general location of these features.

Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

1:700,000

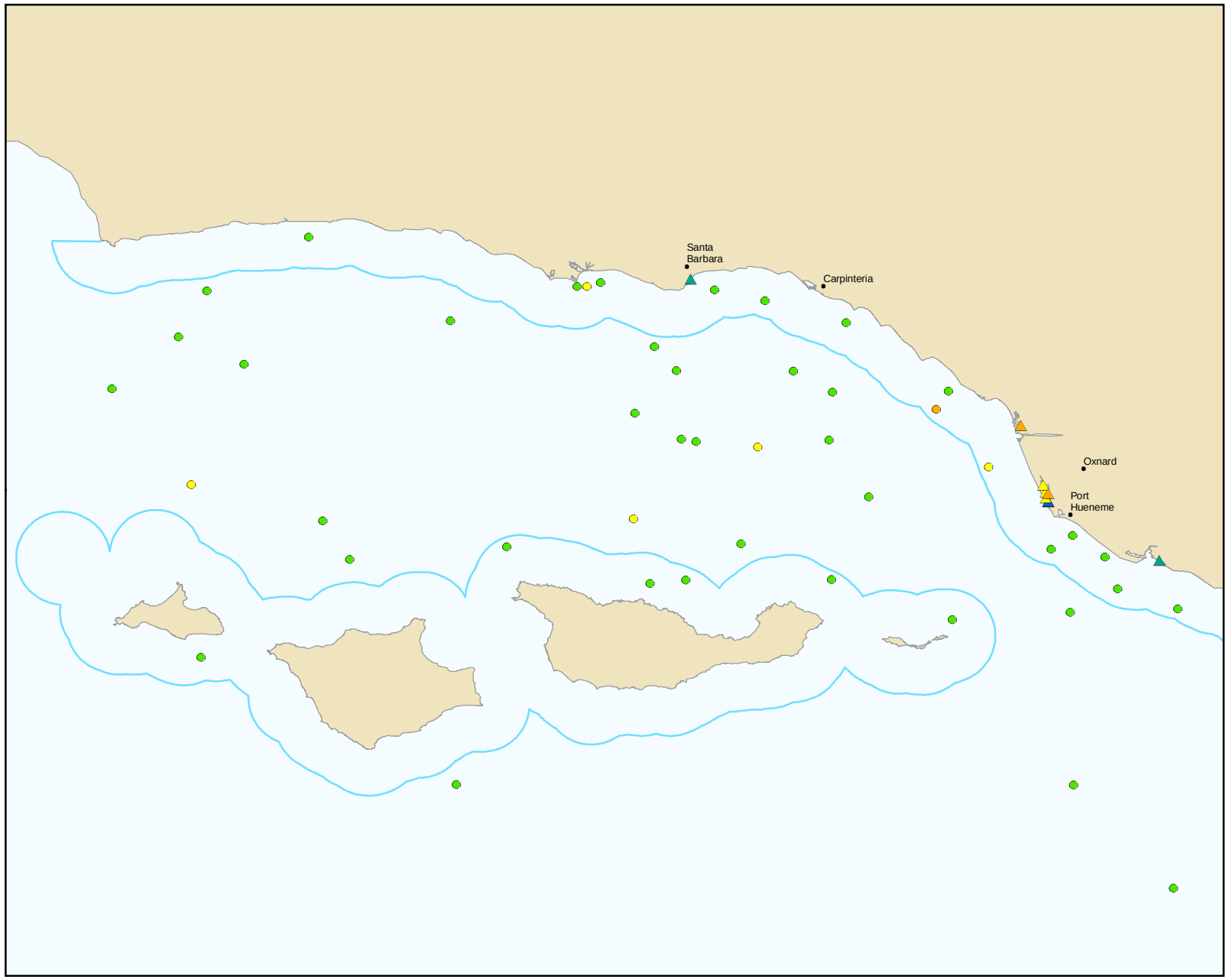
When a water body does not meet established water quality standards, it is placed on an impaired waters list mandated by §303(d) of the federal Clean Water Act.

Version: 1.2
Printing Date: Dec 8, 2008

Map 1a

Areas of Water Quality Concern

Subregion 1 - Point Conception to Point Mugu



Legend

South Coast Study Region Boundary

Sediment Contamination

- Unimpacted
- Likely unimpacted
- Possibly impacted
- Likely impacted
- Clearly impacted

Benthic Condition

- Reference
- Response Level 1
- Response Level 2
- Response Level 3

Benthic Response Level	Benthic Condition	Benthic Condition Description
Reference	Good	Reference
Level 1	Good	Marginal deviation
Level 2	Poor	Biodiversity loss
Level 3	Poor	Community function loss or defaunation

Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

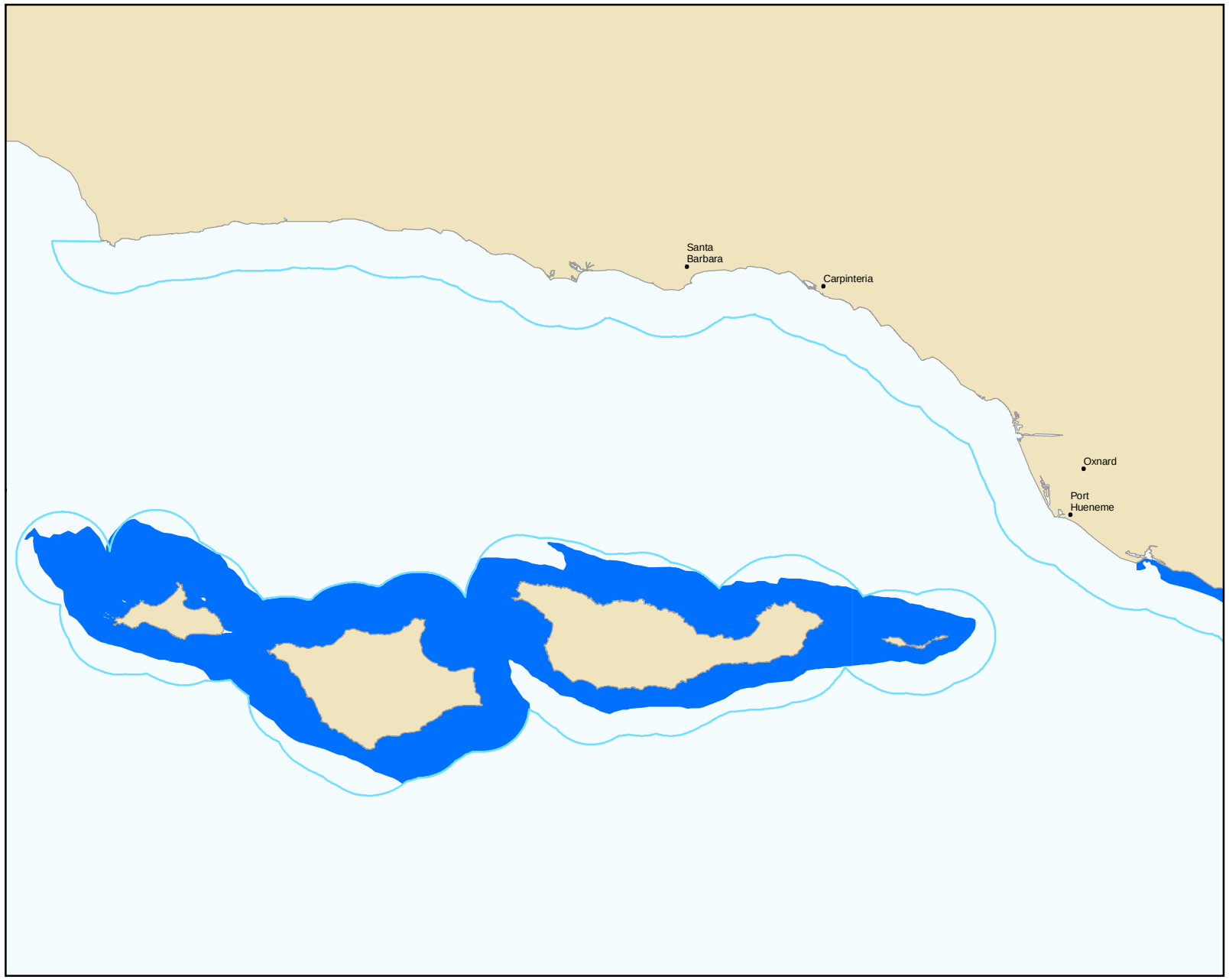
1:700,000

Version: 1.2
Printing Date: Dec 8, 2008

Map 1b

Areas of Water Quality Opportunities

Subregion 1 - Point Conception to Point Mugu



Legend

South Coast Study Region Boundary

Area of Special Biological Significance

Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

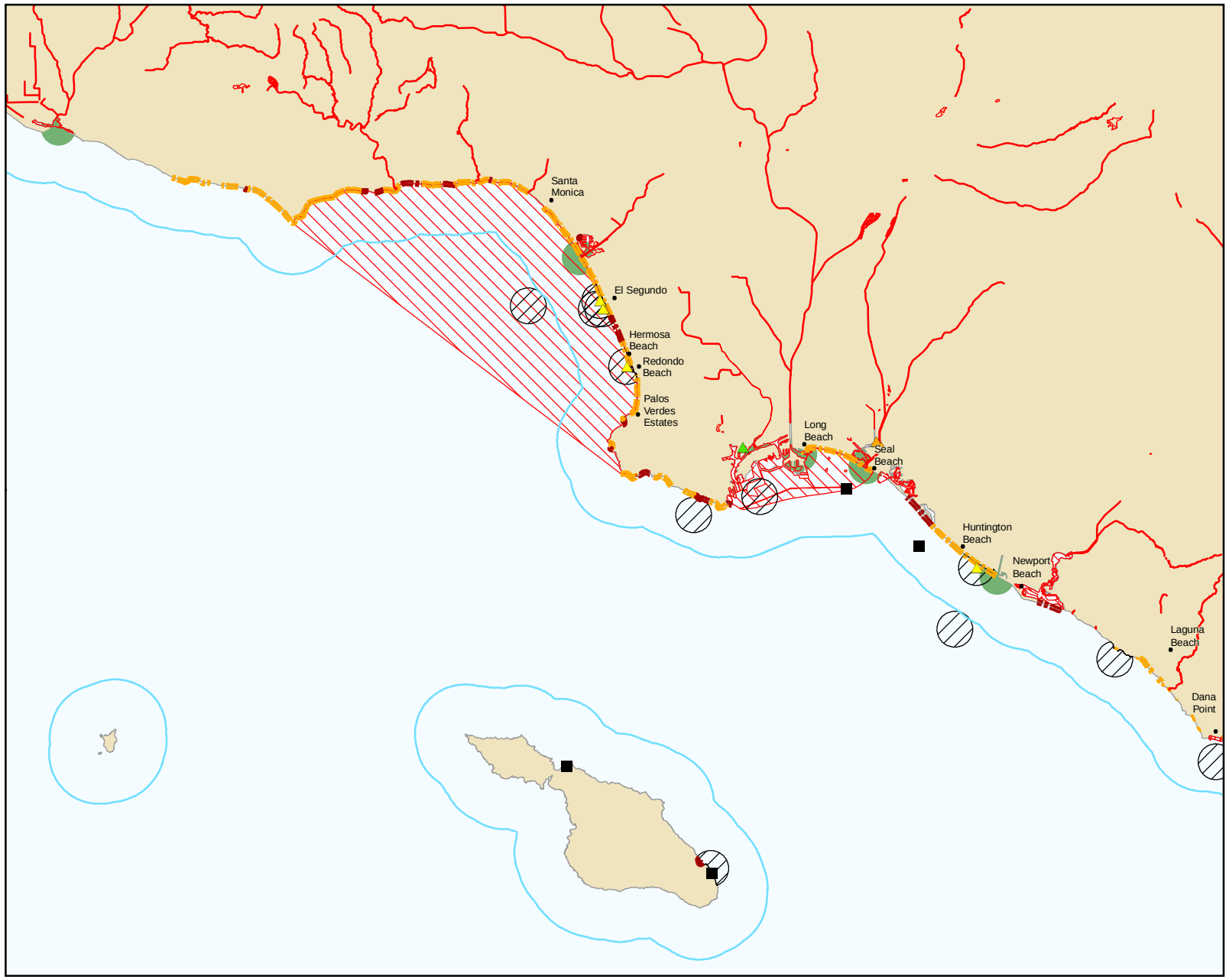
1:700,000

Version: 1.1
Printing Date: Dec 3, 2008

Map 1c

Areas of Water Quality Concern

Subregion 2 - Point Mugu to Dana Point



Legend

South Coast Study Region Boundary

Power Plant Entrainment

# of Larvae per Year Entrained

- 30,000,000 - 99,999,999
- 100,000,000 - 999,999,999
- 1,000,000,000 - 3,199,999,999
- 3,200,000,000 - 6,231,000,000

Impaired Water Bodies*

- Impaired Beaches[1]
- Impaired Beaches[2]
- Impaired Rocky Shores[1]
- Impaired Rocky Shores[2]
- Impaired Water Bodies

Discharge

- Major Stormwater Discharge**
- Major Wastewater Discharge**
- Minor Wastewater Discharge

* [1]Contains all 303d listed pollutants except recreational contact impairments such as bacteria and/or other pathogens.
[2]Only contains 303d listed recreational contact impairments such as bacteria and/or other pathogens.

**The area covered by the symbology used to represent stormwater discharge and major wastewater discharge represents the true area affected by this discharge. The extent of all other symbology on this map is not to scale. The area covered by this symbology represents the general location of these features.

Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

1:650,000

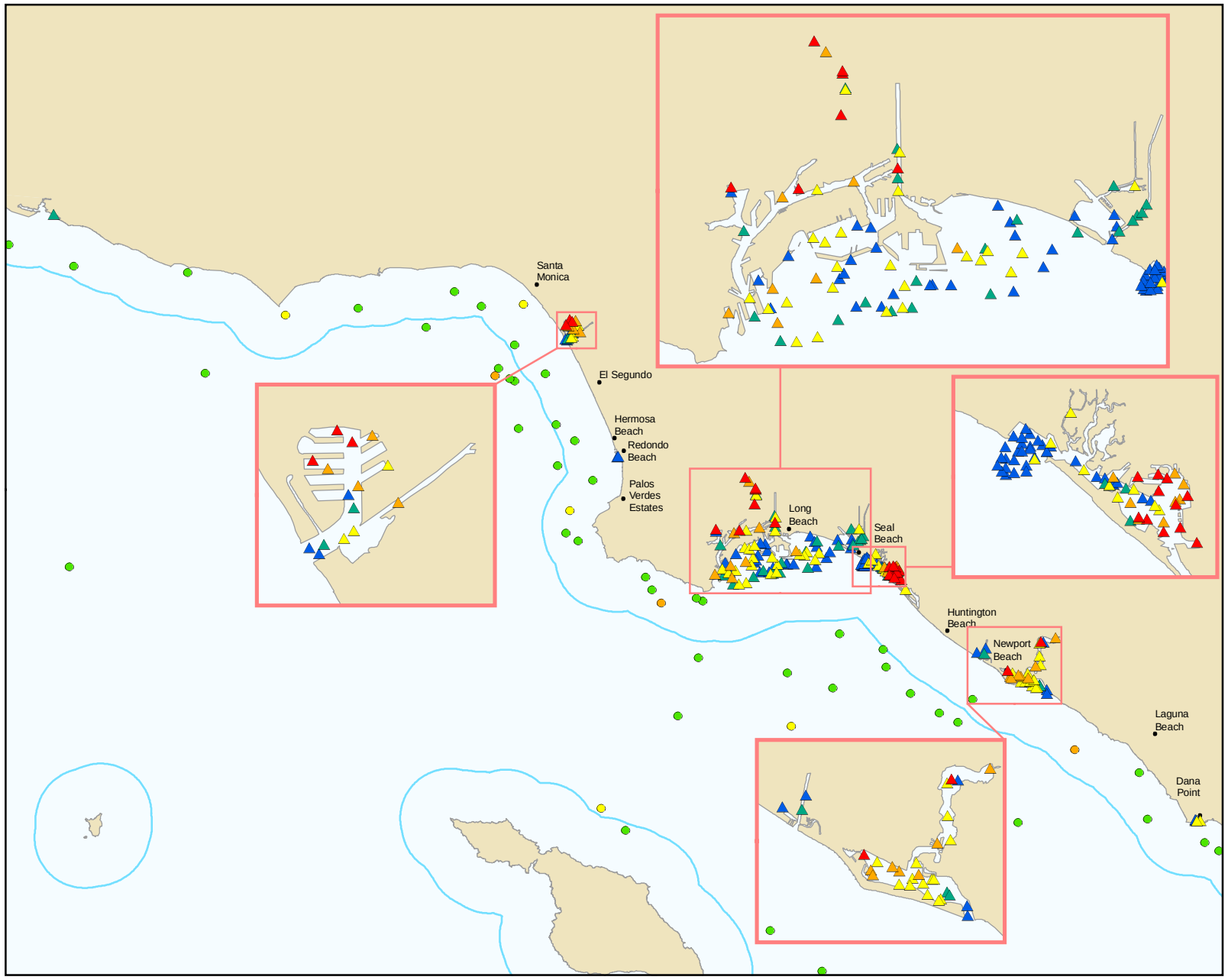
When a water body does not meet established water quality standards, it is placed on an impaired waters list mandated by §303(d) of the federal Clean Water Act.

Version: 1.2
Printing Date: Dec 8, 2008

Map 2a

Areas of Water Quality Concern

Subregion 2 - Point Mugu to Dana Point



Legend

South Coast Study Region Boundary

Sediment Contamination

- Unimpacted
- Likely unimpacted
- Possibly impacted
- Likely impacted
- Clearly impacted

Benthic Condition

- Reference
- Response Level 1
- Response Level 2
- Response Level 3

Benthic Response Level	Benthic Condition	Benthic Condition Description
Reference	Good	Reference
Level 1	Good	Marginal deviation
Level 2	Poor	Biodiversity loss
Level 3	Poor	Community function loss or defaunation

Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

1:650,000

Version: 1.1
Printing Date: Dec 3, 2008

Map 2b

Areas of Water Quality Opportunities

Subregion 2 - Point Mugu to Dana Point

Legend

South Coast Study Region Boundary

Area of Special Biological Significance

Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

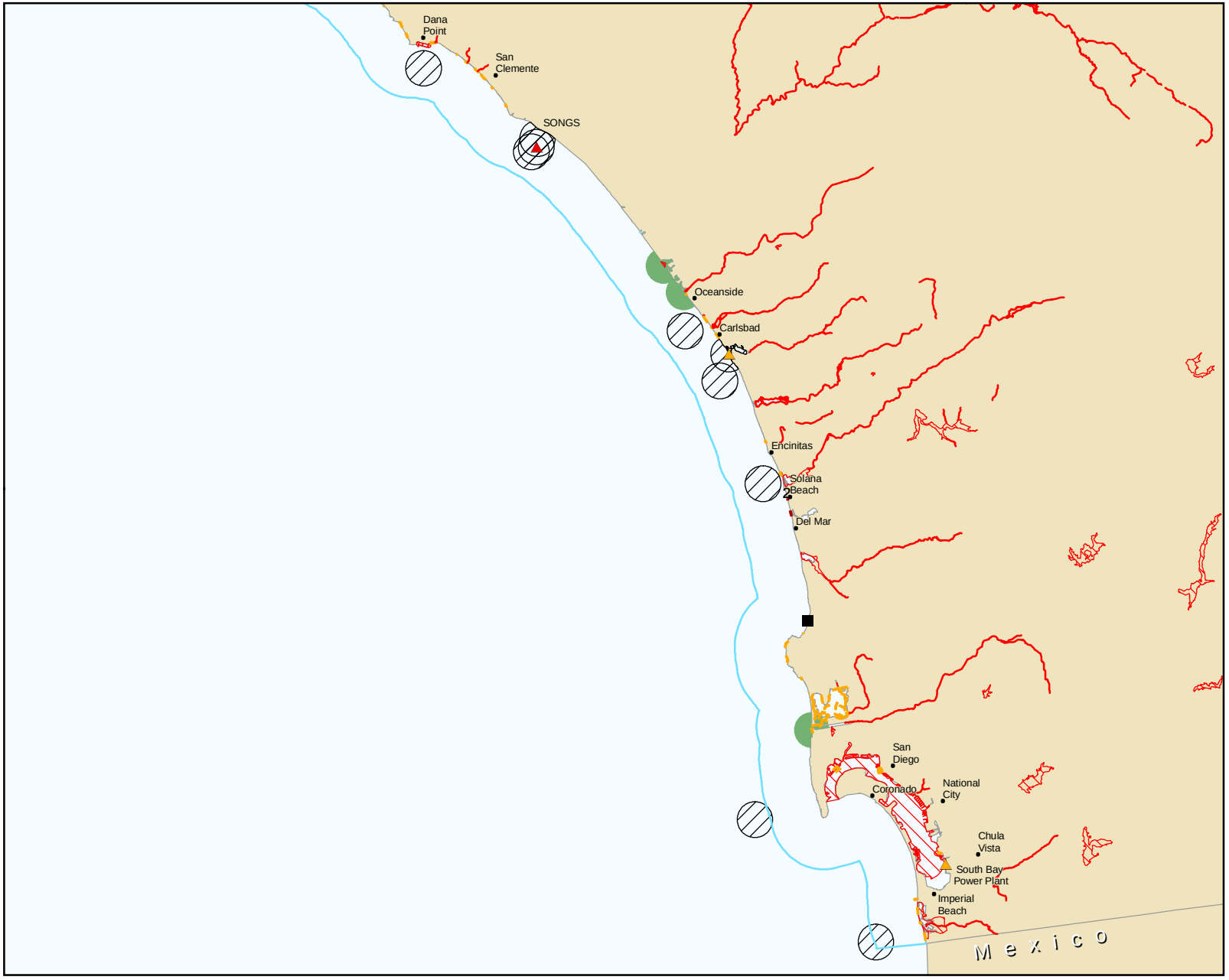
1:650,000

Version: 1.1
Printing Date: Dec 3, 2008

Map 2c

Areas of Water Quality Concern

Subregion 3 - Dana Point to Mexico Border



Legend

South Coast Study Region Boundary

Power Plant Entrainment

# of Larvae per Year Entrained

- 30,000,000 - 99,999,999
- 100,000,000 - 999,999,999
- 1,000,000,000 - 3,199,999,999
- 3,200,000,000 - 6,231,000,000

Impaired Water Bodies*

- Impaired Beaches[1]
- Impaired Beaches[2]
- Impaired Rocky Shores[1]
- Impaired Rocky Shores[2]
- Impaired Water Bodies

Discharge

- Major Stormwater Discharge**
- Major Wastewater Discharge**
- Minor Wastewater Discharge

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Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

1:650,000

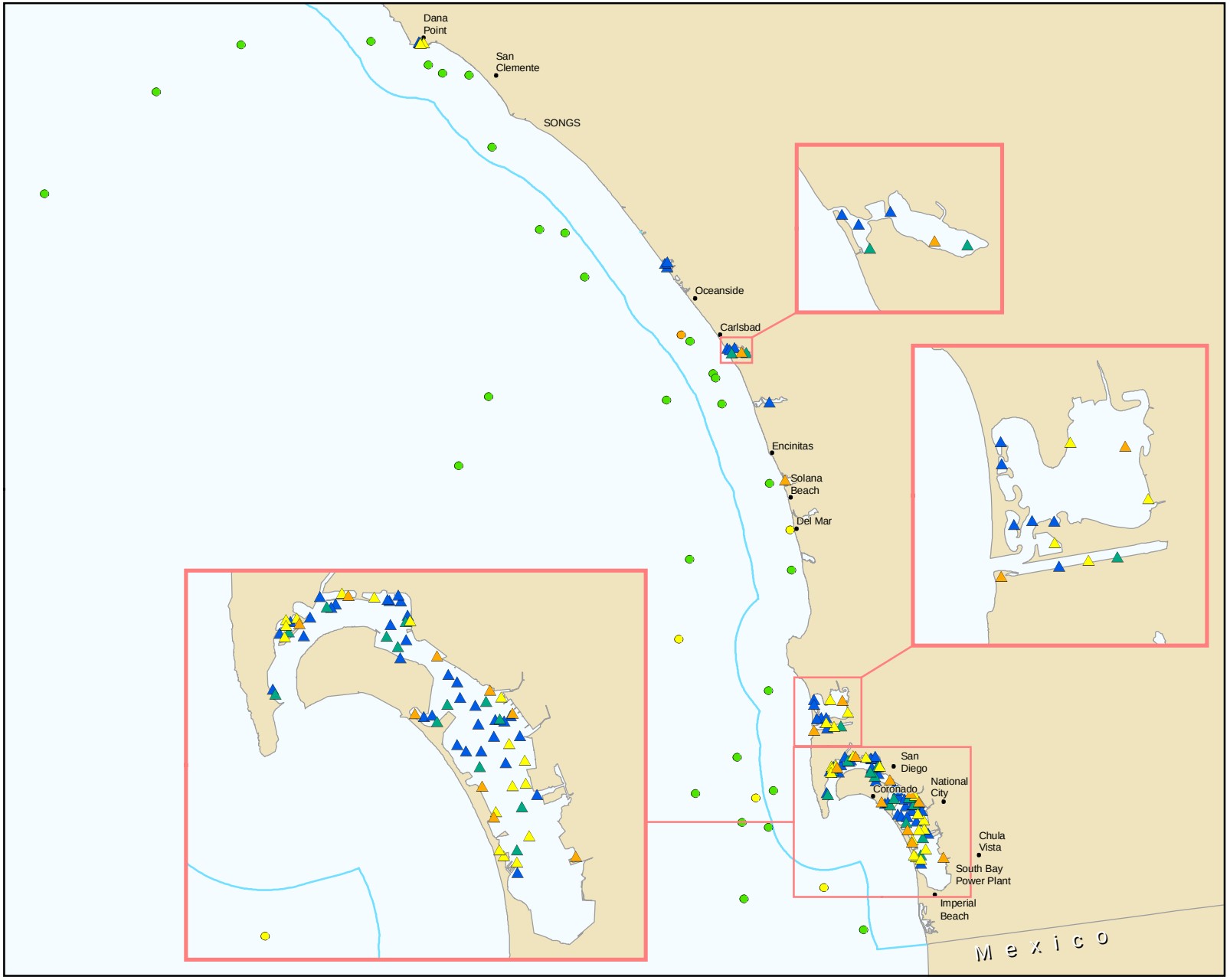
When a water body does not meet established water quality standards, it is placed on an impaired waters list mandated by §303(d) of the federal Clean Water Act.

Version: 1.2
Printing Date: Dec 8, 2008

Map 3a

Areas of Water Quality Concern

Subregion 3 - Dana Point to Mexico Border



Legend

South Coast Study Region Boundary

Sediment Contamination

- Unimpacted
- Likely unimpacted
- Possibly impacted
- Likely impacted
- Clearly impacted

Benthic Condition

- Reference
- Response Level 1
- Response Level 2
- Response Level 3

Benthic Response Level	Benthic Condition	Benthic Condition Description
Reference	Good	Reference
Level 1	Good	Marginal deviation
Level 2	Poor	Biodiversity loss
Level 3	Poor	Community function loss or defaunation

Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

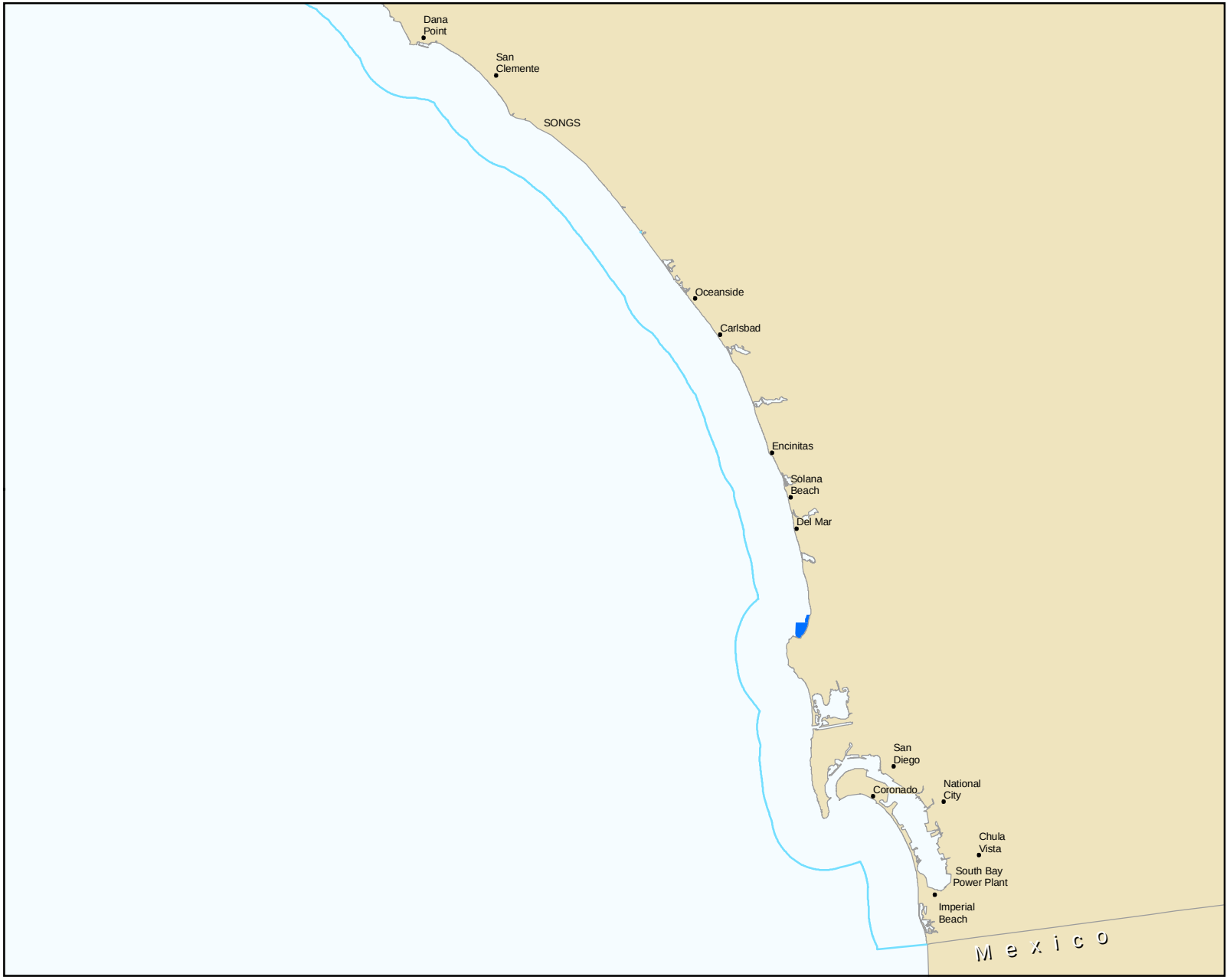
1:650,000

Version: 1.1
Printing Date: Dec 3, 2008

Map 3b

Areas of Water Quality Opportunities

Subregion 3 - Dana Point to Mexico Border



Legend

South Coast Study Region Boundary

Area of Special Biological Significance

Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

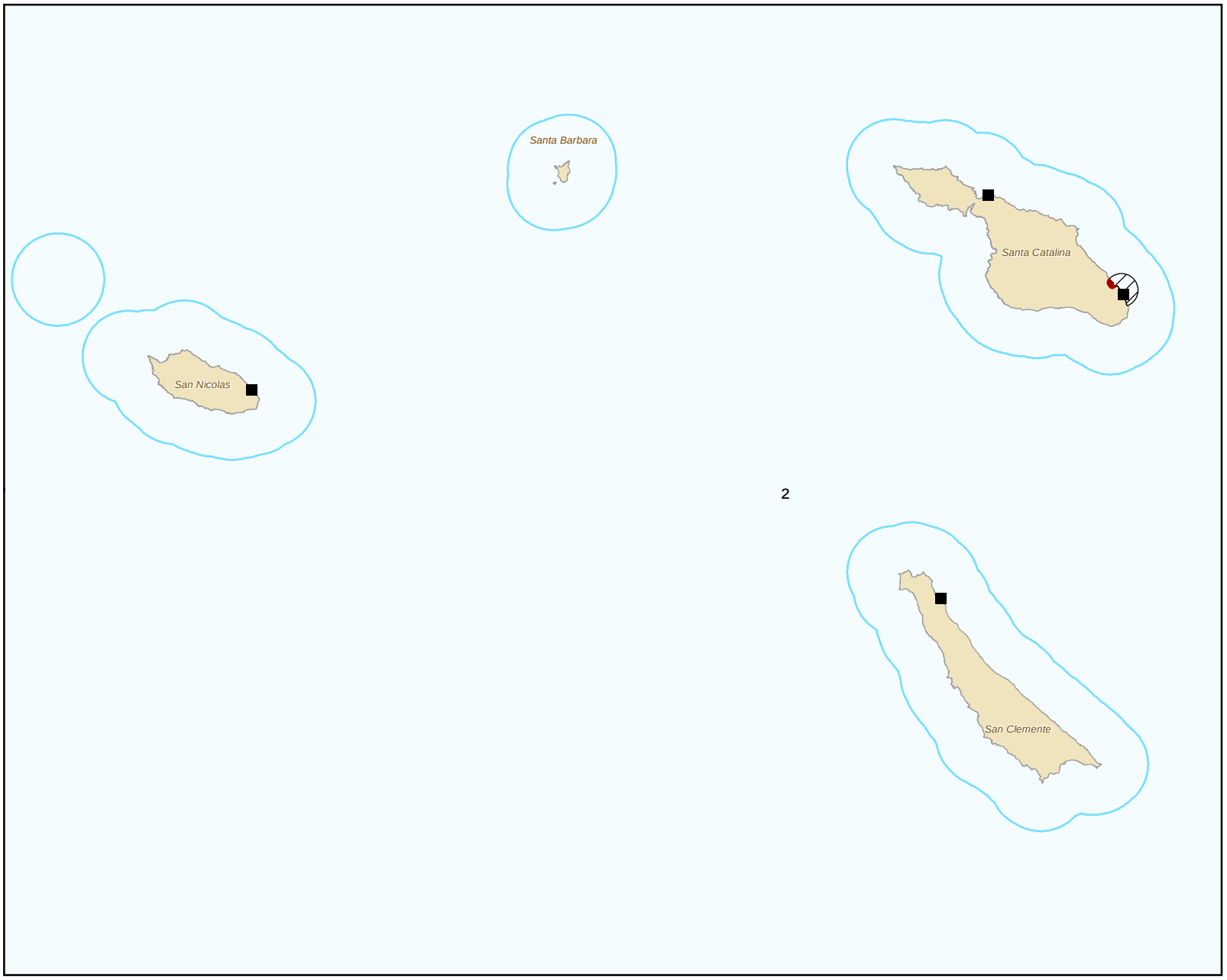
1:650,000

Version: 1.1
Printing Date: Dec 3, 2008

Map 3c

Areas of Water Quality Concern

Subregion 4 - Southern Channel Islands



Legend

South Coast Study Region Boundary

Power Plant Entrainment

# of Larvae per Year Entrained

- 30,000,000 - 99,999,999
- 100,000,000 - 999,999,999
- 1,000,000,000 - 3,199,999,999
- 3,200,000,000 - 6,231,000,000

Impaired Water Bodies*

- Impaired Beaches[1]
- Impaired Beaches[2]
- Impaired Rocky Shores[1]
- Impaired Rocky Shores[2]
- Impaired Water Bodies

Discharge

- Major Stormwater Discharge**
- Major Wastewater Discharge**
- Minor Wastewater Discharge

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Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

1:700,000

When a water body does not meet established water quality standards, it is placed on an impaired waters list mandated by §303(d) of the federal Clean Water Act.

Version: 1.2
Printing Date: Dec 8, 2008

Map 4a

Areas of Water Quality Concern

Subregion 4 - Southern Channel Islands

Legend

South Coast Study Region Boundary

Sediment Contamination

- Unimpacted
- Likely unimpacted
- Possibly impacted
- Likely impacted
- Clearly impacted

Benthic Condition

- Reference
- Response Level 1
- Response Level 2
- Response Level 3

Benthic Response Level	Benthic Condition	Benthic Condition Description
Reference	Good	Reference
Level 1	Good	Marginal deviation
Level 2	Poor	Biodiversity loss
Level 3	Poor	Community function loss or defaunation

Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

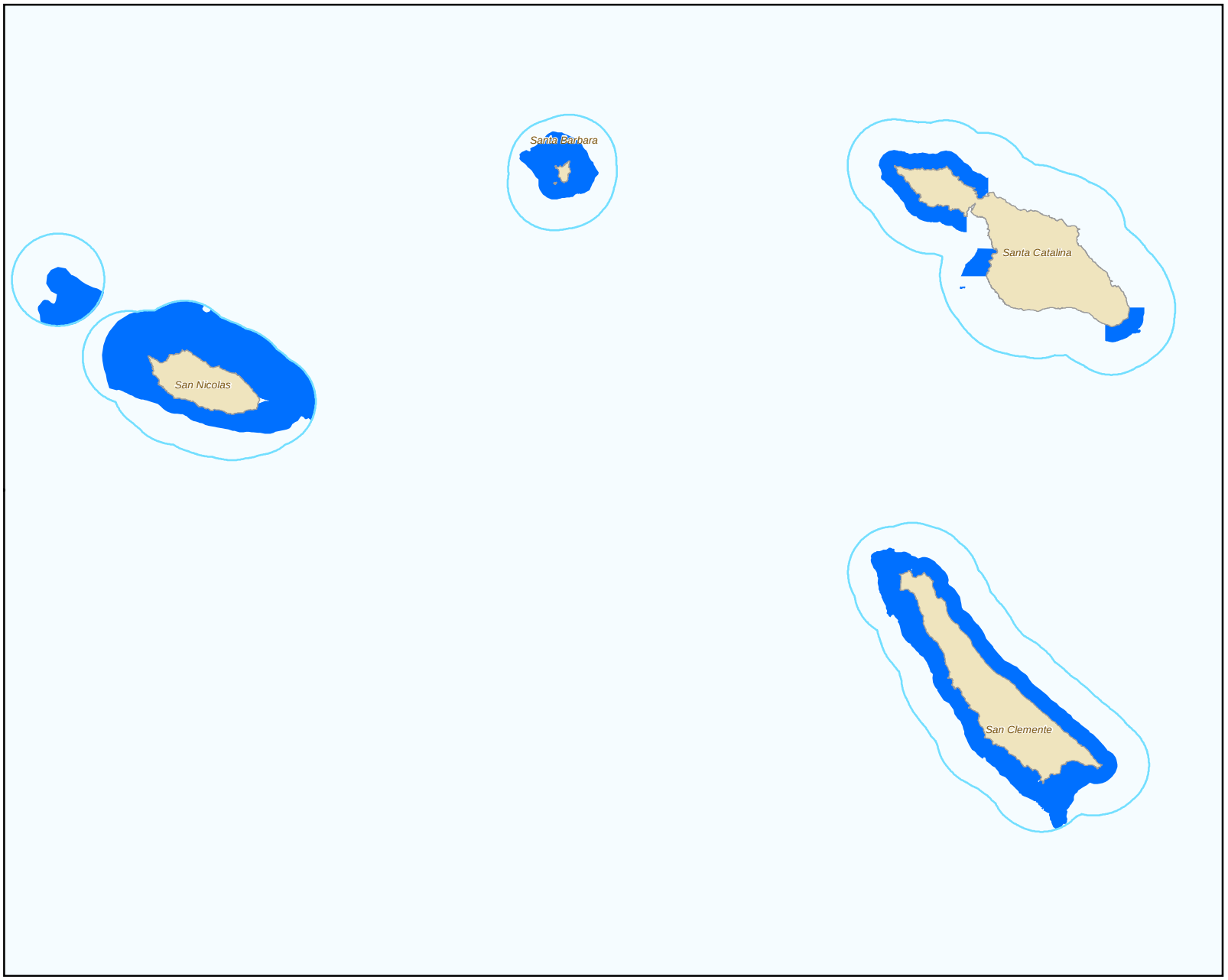
1:700,000

Version: 1.1
Printing Date: Dec 3, 2008

Map 4b

Areas of Water Quality Opportunities

Subregion 4 - Southern Channel Islands



Legend

South Coast Study Region Boundary

Area of Special Biological Significance

Marine Life Protection Act Initiative

Projection Information:

Name: NAD 1983 California Teale Albers
Projection: Albers
Datum: North American 1983

N

0 1.25 2.5 5 Miles

1:700,000

Version: 1.1
Printing Date: Dec 3, 2008

Map 4c