California MLPA Master Plan Science Advisory Team Draft Recommendations for Evaluating Water and Sediment Quality Along the Palos Verdes Shelf – Supplemental Guidance to the Draft Recommendations for Considering Water Quality and Marine Protected Areas in the MLPA South Coast Study Region

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The purpose of this document is to address requests to provide more information and supplemental guidance on the environmental conditions at the Palos Verdes shelf. The Palos Verdes (PV) shelf, located offshore of the PV Peninsula, is up to 4 kilometers (km) wide and 25 km long. There are two specific sites on the PV shelf that have environmental concerns that may affect marine protected area (MPA) performance. These are: the shelf in the vicinity of the Portuguese Bend Landslide and the PV Shelf Superfund Site near White Point (Figure 1 and Figure 2). This document addresses only the impacts that these two sites have on the ecosystem and whether or not the placement of MPAs near or adjacent to these areas would contribute to the goals of the Marine Life Protection Act (MLPA). Health impacts to humans through the consumption of contaminated fish are not addressed in this document since the MLPA focuses on ecosystem structure and function.

Background

During the April 29, 2009 MLPA South Coast Regional Stakeholder Group (SCRSG) meeting, several requests by both SCRSG members and the public were made to the SAT to further evaluate the shelf environment adjacent to Portuguese Bend and containing the Superfund site near White Point. The MLPA Master Plan Science Advisory Team (SAT) Water Quality Work Group has stated in previous guidance that finer-scale water quality evaluations would be performed on these or any other areas, if requested. The two areas requested for further evaluation, the PV Shelf Superfund Site and the Portuguese Bend Landslide, are located on the southwest portion of the PV Peninsula. Conflicting public input regarding the effectiveness of these areas as suitable sites for MPA placement was provided during public comment forming the impetus for this supplemental evaluation.

Sites along the PV Peninsula are currently being considered as candidates for MPA placement in all draft MPA proposals in an effort to meet SAT guidelines such as size, spacing and habitat replication. Previous water quality guidance from the SAT has indicated potential concerns with placing MPAs in areas with major wastewater and stormwater discharges, thus favoring MPA locations northwest of the White Point municipal wastewater outfalls. User groups also appear to concentrate their efforts on the north end of the peninsula. This evaluation will review and examine the Portuguese Bend Landslide and the PV Shelf Superfund Site just north of the White Point municipal wastewater outfalls to more fully inform understanding of the current environmental status of these areas.

Palos Verdes Shelf Superfund Site

Beginning in 1947, the Montrose Chemical Corporation of California operated a chemical production plant that produced large quantities of the synthetic pesticide dichlorodipehnyltrichlorethane (DDT). This chemical and its metabolites (collectively referred to as DDT hereafter), along with other industrial waste products such as polychlorinated biphenyls[2] (PCBs), heavy metals and other contaminants from different industrial discharges, were released into the marine environment through the Los Angeles County Sanitation District (LACSD) sewer lines. The LACSD wastewater facility only used primary treatment, which did not remove the contaminants from the water prior to its discharge through the White Point outfalls located on the PV Shelf. In some instances, sewer lines would clog, and pollutants would get discharged through nearby stormwater drainage sites[3]. By 1971 the LACSD revoked Montrose's discharge permit and the DDT concentration in the LACSD's wastewater discharge dropped dramatically[3]. Although the U.S. Environmental Protection Agency (EPA) banned DDT in 1972, residual DDT waste contained in the wastewater system continued to discharge for many years afterward. By 2002, there were no detectable levels of DDTs being discharged through the County's wastewater outfall[3].

It has been estimated that nearly 726,000 metric tons of DDT was produced by the Montrose Chemical Company during its 35 years of operation, with a small percentage of this being discharged into the ocean[4]. Currently there is an estimated 110 metric tons of DDT contained within the PV Shelf sediment, with the bulk of that contamination occurring near the White Point outfall[4] (Figure 1). The DDT contamination is mostly contained within a layer of sediment just below the surface. The contaminated sediment can be found between 5- 60 centimeters (cm) from the sediment's surface with the highest concentration located between 30- 40 cm, extending from an area just off White Point to an area off San Vicente Point[5]. Years of outfall effluent, natural sedimentation, and erosion material from the nearby Portuguese Landslide Complex aided in burying the contamination layer, however the upgrade to full secondary treatment in 2002 by the wastewater facility eliminated sedimentation created by the outfall effluent. Sherwood et al. (2002) modeled the fate of the DDT in the sediment and determined that most of the buried layer along the 60 meter contour (the location of the discharge) would remain buried and that the concentrations at the surface would slowly decrease over time[6]. However, erosion of the primary deposit layer near the southeast outfall is occurring and could re-suspend buried DDT and reintroduce it into the water column[6].

In 1992, a study[7] to measure the toxicity of the sediment to infauna and epibenthic organisms living on PV Shelf was performed. Sediment toxicity is an important indicator of the quality of sediment. These tests indicate the cumulative effects the chemical compound mixtures have

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[2] PCBs also contribute to the contaminated superfund site (estimated 10 tons in the sediment) and the contamination on the PV shelf. This document will focus on DDT and its affects as a surrogate of the two major contaminants in the area.

[3] Los Angeles County Sanitation Districts (LACSD). 2007. Joint Water Pollution Control Plant Biennial Reciving Monitoring Report 2006-2007. Submitted to the Los Angeles Regional Water Quality Control Board, Whittier, California.

[4] CH2M Hill. 2007. Final Palos Verdes shelf superfund site remedial investigation report. Prepared for U.S. Environmental Protection Agency. Region 9. San Francisco, California 94105.

[5] Lee, H.J., C.R. Sherwood, D.E. Drake, B.D. Edwards, F. Wong, M. Hammer. 2002. Spatial and temporal distribution of contaminated effluent-affected sediment on the Palos Verdes margin, southern California. *Continental Shelf Research*. Vol. 22. Pgs 859-890.

[6] Sherwood, C.R., D.E. Drake, P.L. Wiberg, R.A. Wheatcroft. 2002. Prediction of the fate of *p,p*'-DDE in sediment on the Palos Verdes shelf, California, USA. *Continental Shelf Research*. Vol 22. pgs 1025-1058.

[7] Bay, S., D. Greenstein, J. Brown, and A. Jirik. 1994. Investigation of Toxicity in Palos Verdes Sediments. Final report to Santa Monica Bay Restoration Project. Southern California Coastal Water Research Project, Westminster. 103 pp.

on the benthic biota. Toxicity tests were performed off site on amphipods using a ten day survival test. Sea urchins are also exposed to the contaminated sediments and tested for survivability using a 35 day test. Sea urchin fertilization and growth rates were also measured. Key results from this study indicate that chronic toxicity to sea urchin growth and fertilization (through growth reductions) was detected at sites nearest the larger Y-shape outfall along the 60 m contour line[7]. However, acute toxicity (amphipod mortality) was not detected in any of the stations sampled[7]. In a similar study that measured sediment toxicity in the Southern California Bight, the Southern California Coastal Water Research Project Bight '03 study surveyed 208 sites with one sample occurring near the White Point outfall along the 200 meter contour line, outside of but nearest to the most contaminated DDT zone. Samples collected and tested showed no signs of toxicity to the amphipods[8].

The Joint Water Pollution Control Plant has been monitoring the PV Shelf area since the 1970s, with the purpose of examining the biotic and abiotic conditions surrounding the outfalls along the PV shelf. Benthic infauna condition may be analyzed using the benthic response index (BRI), which is a measure of the infaunal community response to any sediment contamination[9]. The BRI near the outfalls, centered around the most heavily contaminated sediment, has drastically improved over the years[3]. For example, most sites sampled on the PV shelf in 1972 had a high magnitude of stress, with community function loss exhibited throughout the shelf; the highest loss (the most degraded or stressed of the four BRI index categories) occurred near the outfalls. Recovery of PV Shelf, for the most part, is evident by the 2006-2007 monitoring report. The recent surveys found that no sites studied had shown any benthic community loss or defaunation to be occurring along the PV Shelf[3]. However, some sites sampled along the shelf exhibited marginal deviation from reference conditions[10] and a strip along the mid slope just outside the outfall area still had a loss of biodiversity. These two categories are the least degraded of the four BRI index categories. The recovery of the benthos throughout the PV shelf is likely attributed to a few factors which include burial of the legacy contaminants (DDTs, PCBs, etc.) over time and improvements to the quality of effluent after switching to full secondary treatment at the wastewater facility in 2002. Legacy contaminants still remain a problem for the immediate area near the outfalls as the infauna community continues to be slightly impacted[3], although not as severely impacted as historical data indicates.

Benthic trawl surveys are performed on a quarterly basis along the PV Shelf by the Los Angeles County Sanitation District which sample epibenthic invertebrate and demersal fish communities[3]. These surveys extend back to the 1970s where poor sediment and water quality led to an unhealthy epibenthic and demersal fish population. During this time it was common to find stressed populations and diseased fish on the PV Shelf, with a higher rate of disease fishes found near the outfall. Results from fish sampled in the 2006-2007 trawl survey indicate

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[8] Bay, S.M., T. Mikel, K. Schiff, S. Mathison, B. Hester, D. Young and D. Greenstein. 2005. Southern California Bight 2003 Regional Monitoring Program: I. Sediment toxicity. Southern California Coastal Water Research Project. Westminster, CA.
[9] Smith, R.W., M. Bergen, S.B. Weisberg, D.B. Cadien, A. Dalkey, D.E. Montagne, J.K. Stull and R.G. Velarde. 2001. Benthic response index for assessing infaunal communities on the southern California mainland shelf. *Ecological Applications* 11:1073-1087.
[10] Reference sites are those that are used as controls in the experiment which are located in the same area and do not have any contamination or negative impacts associated with them.

that the occurrence of disease had declined, with some forms of physical deterioration disappearing altogether. The county also used a biointegrity metric developed by Allen et al 2001, known as the fish response index (FRI), which gages the pollution tolerance of all species at a particular site[11]. The FRI is a similar approach used to the BRI used to access infaunal conditions previously mentioned. Results from the FRI indicated that fish communities inhabiting the PV Shelf area are considered to be in reference condition and those inhabiting the area nearest the outfall to have been in reference condition since the early 1980s[3].

The EPA performed an ecological risk assessment (ERA) in 2003 with a follow-up revision to the food web exposure model in 2006. The ERA describes the risk associated with the exposure of DDT, and other pollutants, to marine biota which include benthic invertebrates, benthic and pelagic finfish, brown pelicans, double- crested cormorants, bald eagles, peregrine falcons, and pinnipeds and their pups[4]. Exposure from contaminated sediment to benthic invertebrates and fish primarily occurs through ingestion or through dermal permeation or gill exposure. Bioaccumulation, or the increase in the concentration of these chemicals in the fatty tissue of these animals, delivers the contaminated load up through the food chain to higher trophic predators such as birds, marine mammals and large fishes. The ERA results showed the highest biological risk[12] to fish[13] and invertebrates occurring near the immediate vicinity of the outfalls. Intermediate risk occur south to southwest of the outfalls as well as northwest of Point Vicente, while the lowest risk area is around the northern areas of the PV shelf near Redondo Beach. Birds and sea lions continue to be exposed to DDT, with the highest risk for birds that nest near White Point. Risks to sea lions do exist, mostly in the form of impacting the pups by weakening their immune system and potentially leaving them susceptible to disease and other stressful events. However, there is no evidence yet that the sea lion population itself has been negatively impacted by contaminants from the PV Shelf[4].

The Clean Water Act requires the EPA to set ambient water quality criteria (AWQC) to serve as national water quality standards to protect aquatic life. Although the waters overlaying PV Shelf have met the AWQC for PCBs, they do not meet the AWQC for DDTs. The AWQC for protection of aquatic life (including fish) is 1 nanogram/liter DDT. The no observable effects concentration (NOEC) for fish is 1,900 microgram/kilogram whole body tissue for DDTs. White croaker, sandabs, and kelp bass on the PV Shelf generally exceed the DDT NOEC, according to the EPAs standards[14]. For example, for white croaker, the sediment concentration correlated with the DDT NOEC level is 14 milligram/kilogram of sediment. The only sediment that is below this threshold, and is unlikely impacting white croaker is inshore of the 30 m isobath[14,15]. Based on the EPA standards for protecting wildlife, the EPA has determined that

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[11] Allen, MJ, RW Smith, V. Raco-Rands. 2001Development of biointegrity indices for marine demersal fish and megabenthic invertebrate assemblages of southern California. Wesminster, CA: Southern California Coastal Water Research Project.
[12] A biological risk is defined as the contaminant level in a species that exceed toxicity benchmarks set by the Environmental Protection Agency.
[13] The fish used in the ERA study were white croaker, sand dabs and kelp bass.
[14] U.S.E.P.A. 2009. Palos Verdes Shelf Superfund Site operable unit 5 of the Montrose Chemical Corp. Superfund Site. Final Feasibility Study.

contaminants found in the water, sediment and in the fish do not meet the protective requirements of aquatic life[14,15].

The EPA has been monitoring and studying the PV Shelf area, with ongoing activities since the designation of the superfund site in 1997. Along with the designation of superfund site, the lawsuit that was won on behalf of the California Attorney General and the U.S. Department of Justice ensured that funds would be available to pay for the clean up cost. Since the EPA will continually be working in this area through the next several years, if not longer, the SAT determines that it is important to include and consider the current process by the EPA of selecting an interim remedial action for the PV Shelf.

In June of this year, EPA released a proposed plan describing three remedial alternatives plus one no action alternative for the PV Shelf[14]. Because of uncertainties associated with the site, EPA has decided that this will be an interim action, to be followed by a final decision by the EPA after completing additional studies and after public review of the final feasibility report. The alternatives expected to be considered include two alternatives that add a cover of clean, silty sand over part of the deposit between 45 or 50 m depth to 70 m depth[14]. The preferred alternative (Alternative 3 in the Final Feasibility Study[14]) would cap the area in grid 8C (Figure 3). The other alternative (Alternative 4) would produce a larger cap covering areas in grid 6C, 7C, and 8C (Figure 3). EPA will begin pre-design work on its selected remedy this fall which includes additional investigations and pilot studies that will contribute to the design of a Superfund remedy for PV Shelf Superfund site. If either of the two capping alternatives are chosen, it could lead to re-suspension events of the contaminated layer and cause some temporary increase in bioavailability of the toxins and a temporary increase in fish exposure to legacy contaminants[15] (i.e. DDT, PCB). Capping activities are expected to take one to two years to complete and if approved would begin in 2011.

Portuguese Bend Landslide Complex

Historic sedimentation on the PV shelf has been influenced by landslide activity occurring on the PV Peninsula; also know as the Portuguese Bend Landslide. The Portuguese Bend Landslide is located in between Klondike Canyon to the east, and Portuguese Point to the west (Figure 1). Although this landslide is an ancient feature, it was anthropogenically reactivated in 1956 when road construction destabilized the landslide mass by increasing the down shear stress[16]. Another factor contributing to the reactivation and instability of the area was the increase in groundwater created by residential landscaping practices[16]. Over the years, impacts by the landslide include the destruction of the Portuguese Bend Clubhouse and pier, major erosion of the shoreline leading to sedimentation and the burial of once pristine intertidal and nearshore rocky reefs[17]. Subsequent mitigation techniques in the 1980s to control the landslide movement were undertaken and have achieved very short term modest success.

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[15] Carmen White, U.S. Environmetal Protection Agency, San Francisco. Personal Communication to Brian Owens, Department of Fish and Game.
[16] Kayen, R.E., H.J Lee, J.R.Hein. 2002. Influence of the Portugues Bend Landslide on the character of the effluent-affected sediment deposit, Palos Verdes margin, southern California. *Continental Shelf Research*. 22 pgs 911-922.
[17] U.S Corps of Engineers, Los Angeles District. 2000. Draft feasibility report: Ranchos Palos Verdes, Los Angeles County. Volume 1, Environmental Impact Statement.

These efforts include installation of dewatering wells, adding protective wire mesh gabions to prevent wave erosion, adding metal pipe drainage systems and remedial grading[18]. Due to the complexity of the factors involved in contributing to the movement of the landslide, it may be unlikely that mitigation efforts will permanently stabilize the landslide[16].

The Portuguese Bend Landslide occupies a1.06 km^2 portion of the PV Peninsula. It is estimated that from 1956 to 1999 the landslide has contributed between 5.7 to 9.4 million metric tons of sediment to the inner shelf.[16] A sediment plume has been visible in the waters off Portuguese Bend since the reactivation of the landslide in 1956 (Figure 4). The direction of the sediment plume is usually towards the southeast and during heavy erosion events may extend out to 1.5 km[16]. The sedimentation from the landslide reaches as far south as White Point, where it is known to mix with the wastewater effluent, and thus enlarging the sediment deposit on the highly contaminated solids that were discharged from the outfalls[16]. This sedimentation continues to bury rocky reefs in this region (Figure 5). In addition, the longshore current does shift causing the sediment plume sometimes to extend upcoast to Long Point. The Portuguese Bend landslide is a major source of sediments to the rocky subtidal and intertidal environment[19].

The biggest concern from the landslide is the increase in turbidity and sedimentation to the nearshore environment. Communities living on rocky habitat depend on hard substrate and the availability of light, among other needs. Sediment plumes can restrict light penetration and excessive turbidity can reduce growth and reproductive rates for marine plants[20]. Sedimentation can also scour and cover hard surfaces. Over time, as is evident in the Portuguese Bend area, this action can transform the community structure from a hard bottom kelp forest community to a soft bottom community. Vibrant giant kelp forests are indictors of healthy nearshore ecosystems that are characterized by greater biodiversity and overall greater productivity[20]. However in the vicinity of the Portuguese Bend Landslide the sedimentation denudes the reef fauna even when kelp is present. There are vast expanses of bare rock that are not observed on other parts of the peninsula indicating that sedimentation continues to be a significant problem.

Even though turbidity has increased in the waters between Portuguese Point and White Points, LACSD found the eutrophic zone in this area still reaches up to 18 meters, which indicates that enough light is reaching depths that can sustain kelp growth. In fact, the California Department of Fish and Game aerial surveys show kelp forest existing upshore and downshore from Portuguese Bend, although turbidity may be limiting the potential for maximum kelp growth and recruitment in this area. However, the area just off of Portuguese Bend contains little to no kelp, which historically had supported a rich and diverse kelp forest community. Another study showed that the Portuguese Bend area had the lowest habitat value (the value based on fish

[18] City of Rancho Palos Verdes. More information at http://www.palosverdes.com/rpv
[19] Los Angeles County Sanitation District (LACSD). 2002. Annual Report, 2001 Palos Verdes Ocean Monitoring. July.
[20] Foster, M. S., and D. R. Scheil. 1985. The Ecology of Giant Kelp forest in California: A community Profile. Pages 1-152. U.S. Fish and Wildlife Services Biological Report.

assemblages at each habitat) when compared to the reference site at Palos Verdes Point[21]. In this same study, the coastal marine community from Abalone Cove to Point Fermin had deflated habitat values when compared to the reference site[21]. In addition, recent resurveys of rocky intertidal transects performed originally during the 1956-59 revealed large scale changes in macrophyte composition on the downcoast side of Portuguese Point[22]. This shoreline is now populated mostly by disturbance-resistant crustose and small filamentous and turf-forming seaweeds; larger, habitat-forming macrophytes are no longer abundant at this site. In all, the largest impact to the area from the landslide occurs off Portuguese Bend, with dramatic impacts from Bunker Point to White Point and lesser turbiditiy/sedimentation impacts in the Abalone Cove region (Portuguese Point to Long Point). What is left of this rocky habitat is of the poorest quality on the Palos Verdes Shelf.

Guidance for MPA Placement along the Palos Verdes Shelf

Given the history of anthropogenic impacts to the PV Shelf stemming from the alteration of the land and the improper disposal of toxic chemicals and heavy metals, the SAT has performed a careful review of the literature published to date. As indicated above, there are known locations of increased turbidity downstream of Portuguese Bend and increased toxins along the PV Shelf near the White Point outfalls that negatively impact marine life by decreasing growth reproduction and community composition.

An additional consideration is the ongoing research and proposed clean up activities by the EPA. The EPA has identified areas (Figure 3: Grids 6C, 7C and 8C) that are part of their remedial action plan to remediate the toxins near the White Point outfalls. These areas include sites where extensive field studies have been, and will continue to be, conducted and are potential mitigation locations for capping in the near future. As outlined above, capping will result in disturbance to the benthic environment and the potential re-suspension and availability of legacy contaminants would deleteriously affect organisms and potentially community composition in the area. If capping at the first proposed site is successful (Grid 8C in Figure 3), then additional sites in the area would be considered for treatment which would occur approximately 5 to 7 years after initial treatment. This prolonged disturbance could reduce the effectiveness of MPAs that are placed near the mitigation site, and therefore MPA placement in the area should be avoided.

Previous water quality guidance included ½ mile buffer zones around major wastewater outfalls[22]. Based on the detailed information gathered above, the SAT is now providing additional guidance, as requested, that expands the areas of concern along the PV Shelf, including the area near the White Point wastewater outfall. Therefore, the guidance is: (1) Areas northwest of Portuguese Bend have better water quality conditions due to the distance from the superfund site and the lack of a consistent plume transporting sediment to that area

[21] Stephens, J.S., Jr., D. Pondella II., P. Morris. 1996. Habitat value determination of the coastal zone off the city of Rancho Palos Verdes based on habitat-specific assemblage data. Prepared for the U.S. Army Corps of Engineers.

[22] Gerrard AL (2005) Changes in the rocky intertidal floras along the Palos Verdes peninsula (Los Angeles County) since E.Y. Dawson's surveys in the late 1950s. M.S. Thesis, California State University, Fullerton, 86 pp

from the Portuguese Bend Landslide, (2) areas nearest the outfalls are less favorable for MPA placement due to legacy contaminants and the current effluent flow[23], (3) areas of ongoing and planned EPA fieldwork and mitigation activities at White Point are more vulnerable to perturbation and therefore less favorable in the short term for proposed MPA placement, and (4) the area from Portuguese Bend Cove to White Point would be subjected to turbidity and sedimentation at levels that affect organisms and biological communities as addressed above, and would also be less favorable for MPA placement..

In conclusion, the mitigation sites identified by the EPA and the areas with the highest known levels of toxicity and turbidity/sedimentation constitute the least suitable locations for proposed MPAs and are indicated spatially by the shaded areas shown in Figure 6. Caution should be taken and careful consideration given to the potential ecological benefits when considering these areas for MPA placement as they are not recommended by the SAT.

[23] See previous water quality guidance document to RSG titled “California MLPA Master Plan Science Advisory Team Draft Recommendations for Considering Water Quality and Marine Protected Areas in the MLPA South Coast Study Region” revised May 12, 2009.

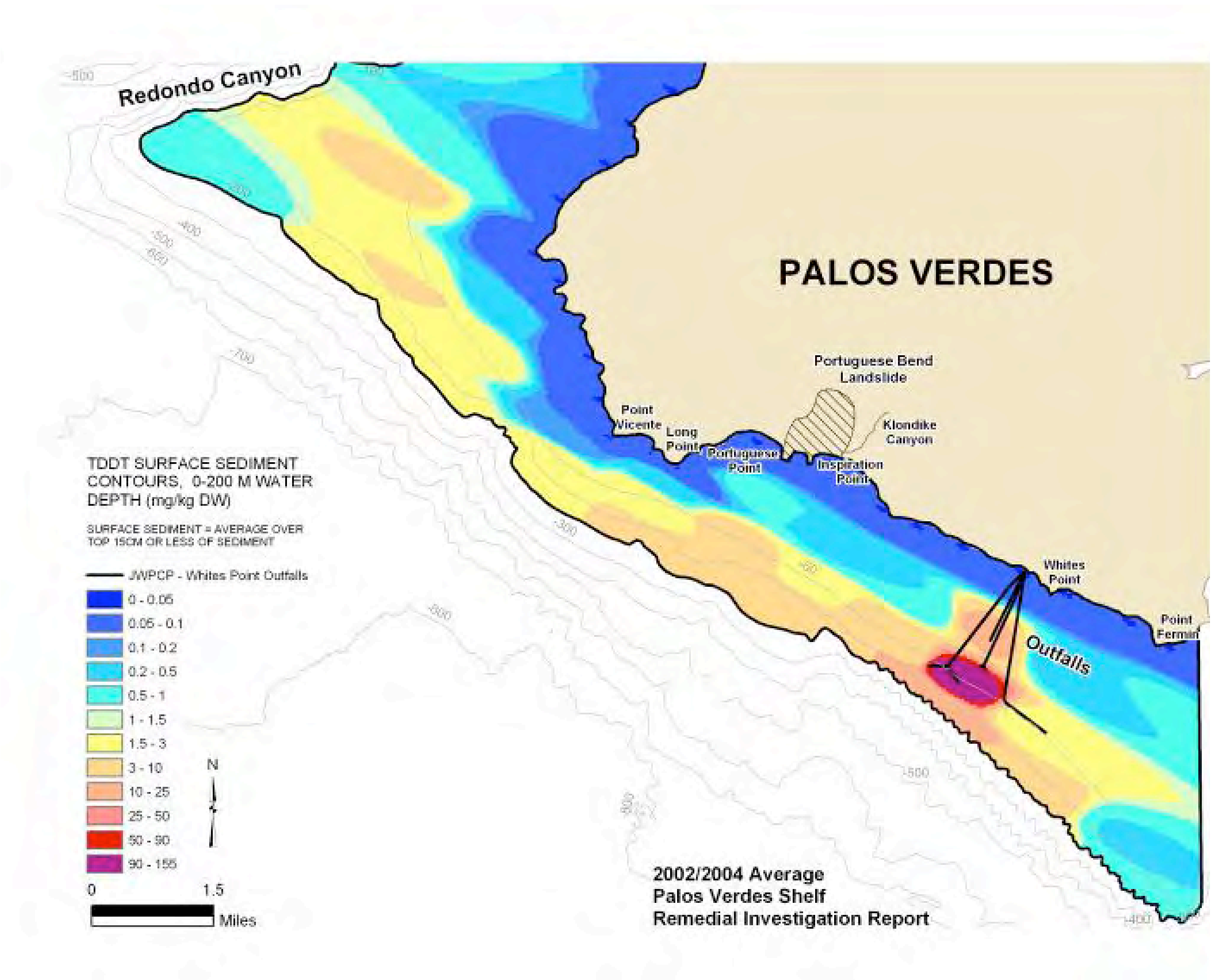

Figure 1. (DDT deposit map): The effluent-affected deposit at the outfalls and along the Palos Verdes shelf, 2002/2004 average. Source: Palos Verdes Shelf Remdial Investigation Report. 2007.

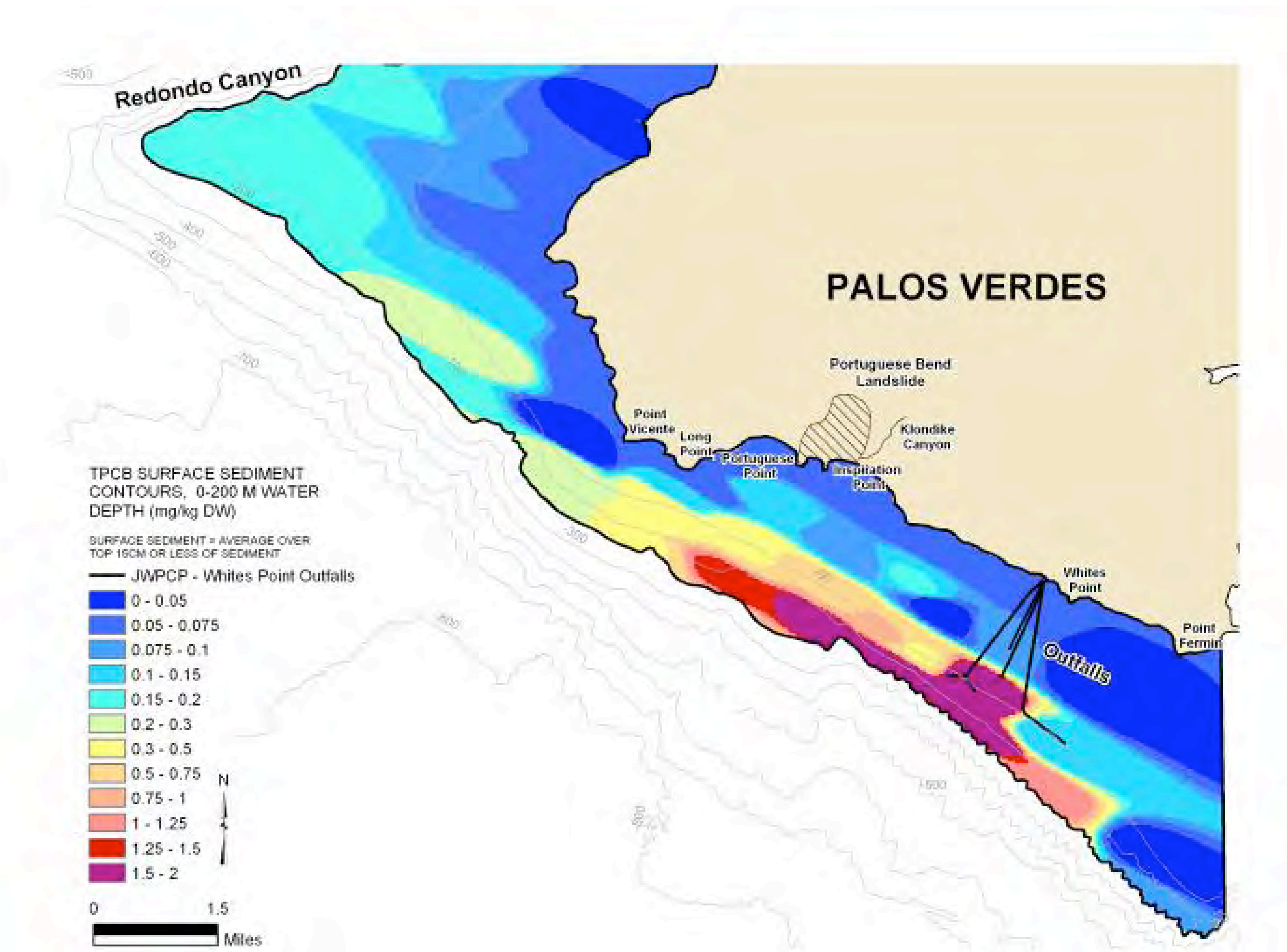

Figure 2. (PCB deposit map): The effluent-affected deposit at the outfalls and along the Palos Verdes shelf, 2002/2004 average. Source: Palos Verdes Shelf Remdial Investigation Report. 2007

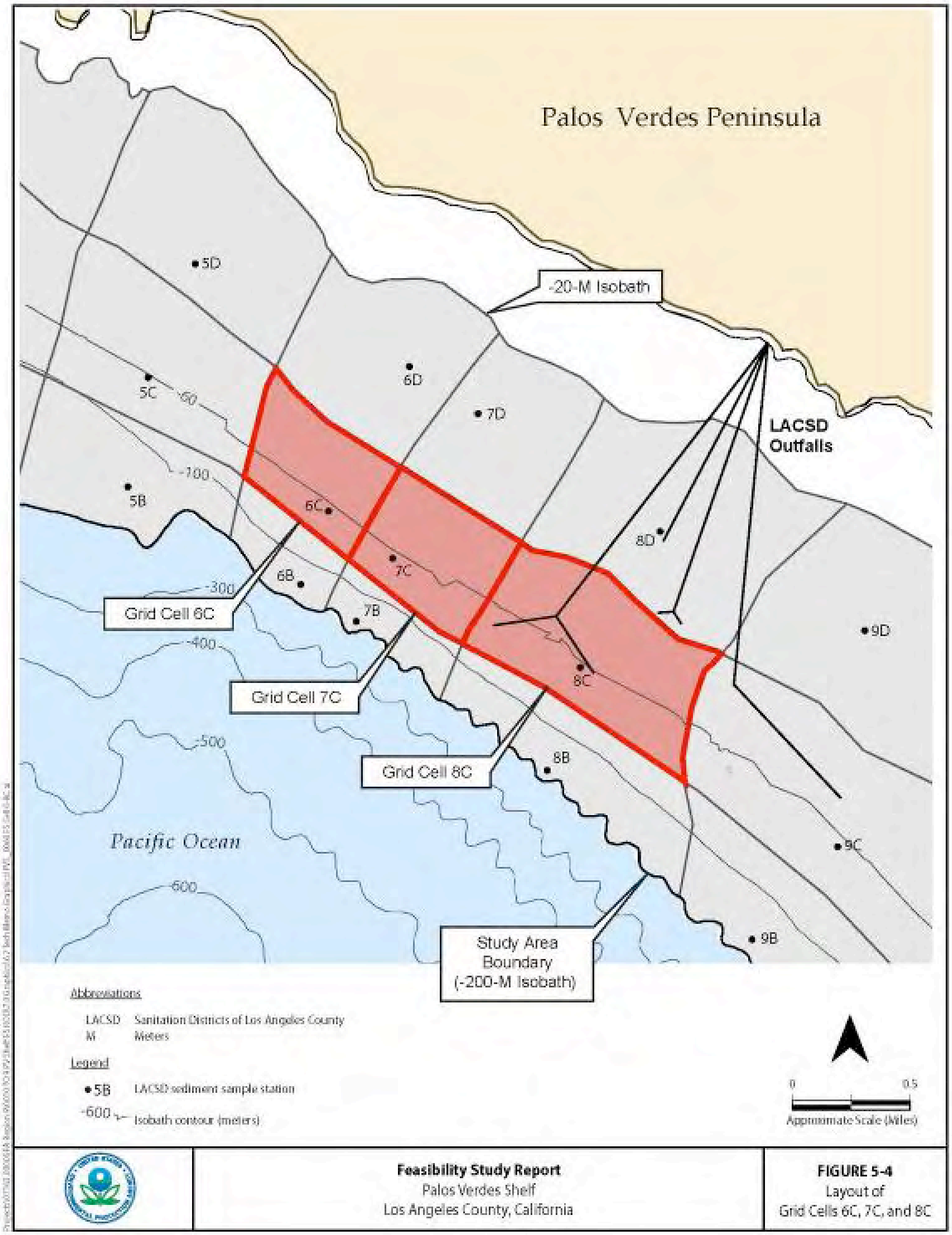

Figure 3. Location of Environmental Protection Agency's remedial action area (in red). Cell 8C is has been designated as the preferred alternative (which includes capping) by their feasiblity study.

Source: U.S.E.P.A. 2009. Palos Verdes Shelf Superfund Site operable unit 5 of the Montrose Chemical Corp. Superfund Site. Final Feasability Study.

Figure 4. Example of turbidity plume from the Portuguese Bend Landslide. Photograph taking sometime in the 1980s, although similar plumes can still be observed today.

Figure 5. Examples of buried reef at Bunker Point (above), October 22, 2008 and White Point (below), June 3, 2009.

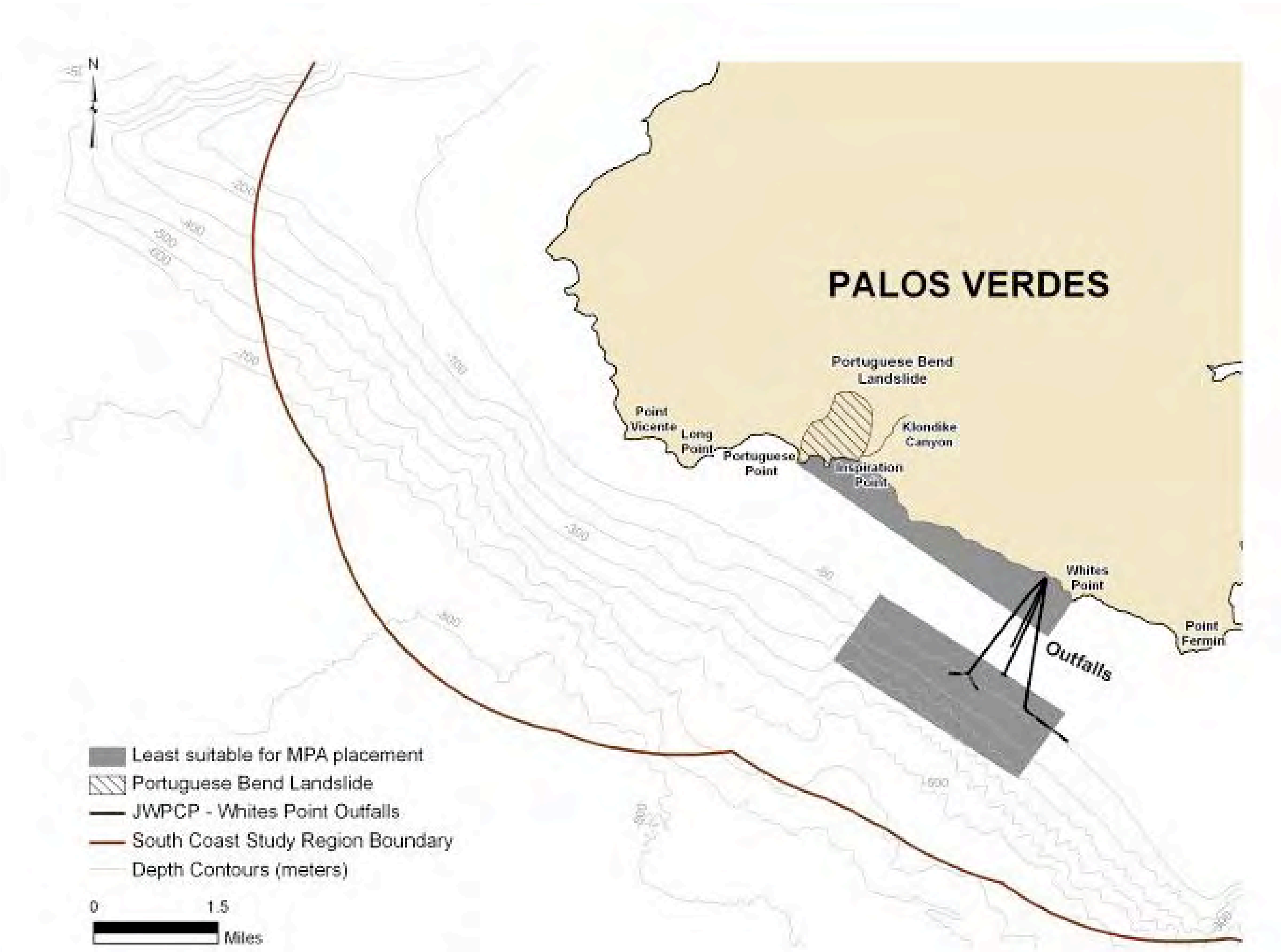

Figure 6. This map shows the areas (shaded gray) the SAT believes are less favorable for MPA placement based on water and sediment quality concerns.