CALIFORNIA COASTAL COMMISSION
45 FREMONT STREET, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE AND TDD (415) 904-5200

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STAFF RECOMMENDATION

ON CONSISTENCY DETERMINATION

Consistency Determination No.	**CD-52-00**
Staff:	MPD-SF
File Date:	5/8/2000
45th Day:	6/22/2000
60th Day:	7/7/2000
Commission Meeting:	6/14/2000

FEDERAL AGENCY: **Environmental Protection Agency**

PROJECT LOCATION: Palos Verdes Shelf, offshore of San Pedro, City and County of Los Angeles (Exhibits 1-3)

PROJECT DESCRIPTION: Pilot study of in-situ capping using up to 500,000 cu. meters of sand for demonstration capping project (Exhibits 4-7)

SUBSTANTIVE FILE DOCUMENTS: See page 15.

EXECUTIVE SUMMARY

The Environmental Protection Agency (EPA) has submitted a consistency determination for a pilot capping study as part of its ongoing Superfund investigation of the Palos Verdes Shelf. In July 1996, under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) the U.S. Environmental Protection Agency (EPA) began a "Superfund" investigation of the large area of DDT- and PCB-contaminated sediments on the Palos Verdes (PV) Shelf off the coast of the Palos Verdes peninsula. This investigation has included an evaluation of human health and ecological risks posed by the contaminated sediments as well as an evaluation of potential clean-up actions. Based on existing risks to human health associated with the consumption of contaminated fish from this area, EPA recently proposed various institutional controls (i.e., enforcement of the commercial fishing ban, public outreach and education about the fish consumption advisory, and monitoring) as an interim response action. In the meantime, EPA is continuing its investigation of the feasibility of in-situ (i.e., in-place) capping for all or a portion of the site.

Part of the dredging has already been authorized and found consistent with the Coastal Act in consistency determination CD-54-95 (Army Corps, Queens Gate Main Channel dredging). That project is being modified to include disposal at the PV Shelf location for the portion of this material needed for the pilot capping project. The rest of the dredging needed for the PV Shelf project consists of new dredging work from a borrow site called "Borrow Area AIII." The Army Corps has submitted two negative determinations for these dredging activities (ND-38-00 and ND-51-00), which are being considered together with EPA's consistency determination.

The Commission found the Queens Gate dredging has been found an allowable use under Section 30233(a)(1) because it supported "New or expanded port, energy, and coastal-dependent industrial facilities." The proposed new dredging of AIII borrow site material, as well as the disposal of both types of material in this pilot capping project, are allowable uses under Section 30233(a)(7) because they involve "restoration" activities. EPA has analyzed and incorporated the most appropriate alternatives needed to minimize impacts and refine variables for long-term capping at the site (which would undergo separate federal consistency review with the Commission). EPA has also included monitoring both to detect any temporary project impacts, as well as to generate data for use in the ultimate design of any long-term capping project on the Palos Verdes shelf. The project does not necessitate any mitigation measure beyond the monitoring (and modification in the event the monitoring detects impacts (e.g., cap placement not occurring as predicted, or if resuspension of contaminants exceed expectations)). Therefore, the project is consistent with the marine resources, water quality, and commercial and recreational fishing policies (Sections 30230, 30231, 30233, 30234, and 30234.5) of the Coastal Act.

STAFF SUMMARY AND RECOMMENDATION

I. Project Background. The Palos Verdes Shelf[1] site consists of a 43 square kilometer (17 square mile) area of DDT[2]- and PCB[3]-contaminated sediments in an offshore area between Point Fermin and Point Vicente (Exhibits 1-3). From 1947 to 1982, the Montrose Chemical Corporation of California, Inc., ("Montrose") manufactured the pesticide DDT at its plant in Los Angeles. Wastewater containing significant concentrations of DDT was discharged from the Montrose plant into the sewers, flowed

[1] EPA defines the Palos Verdes Shelf as the area where DDT concentrations in the sediment exceed 1 part per million (ppm).
[2] DDT= dichloro-diphenyl-trichloethane
[3] PCB = Polychlorinated biphenyls

through the Joint Water Pollution Control Plant (JWPCP, or "White's Point") outfalls, operated by the Los Angeles County Sanitation Districts (LACSD), and was discharged to the ocean waters of the Palos Verdes Shelf. Montrose's discharge of DDT reportedly stopped in about 1971, and the Montrose plant was shut down and dismantled in 1983.

PCBs from several industrial sources were also discharged into the sewer system. The DDT and PCBs that passed through the treatment plant mixed with the suspended solids in the discharge flowing out of the White's Point sewer outfalls and settled to the ocean floor to form a large sediment deposit. This deposit covers a large area of the ocean floor (Exhibit 3) between Point Vicente in the northwest and Point Fermin in the southeast.

Historically, the waters of the Palos Verdes Shelf have been used extensively by both sport and commercial fishermen. Sport fishermen angle from party boats, private boats, rocky intertidal areas and sandy beaches. Currently, high levels of DDT and PCBs are found in the active biologic zone of the Palos Verdes Shelf sediments, and fish from the Shelf are contaminated with DDT and PCBs. Generally speaking, contaminant levels are highest in bottom-feeding fish such as the white croaker and are significantly lower in fish that live higher up in the water column.

In 1985, the State of California issued an interim health advisory recommending limitations on the consumption of sport fish and discouraging consumption of white croaker caught in the Santa Monica Bay, the Palos Verdes Shelf, and the Los Angeles/Long Beach Harbor area because of DDT and PCB contamination in the fish. Based on a 1991 study, the CalEPA's Office of Environmental Health Hazard Assessment (OEHHA) issued a health advisory recommending, in part, the recreational anglers not consume white croaker caught in most areas offshore of Los Angeles County and Orange County, and that anglers greatly limit consumption of a number of other fish species caught on or in the vicinity of the Palos Verdes Shelf due to the levels of DDT and PCBs in fish tissue. These warnings have been included in the California sport fishing regulations since March 1, 1992.

In 1990, the California Department of Fish and Game (CDFG) closed commercial fishing of white croaker on the Palos Verdes Shelf because of the threat to human health posed by the DDT and PCB contamination in these fish. The closure extends from Point Vicente to Point Fermin and from the shoreline out three miles. Concerns exist, however, that some commercial fishing operations are not adhering to the fishing closure and the CDFG does not have sufficient resources to adequately enforce the closure. A 1997 study by Heal the Bay, a local environmental organization, found elevated levels of DDT and PCBs in white croaker (also known as kingfish or tomcod) being sold in a number of Los Angeles and Orange County fish markets. As of March 1998, and in response to concerns about white croaker being illegally sold by sport fishermen to commercial fish markets, CDFG revised the white croaker recreational catch limit from unlimited to a limit of 10 fish per day.

In 1994, the results of multi-year study by the State and Federal natural resource trustee agencies (the "Trustees") of ecological impacts caused by sediment contamination in the area offshore of Palos Verdes peninsula were completed and released to the public. In July 1996, following its review of these reports and other available information, EPA began its Superfund investigation of the Palos Verdes Shelf. Through a process known as an Engineering Evaluation/Cost Analysis (EE/CA), EPA is evaluating the need for cleanup action and the potential alternatives for cleaning up the contaminated sediment in this area (Exhibit 10).

II. Project Description. EPA has submitted a consistency determination for a demonstration capping project as part of its ongoing Superfund investigation of the Palos Verdes Shelf. The demonstration project consists of placing cap material within a small area of the site (approximately 0.7 square kilometers or 180 acres) using a maximum of 500,000 cubic meters of clean sediment. Sediments used will consist of fine-grain sands and coarse-grain sands. Fine-grain sands will be taken predominantly from the Army Corps/Port of Long Beach Queens Gate/Main Channel Deepening Project. Coarse-grain sands will be taken from a nearby borrow site (identified as "Area AIII" on Exhibit 5). Consequently, in addition to this EPA consistency determination, the Army Corps has submitted two accompanying negative determinations for: (1) modification of the Queens Gate/Main Channel Deepening project to transport most of the dredged material needed for this capping project (ND-38-00); and (2) dredging and transport of up to 20,000 cu. yds. of Borrow Area AIII material needed for this capping project (ND-51-00).

The purpose of EPA's demonstration project is to test varying sediment sizes, capping thicknesses, and sediment disposal (i.e., cap placement) methodologies, with environmental monitoring before, during and after cap placement.

A hopper dredge (the *Sugar Island*), will be used to accomplish all dredging and cap placement for the pilot capping project, because: (1) it contains a split-hull hopper opening mechanism that can be used to control the rate of release; and (2) this dredge is equipped with a hopper pumpout capability over the bow and water jets to aid in pumpout operations. Pumpout can also be accomplished through the adjustable skimmers within the hopper or through one of the two dragarms, allowing for a submerged point of discharge. Any of these methods of placement could potentially be used during the pilot project.

The pilot capping project will be conducted within four 300-by-600 meter placement cells located about midway between Point Fermin and Point Vicente. One pair of cells would be located along the landward edge of the site where the water depth is approximately 40 to 45 meters (m), and the second cell pair would be located adjacent to the seaward limit of the continental shelf in a comparatively deeper area where water depths are 60 to 70 m. The two cells within each pair would be separated by a full cell length in the along-shore direction and by a full cell width in the perpendicular direction (Exhibit 4). The cell grid may be adjusted slightly following the collection and evaluation of baseline data. During the pilot project, placement of cap material would occur within the limits of these four cells, although the area monitored would extend to adjacent areas.

The location of the pilot capping cells within the site was determined based on criteria in the Operations and Monitoring Plan (Exhibit 8). One of the primary criteria used to select the location of the pilot cells was to ensure that the pilot capping project would avoid adverse effects on Los Angeles County's (LACSD) sewer outfall system.

Placement of cap material for the pilot project is scheduled to begin in July 2000 and be completed within approximately three months. Although the initial placement of cap material will occur during daylight hours (to facilitate the associated monitoring work), the bulk of the dredging (from either Queen's Gate or the AIII borrow area) and cap material placement at Palos Verdes Shelf will occur in the course of round-the-clock operations.

Also included is a monitoring program which will collect data before, during and after cap placement. Monitoring of the pilot project will enable EPA to address key short and intermediate term questions relative to capping on the Palos Verdes Shelf. The detailed monitoring will enable EPA to evaluate some of the uncertainties regarding the most effective cap placement methods and the suitability of fine-grained versus coarse-grained sediments for cap construction, as well as the extent of construction-related impacts on the marine environment.

Finally, if the pilot project is successful, EPA may propose capping as a long-term response action for the PV Shelf, in which case (pursuant to the requirements of the Superfund program), EPA would circulate a proposed plan for public comment. EPA would also undergo further federal consistency review with the Commission and consider public comments on its plan before deciding whether to proceed with a cap.

III. Status of Local Coastal Program. The standard of review for federal consistency determinations is the policies of Chapter 3 of the Coastal Act, and not the Local Coastal Program (LCP) of the affected area. If the LCP has been certified by the Commission and incorporated into the California Coastal Management Program (CCMP), it can provide guidance in applying Chapter 3 policies in light of local circumstances. If the LCP has not been incorporated into the CCMP, it cannot be used to guide the Commission's decision, but it can be used as background information. The Rancho Palos Verdes LCP has been certified and incorporated into the CCMP. The Los Angeles County and City LCPs have not been incorporated into the CCMP.

IV. Federal Agency's Consistency Determination. The Environmental Protection Agency has determined the project to be consistent to the maximum extent practicable with the California Coastal Management Program.

V. Staff Recommendation. The staff recommends that the Commission adopt the following motion:

MOTION: **I move that the Commission agree with consistency determination CD-52-00 that the project described therein is fully consistent, and thus is consistent to the maximum extent practicable, with the enforceable policies of the California Coastal Management Program (CCMP).**

STAFF RECOMMENDATION:

*Staff recommends a **YES** vote on the motion. Passage of this motion will result in an agreement with the determination and adoption of the following resolution and findings. An affirmative vote of a majority of the Commissioners present is required to pass the motion.*

RESOLUTION TO AGREE WITH CONSISTENCY DETERMINATION:

*The Commission hereby **agrees** with consistency determination CD-52-00 by the Environmental Protection Agency, on the grounds that the project described therein is fully consistent, and thus is consistent to the maximum extent practicable, with the enforceable policies of the CCMP.*

VI. Findings and Declarations:

The Commission finds and declares as follows:

1. Marine Resources, Water Quality, and Commercial and Recreational Fishing. Sections 30230 and 30231 of the Coastal Act provide for the protection of marine resources and water quality. Section 30233 authorizes dredging and filling under certain conditions. Sections 30234 and 30234 provide for the protection of commercial and recreational fishing opportunities. These sections provide:

> 30230: *Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.*
>
> 30231: *The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where*

feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface water flow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.

30233(a): The diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this division, where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects, and shall be limited to ....

(l) New or expanded port, energy, and coastal-dependent industrial facilities, including commercial fishing facilities.

(2) Maintaining existing, or restoring previously dredged, depths in existing navigational channels, turning basins, vessel berthing and mooring areas, and boat launching ramps.

...

(6) Mineral extraction, including sand for restoring beaches, except in environmentally sensitive areas.

(7) Restoration purposes.

(8) Nature study, aquaculture, or similar resource dependent activities.

30233(b) Dredging and spoils disposal shall be planned and carried out to avoid significant disruption to marine and wildlife habitats and water circulation. Dredge spoils suitable for beach replenishment should be transported for such purposes to appropriate beaches or into suitable long shore current systems.

30234. Facilities serving the commercial fishing and recreational boating industries shall be protected and, where feasible, upgraded. Existing commercial fishing and recreational boating harbor space shall not be reduced unless the demand for those facilities no longer exists or adequate substitute space has been provided. Proposed recreational boating facilities shall, where feasible, be designed and located in such a fashion as not to interfere with the needs of the commercial fishing industry.

30234.5. The economic, commercial, and recreational importance of fishing activities shall be recognized and protected.

The proposed activity constitutes dredging and filling of open coastal waters, and as such, along with the overall resource protection and water quality policies of the Coastal Act quoted above, it must also comply with the allowable use, alternatives, and mitigation tests of Section 30233. Part of the dredging has already been authorized and found consistent with the Coastal Act in consistency determination CD-54-95 (Army Corps, Queens Gate Main Channel dredging). EPA and the Corps (in the accompanying negative determination ND-38-00) propose to modify the disposal location for the portion of this material needed for the pilot capping project. The remainder of the dredging is new work and consists of dredging material from a borrow site called "Area AIII" (Exhibit 5 - see also accompanying negative determination ND-51-00). The Commission determined the Queen's Gate dredging an allowable use under Section 30233(a)(1) because it constituted "New or expanded port, energy, and coastal-dependent industrial facilities." The proposed dredging of AIII borrow site material, as well as the disposal of both types of material in this pilot capping project, constitute an allowable use under Section 30233(a)(7) as a "restoration" project, because it would restore the area as nearly as possible (without incurring greater environmental damage) to the condition it was in prior to the DDT and PCB discharges.

Moving to the alternatives analysis, as described below EPA and the Army Corps have conducted detailed studies of available options for remediating Palos Verdes Shelf contamination problems. EPA states:

> *In-situ capping is defined as the placement of a covering or cap of clean material over the deposit of contaminated sediment, thereby isolating it from the environment and preventing DDT and PCBs in the sediment from diffusing into the water column and/or entering the food web. An initial assessment of the technical feasibility of in-situ capping was included in the overall evaluation of options for sediment remediation completed in 1994 as part of the Southern California Natural Resources Damage Assessment (Palermo, 1994). A number of options for sediment restoration have been evaluated as part of EPA's investigation of the PV Shelf (USEPA, 1997), and EPA has identified in-situ capping as the most feasible response action that could be taken in the near term to address human health and ecological risks at the site. In-situ capping is a proven technology that is effective for isolating contaminated sediments.*
>
> *As part of EPA's investigation, the U.S. Army Corps of Engineers (USACE) Waterways Experiment Station (WES) performed a detailed evaluation of the feasibility and effectiveness of in-situ capping options for the Palos Verdes Shelf. The evaluation included prioritizing areas of the PV Shelf to be capped, determining appropriate cap designs, developing a general operations plan for placement of the cap, developing a monitoring plan to ensure successful cap placement and assess long term cap effectiveness, and developing preliminary cost estimates. The complete capping options study is published as a WES report titled "Options for In Situ Capping of Palos Verdes Shelf Contaminated*

> *Sediments"[4]). ... The results of the WES study were incorporated into an Engineering Evaluation/ Cost Analysis (EE/CA) report prepared by EPA to evaluate the need for response actions such as in-situ capping and to evaluate the feasibility of capping options (USEPA, 2000).*

These alternatives evaluations looked at a broad spectrum of potential actions, including "no action," institutional controls, direct removal and treatment of the material, and various alternative forms of capping (summarized in chart form in Exhibit 10). Institutional controls include recreational fishing advisories (already in place), as well as: (1) improved enforcement and monitoring of fisheries controls; (2) increased awareness and effectiveness through public education and outreach programs; and (3) expanded fisheries controls by increasing the area of the closure. These controls are being considered in the interim, because capping would not achieve immediate reductions in DDT or PCB levels in fish tissue. However, EPA does not believe they would adequately reduce present ecological risks and, therefore, that taken alone they would fail to fully achieve the response objectives.

In situ containment (or capping) is proposed in this consistency determination for the PV *shelf*, and will possibly be the long-term measure selected, but not for the slope seaward of the shelf (Exhibit 2). EPA believes that capping sediment on the slope is infeasible due to seismic instability.

Removal and treatment (or disposal) alternatives include: (1) confined disposal facilities (without treatment); (2) contained aquatic disposal (without treatment); (3) disposal in deep, offshore basins (without treatment); (4) disposal at permitted upland sites (without treatment); and (5) various treatment technologies followed by landfill disposal. Confined and contained disposal alternatives were rejected due to significant adverse environmental impacts, high costs relative to in-place capping, and inconsistency with state and federal environmental laws. Deep ocean disposal was rejected because dredged sediments would not meet existing standards for ocean disposal (in addition, a new ocean disposal site would need to be designated). Upland disposal alternatives were rejected due to prohibitive costs (see Exhibit 10), the need for extensive treatment, and limited landfill capacity or suitable areas for upland treatment. The Commission agrees with EPA that, given the currently available information, in-situ capping appears to be the least environmentally damaging feasible response action that could be taken in the near term to address human health and ecological risks at the site.

Concerning the proposed pilot demonstration project itself, the project is being proposed to assist in the alternatives analysis for the long-term capping. Alternatives under consideration for the pilot project are limited to the type of dredge plant, methods of disposal, grain size alternatives, and cap area and thickness. EPA states:

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[4] Report number TR-EL-99-2, available via the WES web site at http://www.wes.army.mil/el/elpubs/pdf/trel99-2.pdf) (Palermo et al., 1999)

> *The proposed pilot project involves dredging and transporting clean sediments to the PV Shelf site where they will be disposed in a controlled manner to construct a demonstration cap over a small area within the contaminated sediment deposit. The proposed pilot project will allow EPA to evaluate cap construction methodologies and short-term impacts in the field. WES technical studies have evaluated the feasibility of in-situ capping at the Palos Verdes Shelf (Palermo et al., 1999), but there are many site-specific factors (e.g., water depth, slope, and the soft-bottom nature of the site) that justify a demonstration project prior to commitment of funds to a full-scale capping project. The detailed monitoring that will be conducted as part of this demonstration project will enable EPA to evaluate some of the uncertainties regarding the most effective cap placement methods and the suitability of fine-grained versus coarse-grained sediments for cap construction, as well as the extent of construction-related impacts on the marine environment.*

Concerning capping thickness and cap area options, EPA states:

> *Two capping approaches were considered in TR EL-99-2 for selected areas of the shelf: 1) placement of a Thin Cap (design thickness of 15 cm) which would isolate the contaminated material from shallow burrowing benthic organisms, providing a reduction in both the surficial sediment concentration and contaminant flux, and 2) placement of an Isolation Cap (design thickness of 45 cm) which would be of sufficient thickness to effectively isolate the majority of benthic organisms from the contaminated sediments, prevent bioaccumulation of contaminants and effectively prevent contaminant flux for the long term.*
>
> *The shelf area presently under consideration for capping lies between the 40- and 70-m depth contours (in TR EL-99-2, this area was defined as two separate capping prisms: prism A centered over the "hot spot", and prism B located northwest of the "hot spot"). If capping is selected as a remedy for the PV Shelf, the operations would be done in an incremental fashion until the total selected area was capped. Since the area that is being considered for capping is large (on the order of several square kilometers), capping placement cells 300 by 600 m have been defined for purposes of managing the placement of material and monitoring.*

Concerning dredge equipment alternatives, EPA states:

> *A hopper dredge will be used to accomplish all dredging and cap placement for the pilot capping project. A hopper dredge is preferable for several reasons, including:*

> *1. Hopper dredges provide better control of placement in the open ocean environment and allow for more flexibility in placement options to include pumpout capabilities; and*
>
> *2. Hopper dredges remove material from channels by hydraulic means, resulting in a breakdown of any hardpacked material and addition of water as material is stored in the hopper for transport. Material from hopper dredges is therefore more easily dispersed in the water column, and would settle to the seafloor with less energy and less potential for resuspension of the contaminated sediment.*

Finally, concerning dredge site alternatives, the Queens Gate/Main Channel is already being dredged. Moreover, the Army Corps notes in its Draft Environmental Assessment for Borrow Area AIII dredging (submitted with ND-51-00) that alternative dredge sites for these coarser sediments would be more environmentally damaging because they would necessitate greater transportation distances (i.e., they are farther to the east – see Exhibit 5), thereby increasing air quality impacts and fuel usage.

Given the above discussion, the Commission agrees with EPA that the project represents the least environmentally damaging feasible alternative and, further, that the project is designed to assist future alternatives analysis to enable any *long-term* capping activity to be implemented in the least environmentally damaging manner.

Concerning the mitigation test of Section 30233, the material proposed for disposal has been tested and is suitable for open ocean disposal. The Queens Gate/Main Channel material was tested prior to Commission concurrence with the Army Corps' original consistency determination for that project (CD-54-95). The Corps and EPA tested the Borrow Area AIII material this year. While disposal of the clean sandy material should only involve short term turbidity and smothering impacts, impacts generally considered insignificant absent the presence of environmentally sensitive habitat, the potential for resuspension of the underlying contaminated sediments must be weighed against the habitat benefits of capping the contaminated sediments. EPA analyzes these project impacts as follows:

> *Oceanography and Water Quality*
>
> *The pilot capping project will result in impacts to the area where the pilot cap is constructed (i.e., the Palos Verdes Shelf). Temporary physical and chemical changes in water quality characteristics will occur because of stripping losses during placement of cap material, resuspension of cap material when it impacts the ocean floor, and the potential resuspension of the contaminated Palos Verdes Shelf sediments. Impacts may include increases in turbidity and suspended solids levels in the immediate vicinity of capping operations. Increased turbidity would*

result in a decrease in light penetration. High levels of turbidity are usually restricted to the immediate vicinity of the capping area and tend to dissipate rapidly.

Stripping losses (i.e., the slow settling of finer grain size particles) would be greater for Queen's Gate sediments than for the AIII sediments. The primary method of placing Queen's Gate sediments will be through conventional disposal (i.e., point dumping) in order to minimize stripping losses. If a spreading method of placement is used with these sediments, it will be by pumping out the hopper through the lowered drag arm of the hopper dredge. Such an approach will make the effective point of release approximately 80 feet below the water surface, thereby minimizing any water quality impacts in the upper water column.

The DDT- and PCB-contaminated sediments on the Palos Verdes Shelf are present as a result of the discharge of these contaminants in partially-treated wastewater, or effluent, from the Los Angeles County sewer system through the ocean outfall pipes off Whites Point. The resulting effluent-affected sediment is fine-grained, with a higher organic carbon content than native sediments. DDT and PCB levels in the water over the Palos Verdes Shelf, although very low due to the hydrophobic nature of these contaminants, are still above both the California Ocean Plan water quality objectives and federal water quality criteria. Resuspension of contaminated sediments may result in desorption and a temporary increase in DDT and PCB levels in the water column in the immediate vicinity of the capping cell.

It is our best professional judgment that resuspension and/or desorption of contaminants as a result of capping activities will be negligible in magnitude and highly localized. One of the objectives of the pilot capping project is to assess the scope and extent of resuspension and/or desorption prior to committing resources to a full-scale capping effort. Monitoring and cap placement have been designed so that if significant resuspension and/or desorption occurs, it will be detected early and either measures will be taken to prevent such resuspension/desorption, or the project will be halted pending further analysis of monitoring data and consultation with the appropriate agencies. [Emphasis added]

Marine Resources

Cap placement activities will cause a disturbance and some redistribution of bottom sediments in the vicinity of the cap placement cells during the period of cap placement (approximately 3 months). Some invertebrates within the cap footprint, especially small crustaceans and benthic infauna, may be smothered, while motile organisms would relocate to areas outside the zone of impact. Invertebrates, epifauna and infauna may be exposed to elevated suspended sediment concentrations during cap placement. These conditions may cause some *clogging of gills and suspension feeding apparatuses, resulting in smothering of invertebrates outside the cap footprint but within the immediate vicinity. Invertebrate populations are expected to recover upon completion of the pilot project, although the distribution of species in the cap footprint may be somewhat altered because of the different physical and chemical nature of the cap material. To the extent that benthic organisms in the pilot cell area are serving as a mechanism for DDT and PCB in the sediments to enter the food chain, their elimination and replacement with organisms living in the cleaner cap material will have a positive effect on the marine ecosystem.*

Suspended solids from the pilot capping project may be carried by onshore currents towards the kelp beds that are present along the Palos Verdes peninsula. As part of its Feasibility Study of options to control impacts from the ongoing Portuguese Bend landslide, USACE has studied the kelp beds and determined that, due to the landslide, they are somewhat degraded. The landslide is a constant source of turbidity to those kelp beds. Nevertheless, the kelp beds are still doing well. Due to the distance and short-term nature of the pilot capping project, EPA believes that the there will not be any significant impacts to kelp beds. However, as part of the monitoring program, EPA will be evaluating the transport of suspended solids from the pilot capping area to the kelp beds.

Threatened and endangered species: The following listed species may occur in the study area of this project:

- *California least tern (Stern antillarum browni) - endangered*
- *Brown pelican (Pelecanus occidentalis) – endangered*
- *Bald eagle (Haliaeetus leucocephalus) - threatened*
- *Peregrine falcon (Falco peregrinus) – delisted, species of concern*

EPA has determined that cap placement will take place in deep water sufficiently removed from the shallow water foraging areas used by the California least tern so as to have no effect on this listed species. EPA has also determined that the placement of dredged materials at the Palos Verdes Shelf will not have an effect nor jeopardize the continued existence of any other federal listed threatened or endangered species. Formal consultation pursuant to Section 7 of the Endangered Species Act is not required for this pilot project implementation.

In addition to this impacts analysis, EPA has included monitoring for both temporary project impacts, as well as for further assisting the ultimate design of any long-term capping project on the Palos Verdes shelf. EPA has incorporated an "Operations and Monitoring Plan (Appendix B) (Exhibit 8), which describes the overall scope and objectives of the cap placement monitoring plan. The monitoring/sampling techniques will include sediment cores, shear strength tests on sediment core subsamples, side-scan sonar, sediment profiling, fixed (bottom-moored) and ship-deployed optical back scatter (OBS)/acoustic Doppler current profile

(ADCP) meter arrays, and water column samples. EPA will also collect hopper dredge operation data that includes positioning during placement, load volume, time to release material, and samples of hopper inflow and overflow for grain size and other geotechnical properties.

The monitoring program will collect data before, during and after cap placement. The monitoring plan has been designed to enable the EPA to address key short and intermediate term questions relative to capping on the Palos Verdes Shelf, including:

1. Does placement occur as modeled (e.g., how far does the cap material spread, how many loads does it take to achieve a desired cap thickness, what are the effects of water depth, slope and material type, and are there any indications of turbidity flows or mudwaves)?
2. Can a uniform cap be constructed?
3. Can disturbance to in-place sediments be kept within tolerable limits?
4. Does the cap remain clean?
5. Does the cap remain stable during and after placement?

EPA further states:

> *The construction of the field pilot study cap is anticipated to occur over a time period of several weeks, and the associated monitoring effort will focus on short term processes associated with cap construction. The pilot study would therefore meet several objectives related to capping operations and processes occurring during and shortly after cap material placement. A full-scale monitoring program to be conducted during any placement of a full-scale cap and in the years to follow would additionally include activities aimed at long-term processes which could not be easily observed during the time period available for a pilot study (e.g. erosion during storm events or migration of contaminants due to diffusive processes). Depending on the time scales in which the pilot cap is left in place prior to any full scale cap placement, there may be opportunity to obtain data from the pilot area related to such long-term processes, but such activities are not included in the present pilot scope.*

Concerning longer-term monitoring, EPA further states:

> *The monitoring scope that has been developed for the Pilot project does not include far field or long term monitoring, though this scope will be prepared when requested by the EPA project managers. TR EL-99-2* [Options for In Situ Capping of Palos Verdes Shelf Contaminated Sediments] *provides the outline for that effort, but briefly, it would include coring, sediment profile camera surveys, and sub-bottom profiles.*

> *Several other items related to monitoring are not explicitly addressed in this plan. This includes determination of the abundance of deep burrowers, reductions in water column contaminant concentrations, verification of the diffusion model, and reductions in tissue levels in resident benthic or fishery species. If EPA decides to proceed with a full-scale capping remedy, a detailed monitoring program to address long term questions would be included.*

Heal the Bay has commented on EPA's proposal (Exhibit 9) and requested additional data gathering, including longer term monitoring, as well as experimenting with a thicker cap, dredging during "worst-case" tidal conditions, disposal in areas with deep burrowing organisms, monitoring benthic communities and kelp beds. Nevertheless, Heal the Bay also states that it "... supports EPA's decision to move to a pilot capping approach in order to provide additional information before final remediation decisions are made."

Finally, EPA has agreed to submit its monitoring reports to the Commission staff when they are available. In conclusion, with the monitoring plan incorporated into the project, the Commission finds that the project represents an allowable use under the Coastal Act, is the least environmentally damaging feasible alternative, and does not necessitate any mitigation measures beyond the monitoring (and modification (subject to potential further consistency review) in the event the monitoring detects impacts (e.g., cap placement not occurring as predicted, or if resuspension of contaminants exceed expectations)). The Commission therefore concludes that the project is consistent with the marine resources, water quality, and commercial and recreational fishing policies (Sections 30230, 30231, 30233, 30234, and 30234.5) of the Coastal Act.

VII. SUBSTANTIVE FILE DOCUMENTS:

1. *Environmental Information Document for Pilot Cap Placement, Palos Verdes Shelf Capping Demonstration Project,* U.S. Environmental Protection Agency, May 2000.

2. *Options for In Situ Capping of Palos Verdes Shelf Contaminated Sediments,* Technical Report EL-99-2, U.S. Army Engineer Waterways Experiment Station, Palermo, Michael, Paul Schroeder, Yilda Rivera, Carlos Ruiz, Doug Clarke, Joe Gailani, James Clausner, Mary Hynes, Thomas Fredette, Barbara Tardy, Linda Peyman-Dove, and Anthony Risko, Vicksburg, MS., 1999.

3. *Screening Evaluation of Response Actions for Contaminated Sediment on the Palos Verdes Shelf,* U.S. Environmental Protection Agency, July 1997.

4. Consistency Determination CD-54-95, Army Corps, Main Channel Deepening project.

5. Negative Determination ND-63-98, Army Corps, Modifications to Main Channel Deepening project.

6. Negative Determination ND-38-00, Army Corps, Modifications to Main Channel Deepening project for EPA pilot capping project.

7. Negative Determination ND-51-00, Army Corps, Dredging/Transportation of AIII Borrow Site material for EPA pilot capping project.

8. *Draft Environmental Assessment for Borrow Site Dredging and Transportation, Palos Verdes Shelf Capping Demonstration Project,* U.S. Army Corps of Engineers, May 2000.

9. *Draft Supplemental Environmental Assessment for Palos Verdes Shelf Capping Demonstration Project,* U.S. Army Corps of Engineers, April 2000.

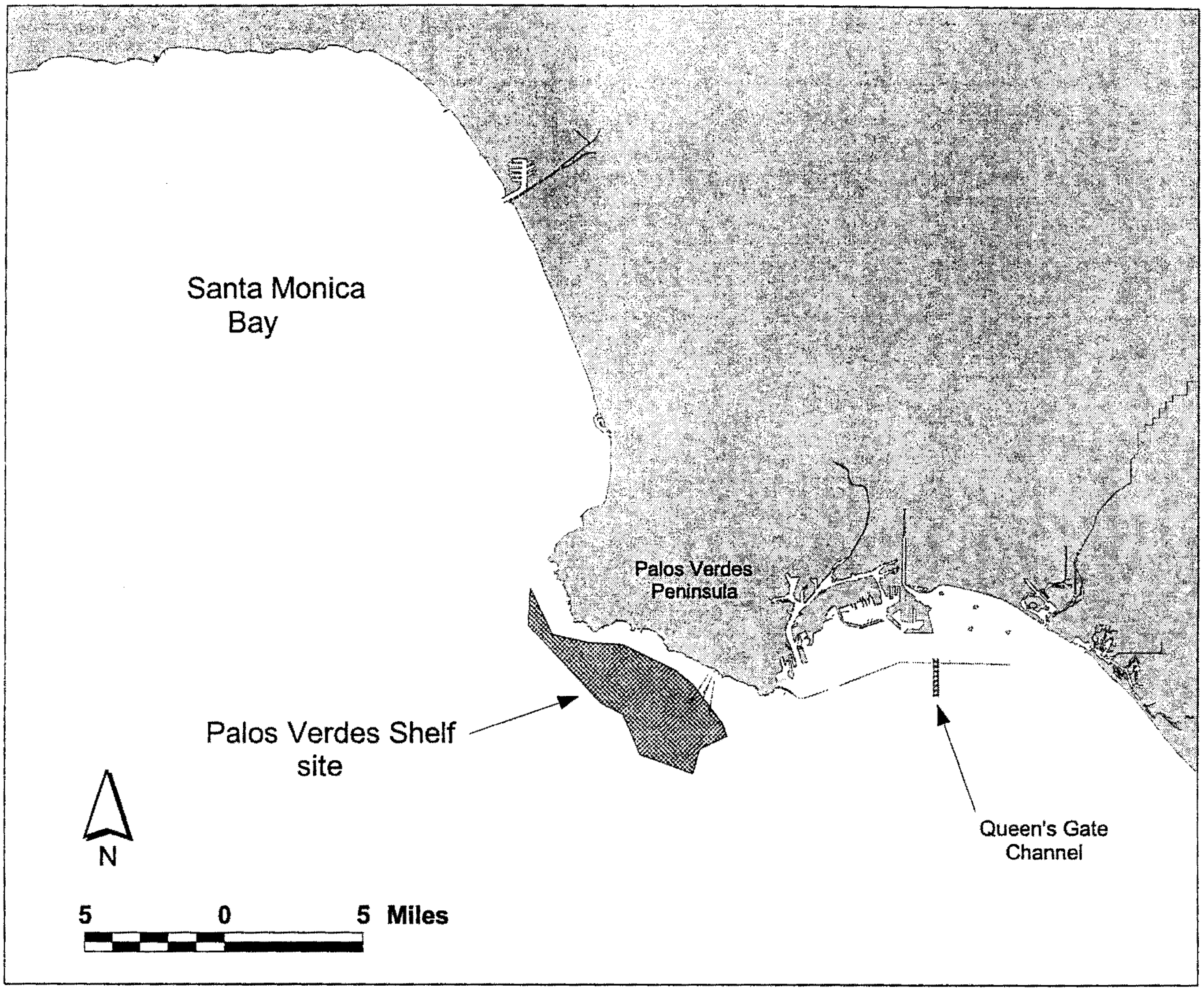


Figure 1. Project Location

EXHIBIT NO. 1	
APPLICATION NO.	
CD-52-00	

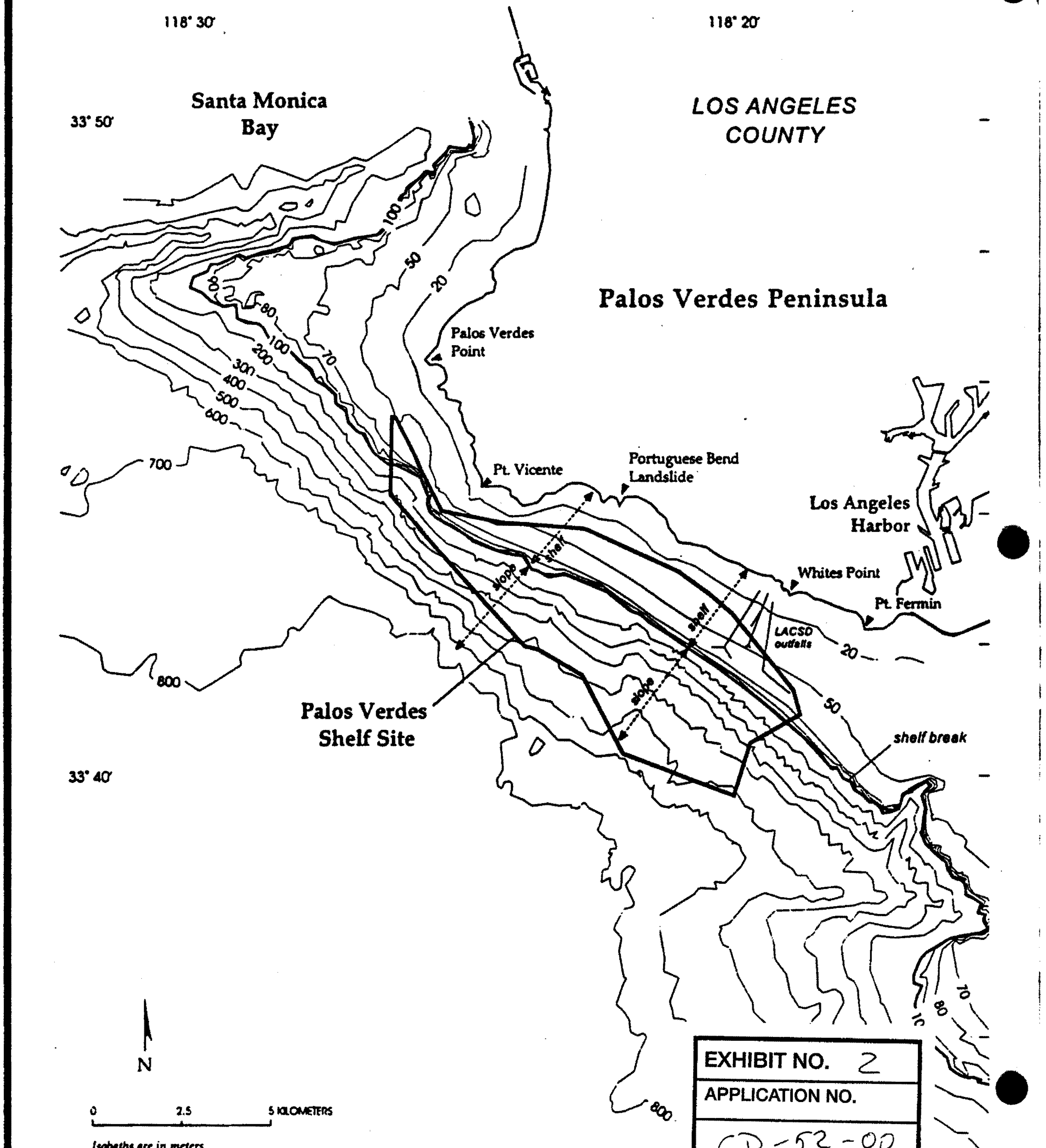


EXHIBIT NO. 2

APPLICATION NO.

CD-52-00

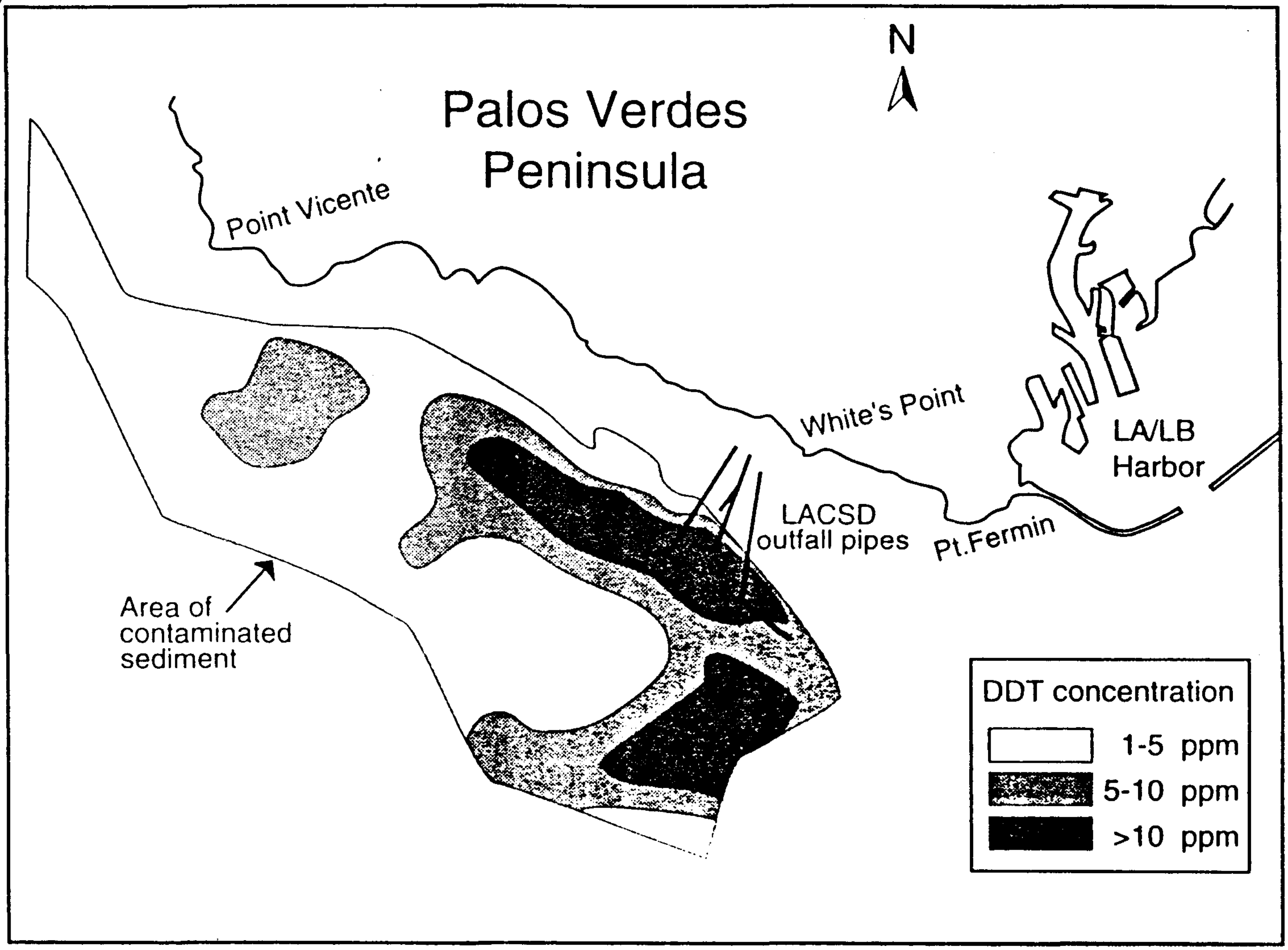


EXHIBIT NO. 3
APPLICATION NO.
CD-52-00

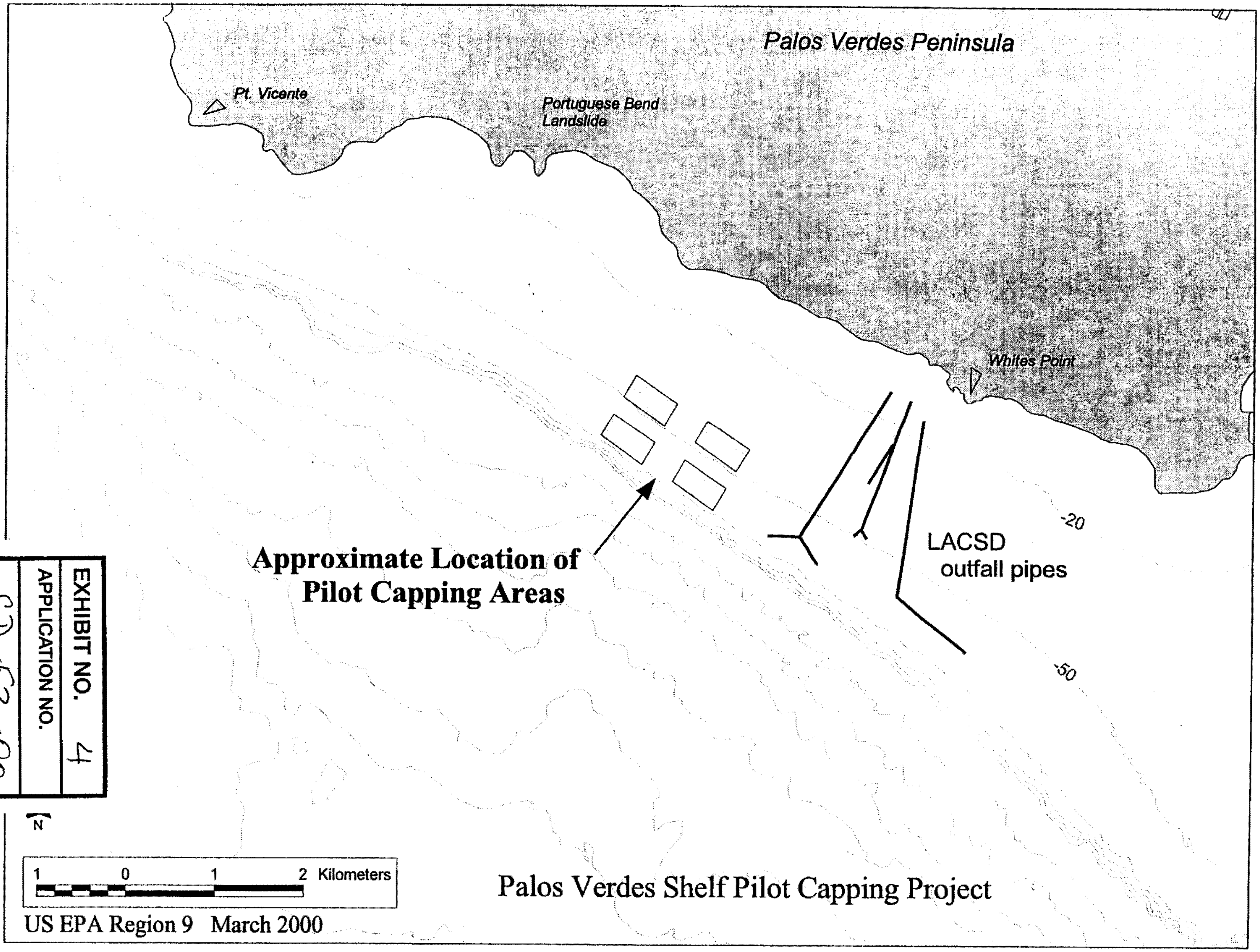
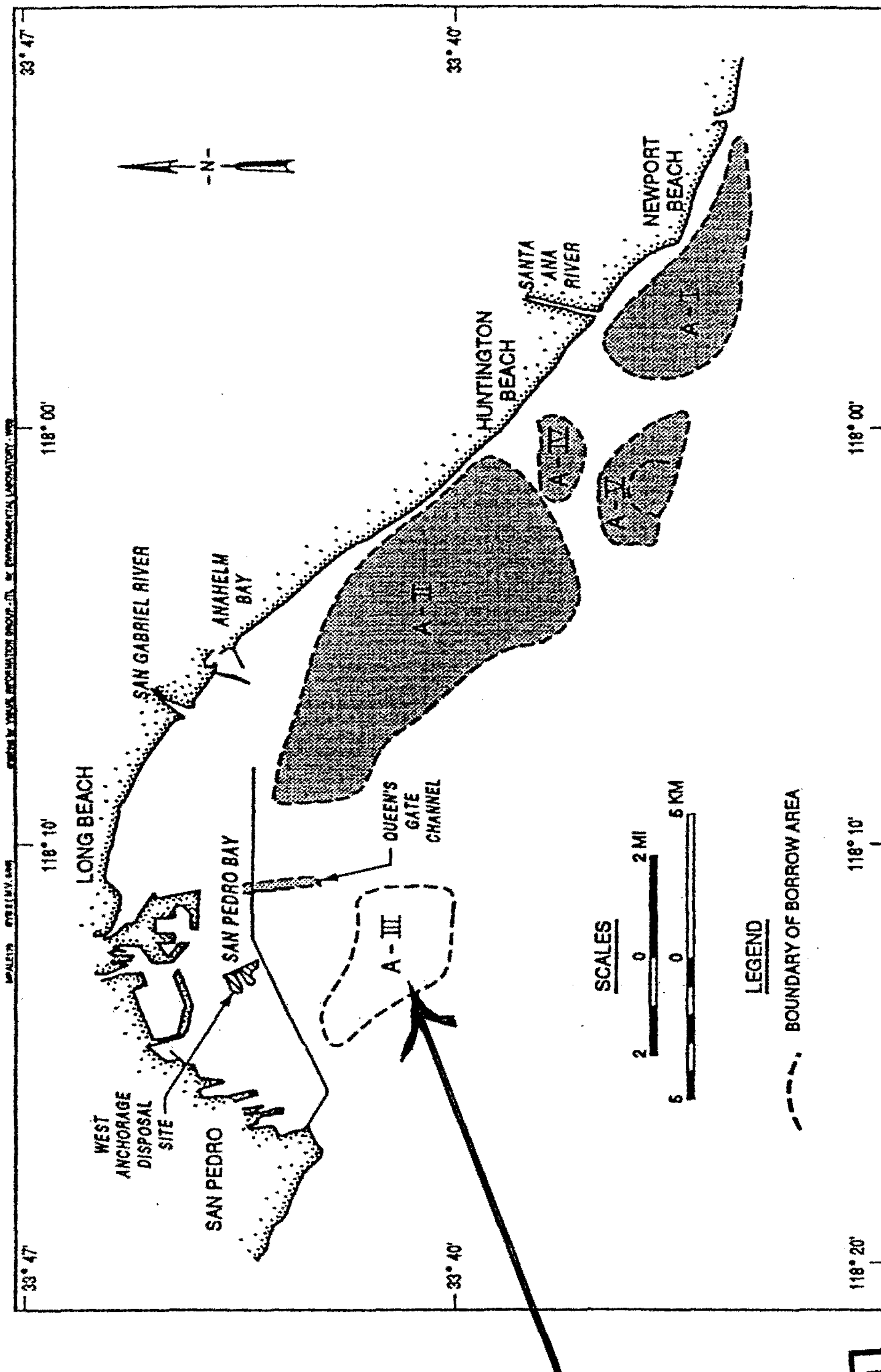


Figure 3. Location of Pilot Capping Cells

EXHIBIT NO. 4
APPLICATION NO. CD-52-00

FIGURE 2. Potential Borrow Sites



Map showing potential cap material sources

BORROW AREA AIII
(and other potential borrow sites)

EXHIBIT NO. 5
APPLICATION NO. CD-52-00

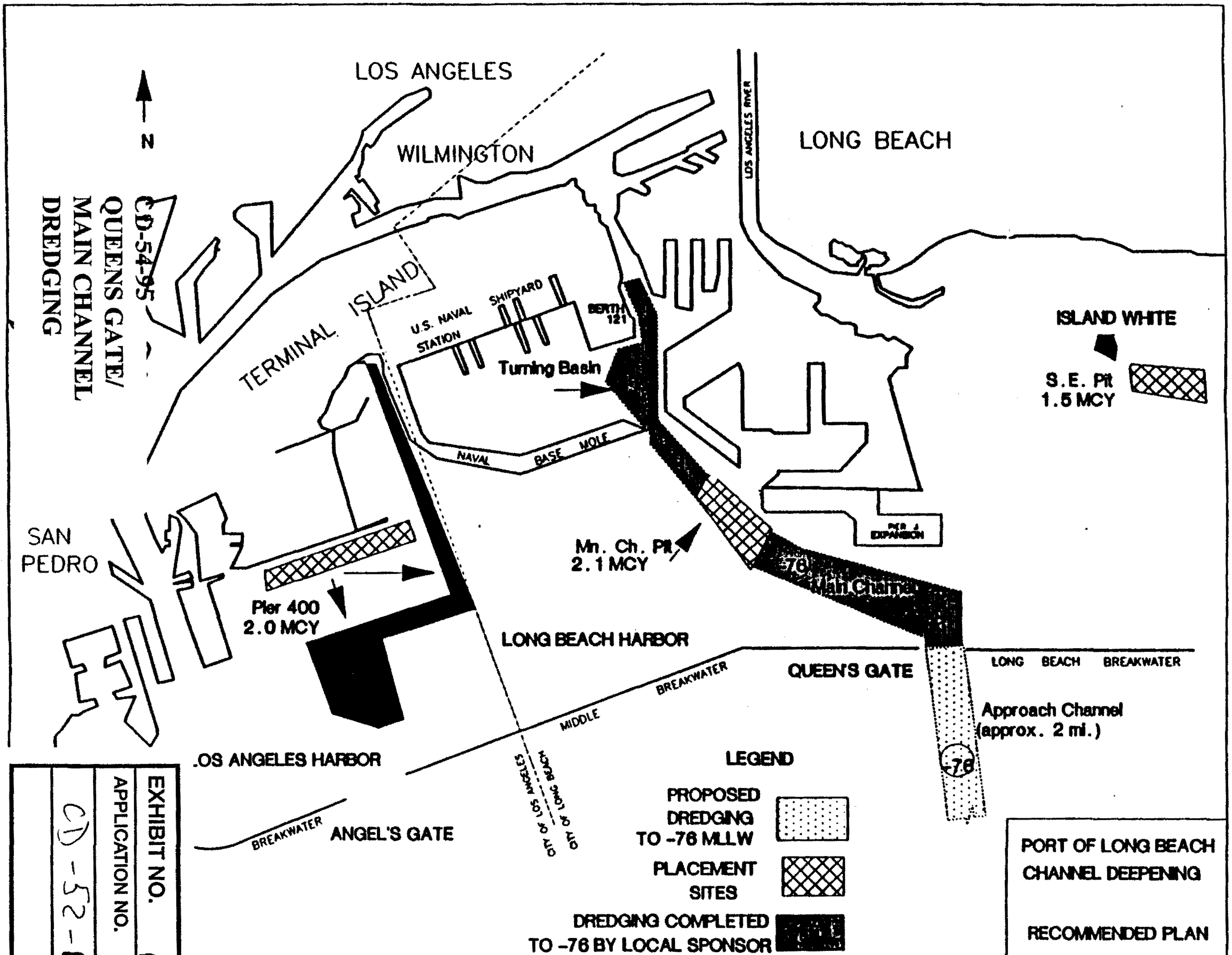
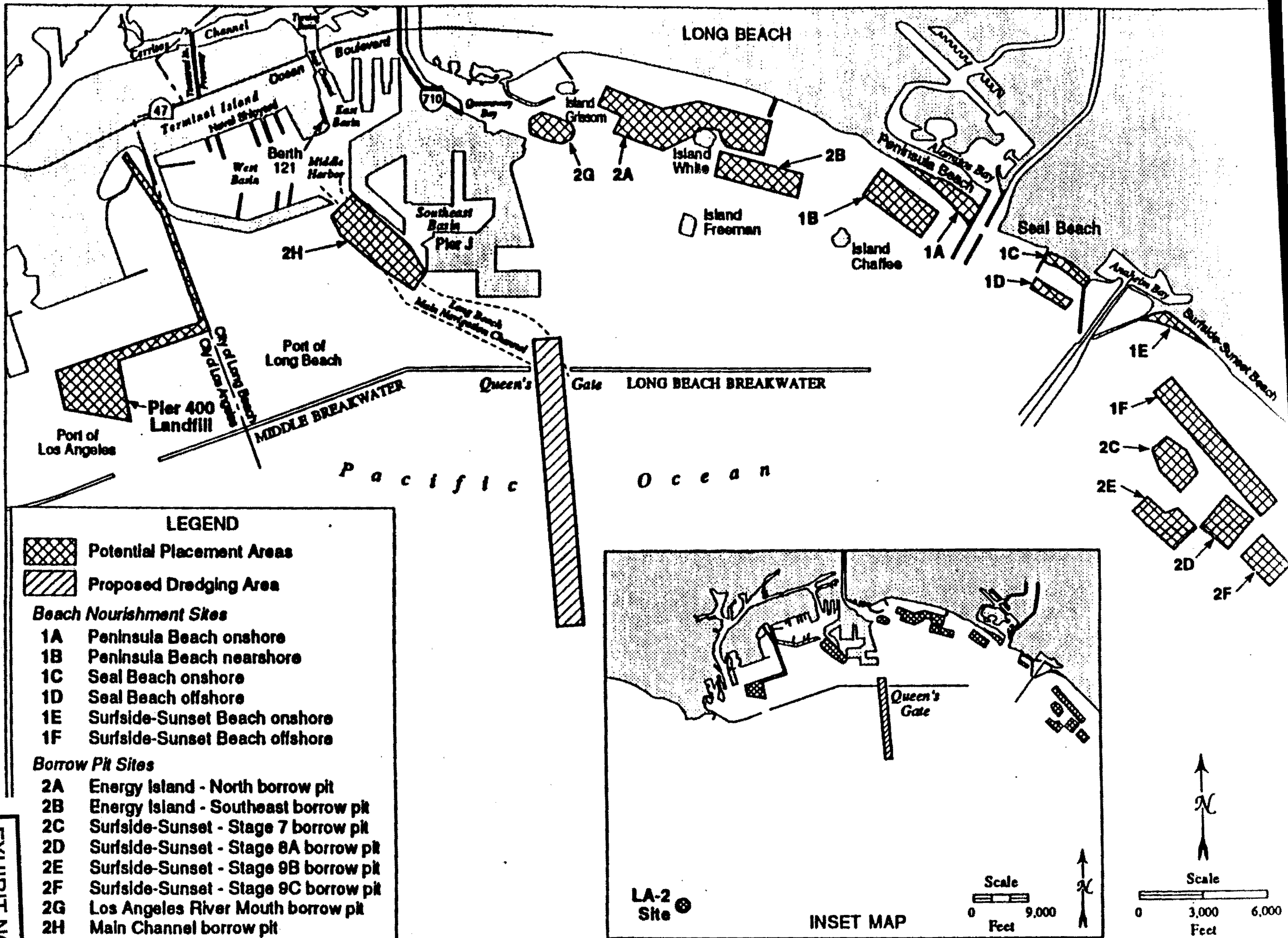


FIGURE 2. RECOMMENDED DREDGED MATERIAL PLACEMENT AREAS.

EXHIBIT NO. 6
APPLICATION NO. CD-52-00

CD-54-95
QUEENS GATE/
MAIN CHANNEL
DREDGING



...ure 3-1. Proposed Dredge Site and Sediment Placement Sites ...tially Considered for Queen's Gate Deepening Project

EXHIBIT NO. 7
APPLICATION NO. CD-52-00

Field Pilot Study of In-Situ Capping of Palos Verdes Shelf Contaminated Sediments-Operations and Monitoring Plan

Background

The U.S. Environmental Protection Agency (EPA) is continuing its investigation regarding the feasibility of in-situ capping all or a portion of the dichlorodiphenyltrichloroethane (DDT) and polychlorinated biphenyl hydrocarbons (PCB) contaminated sediments on the Palos Verdes (PV) shelf off the coast of Los Angeles, California. In-situ capping is defined as the placement of a covering or cap of clean material over the in-situ deposit of contaminated sediment.

The U.S. Army Corps of Engineers (USACE) has performed an evaluation of in-situ capping options for Region 9. The evaluation included prioritizing areas of the PV shelf to be capped, determining appropriate cap designs, developing an equipment selection and operations plan for placement of the cap, developing a monitoring plan to ensure successful cap placement and long term cap effectiveness, and developing preliminary cost estimates. The complete capping options study is published as USACE Waterways Experiment Station report TR-EL-99-2 (**http://www.wes.army.mil/el/elpubs/pdf/trel99-2.pdf**).

EPA region 9 has recently entered into an interagency agreement with the USACE Los Angeles District (LAD) to provide technical support for ongoing needs at the PV Shelf Site to include tasks related to Pre-Design Data Collection & Studies. One aspect of the pre-design studies is a field pilot study of cap placement on the shelf. This document serves as the operations and monitoring plan for the field pilot study.

Description of In-Situ Capping Options

Two capping approaches were considered in TR EL-99-2 for selected areas of the shelf: 1) placement of a Thin Cap (design thickness of 15 cm) which would isolate the contaminated material from shallow burrowing benthic organisms, providing a reduction in both the surficial sediment concentration and contaminant flux, and 2) placement of an Isolation Cap (design thickness of 45 cm) which would be of sufficient thickness to effectively isolate the majority of benthic organisms from the contaminated sediments, prevent bioaccumulation of contaminants and effectively prevent contaminant flux for the long term.

The shelf area presently under consideration for capping lies between the 40- and 70-m depth contours (in TR EL-99-2, this area was defined as two separate capping prisms: prism A centered over the "hot spot", and prism B located northwest of the "hot spot"). If capping is selected as a remedy for the PV Shelf, the operations would be done in an incremental fashion until the total selected area was capped. Since the area that is being considered for capping is large (on the order of several square kilometers), capping placement cells 300 by 600 m have

EXHIBIT NO.	8
APPLICATION NO.	CD-52-00

been defined for purposes of managing the placement of material and monitoring[1].

Pilot Study Objectives and Approach

The overall objective of the field pilot study is to demonstrate that a cap can be placed on the shelf as intended by the design and to obtain field data on the short-term processes and behavior of the cap as placed.

Specific objectives to be addressed as a part of the pilot include:

1. Demonstrate that an appropriate cap thickness can be placed with an acceptable level of variability in cap thickness.
2. Demonstrate that excessive resuspension of existing sediments and excessive mixing of cap and contaminated sediments can be avoided.
3. Demonstrate that excessive losses of cap materials can be avoided.
4. Determine, to the degree possible, the effect of variable cap material type, bottom slope, water depth, and placement method (e.g., conventional versus spreading) on cap thickness and sediment displacement and resuspension.
5. Demonstrate the effectiveness of the cap with respect to short-term isolation of contaminants during the initial advective flow resulting from sediment consolidation.
6. Demonstrate the ability to monitor operations and success.
7. Evaluate and modify, where needed, all operational and monitoring approaches.
8. Improve the knowledge base contributing to decisions on implementation of a full scale cap.

The construction of the field pilot study cap is anticipated to occur over a time period of several weeks, and the associated monitoring effort will focus on short term processes associated with cap construction. The pilot study would therefore meet several objectives related to capping operations and processes occurring during and shortly after cap material placement. A full-scale monitoring program to be conducted during any placement of a full-scale cap and in the years to follow would additionally include activities aimed at long-term processes which could not be easily observed during the time period available for a pilot study (e.g. erosion during storm events or migration of contaminants due to diffusive processes). Depending on the time scales in which the pilot cap is left in place prior to any full scale cap placement, there may be opportunity to obtain data from the pilot area related to such long-term processes, but such activities are not included in the present pilot scope.

The pilot study approach consists of controlled operations for placement of capping material within selected areas on the PV shelf and associated monitoring prior to, during, and following the placements. Operational aspects for the pilot include the selection of appropriate placement areas for the pilot, capping materials, and placement techniques. Monitoring aspects for the pilot include cap thickness as placed, mixing of cap and contaminated sediments, resuspension of contaminated sediments during cap placement, short term cap benthic recolonization, and short term physical and chemical characteristics of the cap and underlying sediments immediately after capping and following initial sediment consolidation.

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[1] It should be noted that a grid of 56 capping placement cell locations was defined in TR EL-99-2 for purposes of volume and cost estimates for various capping options, however, these cell locations are not considered "cast in concrete" for purposes of either the pilot or any full scale capping operation. A new grid has been defined for purposes of the pilot with cells as shown in Figure 1 .

The remainder of this Operations and Monitoring Plan is divided into the following sections:

- Selection of Pilot Capping Placement Areas
- Selection of Cap Material Sources
- Placement Equipment and Contract Arrangements
- Pilot Cap Thickness and Volume
- Refined Model Predictions
- Sequence of Placement Operations
- GIS-Based Project Management Tools
- Monitoring Requirements
- Reports and Interpretation
- References
- Appendix A - Monitoring Scope of Work

Selection of Pilot Capping Placement Areas

Specific considerations for selection of the pilot placement locations include:

1. To the extent possible, placement locations for the pilot should be representative of the overall range of conditions within the total anticipated capping prism for a full scale remediation.
2. Different pilot placement locations will be necessary to demonstrate the effect of water depth, bottom slope, cap material type, and placement method on cap thickness and sediment resuspension.
3. Physical bottom material type in the pilot placement areas should be clearly distinguishable from capping material. This requirement would be met by any location with surficial fine-grained effluent-affected (EA)sediment, since the capping material is anticipated to be composed of fine sandy sediment.
4. The thickness of the EA sediment in the pilot placement areas should be greater than the maximum depth of EA sediment resuspension that will occur during placement. The thickness must also be sufficient to measure the effects of advection due to consolidation. The mixing thickness requirement with respect to resuspension would be met with any location with surficial fine-grained EA sediment thickness in excess of 10 cm. The thicker the EA deposit, the easier the measurement of advection effects.
5. The level of surficial EA sediment contamination (upper few cm) for the pilot placement areas will affect whether water column measurements of contaminants (DDT and/or PCBs) can be used to evaluate resuspension and transport. Areas with lower ranges of surficial contamination (i.e. a few mg/kg DDT) have low potential for water column release. Areas with higher ranges of surficial contamination (i.e. 10 to 20 mg/kg DDT) would provide conservative (worst-case) data on resuspension and water column release.
6. There are concerns related to placement of capping materials directly over or immediately adjacent to the LACSD outfall pipes. Until the nature of cap accumulation is demonstrated, cap placements should NOT be located directly over or immediately adjacent to LACSD outfall pipes.
7. Recontamination of the pilot cap during cap placement may complicate the interpretation of pilot study results, and if such recontamination occurs following placement (e.g., due to transport of contaminated sediments from uncapped areas "upcurrent " of the pilot cap), the area may have to be capped a second time if EPA

decides to proceed with a full-scale capping remedy. The potential for such recontamination will vary depending on pilot cell locations (among other things). The prevailing bottom current is from southeast to northwest, so locations to the southeast are preferable from this standpoint.

8. The southeastern boundary of capping Prism A as defined in TR EL-99-2 is currently based on the EA sediment footprint as defined by the 1994 USGS box core data. LACSD data indicate that EA sediment extends well to the southeast of this boundary, although thickness and contaminant concentrations decrease as well. This area is not well characterized in terms of sediment core data. Additional data is needed to further define the most appropriate boundary which should be considered for capping, including any decision to locate the pilot capping cells in this area.
9. The size of the pilot capping area(s) should be sufficiently large to avoid interference between intentionally separate placements (using different placement methods and/or cap materials) and to allow for demonstrating the effect of multiple placements in building the desired cap thickness. Modeling results indicate the size of a footprint of measurable cap thickness accumulation resulting from a single conventional placement is about the size of a single 300 by 600 meter capping cell. Therefore a buffer of approximately 300 to 600 m between capping cells and/or separate placements should be sufficient to avoid interference between intentionally separate placement events (whether they are single hopper loads or multiple loads within a cell). Also, mulitple placements within a single capping cell would result in deposits sufficiently large to observe the buildup effect.

Based on the above considerations, four 300 by 600 meter capping placement cells are recommended for the pilot. One pair of cells would be located adjacent to the landward limit of the capping area in a comparatively shallow site with comparatively flat bottom slope (40 m to 45m depth contour with an average slope across the cell of about 1.5 degrees). A second cell pair would be located adjacent to the seaward limit in a comparatively deeper site with steeper bottom slope (60 to 70 m depth contour with average slope across the cell of about 2 degrees). The two cells within each pair would be separated by a full cell length in the along-shore direction and by a full cell width in the perpendicular direction to avoid the potential for interferences during monitoring.

No one area within the identified capping prisms is ideal with respect to all the considerations listed, therefore two potential locales with differing conditions were identified and compared in selecting the pilot cell locations. One locale evaluated for the placement cells is at the southeastern end of capping prism A, in the area roughly bounded by the 40 and 70 m depth contours and between LACSD transects 9 and 10. This area is to the southeast of the terminus of the outfalls, on the "upcurrent" end of the capping area with respect to prevailing bottom currents. There is little USGS boxcore data for this area, however, available LACSD data indicates the EA sediment thickness in this area easily exceeds 10 cm (refer to Figure 60 in Lee et al 1994) and the surficial dichlorodiphenyldichlorothene (DDE) concentration is about 2 mg/kg (refer to Figure 5 in Lee et al 1994). This locale has the advantage of "upstream" location with respect to bottom currents, but the disadvantage of thin EA sediment thickness and low DDE concentration with respect to the overall area.

A second locale evaluated for pilot placement is to the northwest of the terminus of the outfalls. This area is on the "upcurrent" end of the outfalls with respect to prevailing bottom currents. There is good USGS boxcore data coverage for this area. The EA sediment thickness in this area is in excess of 50 cm (refer to Figure 60 in Lee et al 1994) and the surficial DDE concentration is 10 to 20 mg/kg (refer to Figure 5 in Lee et al 1994). This locale has the disadvantage of being "downstream" with respect to bottom currents, with a higher potential for surface recontamination. But the sediment thickness is greater, with easier interpretation of consolidation effects, and the surficial DDE is high, yielding better resolution potential for cores and worst-case resuspension data. This locale is "downstream" with respect to the outfalls, thus minimizing the possibility for interference with outfall operations.

In evaluating and comparing these two locales, the potential disadvantages of recontamination during placement for the northwest locale were deemed acceptable, and this locale was therefore selected for the pilot placements. The four cell locations recommended in this locale are labeled LU (Landward Upcurrent) at cell location F4 in Figure 1, LD (Landward Downcurrent) at cell location F2, SU (Seaward Upcurrent) at cell location H4, and SD (Seaward Downcurrent) at cell location H2. The cell grid in Figure 1 may be adjusted following the collection of baseline data as described below. Pilot placements would occur within the limits of these four cells, but the area monitored would extend to adjacent cells as described below.

Selection of Cap Material Sources

LAD surveyed the region for potential cap material sources as a part of the capping options study and is currently updating available information on borrow sources. Dredged sediments from navigation channels (primarily the Queen's Gate deepening project) and sand borrow areas were identified as the two primary borrow sources, and the cap designs and placement approaches were developed based on those potential sources. Available data for these sources indicate that the materials are variable and are mixtures of fine sands, silts and clays. LAD is currently arranging for additional exploration of both the Queen's Gate and Borrow Areas.

The cap material used for the pilot study must be representative of the materials which would be available for a full scale capping remedy. Other drivers in selection of pilot capping materials are cost and schedule. Use of dredged material from on-going navigation projects will be far less expensive than excavation from borrow sites, since the operational cost attributable to the pilot would be limited to the difference in transportation and disposal cost to the PV shelf as compared to the selected disposal sites. But use of dredged material from the on-going project is dependent on close coordination of navigation dredging schedules and contracts. Use of dredged material from an approved navigation project can also be advantageous for the overall schedule, since the dredging impacts in the channel areas and ocean disposal of the sediments will have already been evaluated, thus making the National Environmental Policy Act (NEPA) process and other regulatory considerations for the pilot project more straight-forward.

The Queen's Gate project is the only on-going navigation project identified to date with sufficient volumes of clean material to conduct the pilot project described in this plan. The material has an in-situ mean grain size of approximately 0.1 mm. Recent sampling has indicated that there may be localized areas with coarser mean grain size. Also, dredging operations for Queen's Gate and any subsequent placement of the materials in rehandling sites such as the West Anchorage site, results in some losses of fines during overflow and placement, with a subsequent "coarsening" of the material. Modeling to date indicates that the Queen's Gate material can be used for cap construction if the conventional method of placement is used. LAD has indicated that the finer material mixtures from Queen's Gate may be representative of much of the material available from the borrow areas. Therefore, in the context of the pilot, use of Queen's Gate is appropriate for demonstration of conventional placement techniques with a finer material type available in the Los Angeles region. LAD is currently considering additional borings in selected areas within and adjacent to the present navigation project to locate coarser grained materials. If such areas are found, they would be appropriate for demonstration of spreading placement techniques with a coarser material type.

Sand borrow areas outside the harbor breakwaters (designated as AII and AIII) have in-situ mean grain sizes in excess of 0.2 mm based on available data. However, these materials are also highly variable, and available data do not allow for fine resolution of grain size distributions within the larger borrow areas. There are also environmentally sensitive areas located within the larger borrow areas corresponding to submerged aquatic vegetation (SAV) and rock "pinnacles" with high fisheries values. LAD is planning to obtain borings in selected portions of borrow areas AII and AIII (water depths less than 80 ft and outside known sensitive areas) to define a source of coarser material for the pilot.

Modeling conducted to date indicates that use of mixtures of fine sand and silt/clay cap material (such as material from Queen's Gate) results in a larger proportional dispersion off-site, and potentially greater spread downslope as compared to a coarser sand (such as from the sand borrow areas). The finer materials will initially be placed using conventional release from the hopper dredge. The coarser materials will initially be placed using a spreading method of placement.

Placement Equipment and Contract Arrangements

Hopper dredges were identified as a preferable placement equipment type in TR EL-99-2, and use of a hopper dredge is anticipated for the pilot. A hopper dredge is the equipment of choice for the pilot capping on the PV shelf for the following reasons:

a. Hopper dredges are currently the most readily available equipment for the pilot work.
b. Hopper dredges provide better control of placement in the open ocean environment and allow for more flexibility in placement options to include pumpout capabilities.
c. Hopper dredges remove material from channels by hydraulic means, resulting in a breakdown of any hardpacked material and addition of water as material is stored in the hopper for transport. Material from hopper dredges is therefore more easily dispersed in the water column, and would therefore settle to the seafloor with less energy and less potential for resuspension of the contaminated sediment.

Current plans call for use of the NATCO Manhattan-class dredge *Sugar Island* for the pilot placements. The *Sugar Island* utilizes a split-hull hopper opening mechanism that can be used to control the rate of release. This dredge is also equipped with a hopper pumpout capability over the bow and water jets to aid in pumpout operations. Pumpout can also be accomplished through the adjustable skimmers within the hopper. NATCO has indicated that, with minor modifications, pumpout can be accomplished through one of the two dragarms, allowing for a submerged point of discharge. Any of these methods of placement could potentially be utilized during the pilot.

Pilot Cap Thickness and Volume

Two objectives of the pilot are drivers in determining the volumes of material necessary for placement for the pilot: 1) the need to determine differences in cap material behavior for differing placement options, and 2) the need to determine the volume of material required to construct a full design cap thickness over a given area. Time and cost limitations for the pilot make it impractical to undertake construction of the full design thickness for each possible combination of cap material type, water depth, bottom slope, and placement technique. Therefore the pilot should include some combination of small placement volumes and larger placed volumes. Data on various placement methods and variable material types can be obtained from a few hopper placements with small placement volumes. The most likely placement method and material type to be employed full scale should be evaluated for construction of a full cap design thickness over a sufficient area to determine the process of cap thickness buildup for adjacent placements. Since the bottom slope only slightly increases with water depth for areas between the 40 and 70 meter depth contours, a comparison of shallow and deeper placement areas for the pilot would provide the needed information for both depth and slope.

Based on these considerations, a total of four types of pilot placements are anticipated:

Fine material/ conventional placement/ shallow cell
Coarse material/ spreading placement/ shallow cell
Fine material/ conventional placement/ deep cell
Coarse material/ spreading placement/ deep cell

Small Volume Pilot Placements

Placement of a relatively small volume should be sufficient to observe the differences between conventional versus spreading placement methods, finer vs. coarser material types (cap material sources) and shallow versus. deeper cells. Based on the modeling conducted to date, the spreading method of placement is appropriate for the coarser material type. Placement of coarser material using conventional methods is not considered desirable, at least for the initial layer of cap material, because of the higher potential for sediment displacement and resuspension.

Removal of large volumes from the sand borrow area may require extensive and time-consuming studies. Large volumes of coarse material have not be identified within the scope of the current Queen's Gate project. For these reasons, placement of coarser material for a full cap thickness over a large area is not anticipated for the pilot, and the placement of coarse material will be evaluated with small volume placements. The small volume placements should be at least a few hopper loads (say five to ten hopper loads) to confirm the rate of buildup of cap thickness and spreading and dispersion behavior.

The anticipated hopper load for a Manhattan class dredge is approximately 1200 cubic meters (hopper or "bin" volume)[2]. Coarse cap material should be placed using spreading methods only, but placed in both shallow and deep cells, so multiple small volume placements would be required. Therefore, on the order of 20,000 cubic meters (in hopper volume) is required from a coarse grained site.

Full Design Cap Placements

Designs of 15 cm for a thin cap and 45 cm for an isolation cap were recommended in TR EL-99-2. Sufficient material should therefore be placed during the pilot to determine if these cap thicknesses can be constructed over a larger area with acceptable rates of buildup and acceptable variability in cap thickness, considering the overlapping effect of adjacent placements. The major consideration here is to observe the rate of sediment accumulation as a function of distance from clusters of individual hopper dredge placements. It may not be necessary to construct a full 45 cm cap thickness to obtain the needed field data on full design cap placement. If a 15 cm cap can be constructed over a larger area, then the same methods of placement can be used to construct a 45 cm cap. However, the pilot scope should allow for the possible construction of the full 45 cm thickness.

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[2] Personnal communication with Bill Pagendarm, NATCO.

Data on placement behavior for the full design cap thickness are needed for both shallow and deep pilot cap placement areas. The source of fine grained cap material will be Queen's Gate and this material source would be used to build the design cap thickness in both shallow and deep locations. Data for cap buildup can be obtained from a minimum thickness of 15 cm, but a 45 cm thickness would be desirable over at least a portion of the area. A 15 cm coverage over one 300 by 600 m cap cell equates to 27000 cubic meters in-cap volume. For Queen's Gate sediment, 27000 cubic meters in-cap is equivalent to approximately 58000 cubic meters in-hopper or approximately 42000 cubic meters in-source volume. For a 45 cm coverage over one cell, approximately 174,000 cubic meters in-hopper would be needed. To accumulate these thicknesses uniformly over a total cell, a larger volume must be placed, with some of that material going onto adjacent cells and some being lost during placement. So, the required total volume of Queen's Gate material placed on the shelf for two cells capped at 45 cm would be in the range of 300,000 to 500,000 cubic meters in-hopper volume[3].

The present cap designs and recommended operational approaches call for placement of the needed volumes uniformly over each of the capping cells, to include those adjacent to the seaward capping limit at the 70 m depth contour. However, there are concerns regarding the potential for flow of cap material over the shelf break during placement. The need for placement of materials uniformly over a deeper cap cell may depend on the observed behavior of cap placements at the shallower depths. The limits of seaward placement locations may be established at depths landward of the 70 m depth contour, and this may limit the cap thickness which can be constructed down to 70 m.

Refined Model Predictions

The USACE MDFATE model was used to predict the rate of cap material buildup for specific sediment characteristics, various water depths over the shelf and various placement approaches. The USACE STFATE and SURGE models were used to predict cap material dispersion during placement and evaluate the velocities of bottom impact on spreading behavior, respectively. These predictions were based on a broad range of assumed properties for the cap material. Once specific cap material sources are selected, refined predictions using the specific site conditions and cap material properties should be made. Results of the refined predictions will determine any needed adjustments in the operational approach and monitoring station placement for the initial placements for the pilot. The models will also be used during the course of the pilot placements to refine operational methods for full cap placements constructed as a part of the pilot.

Sequence of Placement Operations

A sequence of the pilot placements must consider the need to observe the basic behavior of single hopper dredge placements for finer versus. coarser cap material, seaward versus. shoreward cell locations, and spreading versus. conventional placement methods. In this way, if the behavior of a given placement exceeds acceptable limits on spread or dispersion or

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[3] A detailed discussion of the volumes required to construct the design cap thicknesses is found in Appendix E of TR-EL-99-2. The ratios of in-channel, in-source, in-hopper, and in-cap volumes used here are given in Table E6 of TR EL-99-2. Note that NATCO currently estimates an average in-situ density for Queen's Gate material of 1.936, and an average in-hopper density of 1.4, and these represent volume relationships similar to those in Table E6.

resuspension, adjustments can be made to the operation prior to placement of larger volumes over a larger area during the pilot.

The proposed Placement/ Monitoring sequence is summarized in Table 1 and is described as follows:

Event #0: Verifying Release Rates - Prior to any actual pilot placement on the site, releases of the Queen's Gate material with conventional placement methods at the disposal sites now in use should be observed to determine the nature and rate of release from the hopper. Placements of coarser material with the spreading method of placement should also be observed at the disposal sites now in use or at the borrow source to determine the rate of release from the hopper and any tendency of the material to bridge. These can be considered "practice releases" for purposes of the pilot and must be conducted outside the potential capping prism.

Event #1: Single Conventional Discharge in Cell LU - The first pilot placement would be a single hopper load of the finer material from Queen's Gate discharged at the center of cell LU (see Figure 1). This load would be placed using the conventional placement method. Approximately one week of downtime following this single placement should be planned to assess the adequacy of the monitoring equipment and techniques, shift instrumentation for the next placement, and analyze the monitoring results for this single placement. This single hopperload would be followed later (in Event #3) by a full 15 cm cap over cell LU.

Event #2: Single Spreading Discharge in Cell LD - If a suitable coarse material source is available, this event would be a single hopper load discharged at along the centerline of cell LD (see Figure 1). A single load would be placed using a spreading method of placement. The direction of travel of the hopper should be in a direction away from the outfallsto allow for any overshoot of the placement away from the outfalls. Once the data from a single hopper placement have been assessed, placement of up to 10 additional hopper/barge loads will occur later (as part of Event #3), with the intent of creating a thicker cap using this method. Once it has been determined that data collection is complete for Event #2, (i.e. data such as SPC images are captured), Event #3 could proceed from a scheduling standpoint prior to complete initial analysis of data from Event #2.

Event #3: Full 15 cm Cap Thickness in Cell LU/ Small Volume in Cell LD - Event #3a is the essentially uninterrupted placement of a full 15 cm cap thickness over cell LU. Event #3b is the additional spreading of coarse material in cell LD. Event #3 can proceed if the spreading and dispersion observed for the Event #1 single placement is acceptable, and the initial placements for Event #3 would not interfere with Events #4 and #5 in the seaward cells SU and SD located downslope from cell LU. The Event #3a would be conducted using conventional placement techniques and finer material from Queen's Gate. Additional hopper placements would be made at the same release point as used for Event #1 until a cap thickness of ~ 15 cm is constructed. Then placement locations would be shifted to the next placement point and the process repeated to build the thickness over a larger area. Spacing between placements of 60 meters is recommended in TR EL-99-2, and this spacing will be refined based on additional modeling. Once placements are completed along the entire landward lane, the placements would be shifted to the next lane. Spacing between lanes would initially be set at 60 meters. Both the lane and placement spacings may be adjusted, during the cap placement, depending upon observed rates of buildup. Event #3b consists of the placement of additional hopper loads of coarser material in cell LD using the spreading method to evaluate the buildup of cap thickness using this method of placement.

Event #4: Single Conventional Discharge in Cell SU- This placement is similar to Event #1 except in a deeper seaward cell. A single hopper load of the finer material from Queen's Gate would be discharged at the center of cell SUwhich is at the ~60 to 65 m depth. This load would be placed using the conventional placement method. Essentially no dredge downtime would be needed to analyze the monitoring results for this single placement if previous data from Event #1 indicates no interference from on-going cap placement during Event #3. Once it has been determined that data collection is accomplished for this event, and instrumentation is shifted, the next event could begin.

Event #5: Single Spreading Discharge in Cell SD - Event #5 would be similar to Event #2 except in a deeper seaward cell. If a suitable coarse material source is available, this event would be a single hopper load discharged along the centerline of cellSD. This load would be placed using a spreading method of placement. The direction of travel of the hopper should be away from the outfalls to allow for any overshoot of the placement away from the outfalls. Once the data from a single hopper placement have been assessed, placement of up to 10 additional hopper/barge loads will occur as a part of Event #6 with the intent of creating a thicker cap using this method. Once it has been determined that data collection is accomplished for this event, and instrumentation is shifted, the next evént could begin. Once the data from a single hopper placement have been assessed, placement of up to 10 additional hopper/barge loads will occur later (as part of Event #6), with the intent of creating a thicker cap using this method.

Event #6: Full 15 cm Cap Thickness in Cell SU/ Small Volume in Cell SD- Event #6a is the essentially uninterrupted placement of a full 15 cm cap thickness over cell SU. Event #6b is the additional spreading of coarse material in cell SD. Event #6 can proceed if the spreading and dispersion observed for the Event #4 single placement is acceptable. Event #6a would be conducted using conventional placement techniques and finer material from Queen's Gate. Initial placements start at landward boundary of cell SU. Spacing between placements would initially be set at 60 meters. Once placements are completed along the entire landward lane, the placements would be shifted to the next lane. Spacing between lanes would initially be set at 60 meters. Both the lane and placement spacings may be adjusted, during the cap placement, depending upon observed rates of buildup. Depending on observed behavior, placements on lanes near the 70m depth contour (near the seaward boundary of cell SU) may be limited to avoid excessive buildup of capping material in areas with steeper slopes. Event #6b consists of the placement of additional hopper loads of coarser material in cell SD using the spreading method to evaluate the buildup of cap thickness using this method of placement.

Event #7: Full 45 cm Cap in Cell LU/ Cell SU - Event 7 is the additional placement of material in cell LU and SU to build a 45 cm design cap thickness. The methods of placement would be similar to those used for the construction of the 15 cm cap thickness in Events #3a and #6a. The area over which the 45 cm cap thickness is constructed would depend on the availability of capping material and the results obtained during construction of the 15cm thickness within the respective cells.

GIS-Based Project Management Tools

Once the placement operations begin, data will be available from side-scan surveys, sediment profile surveys, etc. within hours to a day. Decisions to continue placement with an initial operational approach or to change the approach must be made in a matter of days throughout the period of the pilot. This will require a reliable and flexible data management tool. GIS-based approaches are proving to be invaluable in such project environment. Such a system is now in use in management of the Historic Area Remediation Site off New York Harbor. Similar approaches will be developed and used for the PV Shelf pilot project and could be later used for a full scale cap placement.

Monitoring Requirements

Key Questions to be Addressed

Monitoring of the Pilot project will enable the EPA to address five key short and intermediate term questions relative to capping on the Palos Verdes Shelf. These questions are:

- Does placement occur as modeled?
- Can a uniform cap be constructed?
- Can disturbance to in-place sediments be kept within tolerable limits?
- Does the cap remain clean?
- Does the cap remain stable during placement?

Each of these questions (with slight variation in wording) and the generic monitoring approach was addressed in Appendix F of TR EL-99-2, but the environmental concerns that relate to these issues are summarized here. The detailed scope of work to accomplish this monitoring is attached as Appendix A to this document.

Does placement occur as modeled? This question and its associated monitoring will incorporate several concerns that have been raised about the placement of sediments from vessels at the ocean surface onto the seafloor below. These concerns include:

- how far the sediments spread,
- how thick the material is once it comes to rest on the bottom,
- the effect of depth, slope, and material type,
- and the potential for the creation of turbidity flows or mudwaves.

For example, modeling predicts that one hopper load of sediment placed by split-hull methods will produce a deposit approximately 500 meters in diameter with a maximum thickness of 3 cm at the center and thinning to 0.1 cm at the edge.

Several monitoring tools will be used to measure the actual distribution and thickness of the deposit during the Pilot project (Table 2). Combined these will allow an assessment of how actual field conditions reflect those predicted by the model.

Can a uniform cap be constructed? This question involves the ability to place multiple loads of sediment over an area without exceeding an acceptable range of variation in cap thickness. At issue is how effectively we can adjust parameters under our control (such as placement method or type of cap material) in order to overcome any adverse effects on construction that are a function of things we can't control (such as water depth, EA sediment characteristics or bottom slope). The ability to control placement will be assessed both during the series of hopper placements and once they are complete. Many of the same tools used for the above effort will be utilized in these interim surveys with the addition of sub-bottom profiling and possibly bathymetric surveys.

Can disturbance to in-place sediments be kept within tolerable limits? Sediments released from the placement vessel will fall through the water column, reach the bottom, and then spread laterally. This process has the potential to disturb the in-place sediments both at the direct point of impact, and to a lesser degree in the area where lateral spread occurs. The Operations Plan is intended to minimize potential disturbance by only disposing directly on the EA sediment with the initial hopper load. Following this first hopper load, the next several will be directed to the same location so that disturbance of the EA sediment will be insulated by the sediments already in place from the first load. From that point on, all subsequent disposal will always occur over cap sediments that have already reached their position on the seafloor through lateral spreading.

The amount of disturbance to the EA sediments will be assessed both at the point of impact and in the area of lateral spreading. The sediment profile camera and coring will be the principal methods used to assess this level of disturbance. In particular, the absence or thickness of the sediment's oxidized layer, which will be measured prior to disposal, will provide a very good marker for this assessment.

A second concern regarding mixing is the effect on water quality. Again, because of the operational approach, resuspension of EA sediment should be greatly reduced after the initial placement, but the amount of contaminant in the plume will be monitored to assess this expectation. This effort will involve tracking the plume and measuring suspended solids and contaminant concentration relative to background.

Does the cap remain clean? In the short and intermediate term this question will be addressed as part of the assessment of mixing of the EA and cap sediments. Both direct coring with chemical analyses and the sediment profile photographs will be useful for evaluating whether the cap was placed with minimal mixing. Some presence of contaminants in the cap can be expected, because of the natural resuspension and transport of EA sediments that will occur during the cap construction process, along with resuspension caused by the operations themselves. However, the monitoring will allow measurement of what levels can be expected immediately after capping. These data will then be useful for determining any changes in the sediment or contaminant profiles in future cores.

Does the cap remain stable during placement? The stability of the cap both during and immediately after construction will be determined by the combination of surveys that are being conducted to assess the distribution of the cap over the EA deposit. The bottom mounted arrays will document the changes in bottom lateral surge speeds that occur during the placement process. Side-scan, sediment profile photography, and coring will all be used to map the actual extent of the deposit. Side-scan in particular, will be useful for assessing the down slope spread of material in assessing the potential for turbidity flow.

Monitoring Program Components

The monitoring program, as detailed in the appendix, consists of several integrated components. The lists below provide a summary of these components, the tools, and the data that will be collected.

Baseline Data Collection

Vane shear strength for in-situ sediments

Side scan sonar
Relative density/ water content of in-situ sediments
Grain size
Chemistry (total DDT and total PCBs) from cores
Sediment profile camera photographs

Hopper Dredge Operation Data

Transit route
Positioning during placement
Time to release material

Hopper Load Monitoring

Hopper load curves for all loads
Samples of hopper inflow and overflow for GSD, TSS, and TOC
(Samples for each load for small placements; 5% of loads for full cap)

Data Collection During Placement

OBS/ADCP bottom array
Ship deployed OBS/ADCP
Water column samples
Sediment profile camera photographs (for cap buildup and extend of accumulation)
Sediment cores
Side-scan sonar survey

Post Cap Construction Monitoring

Subbottom profiling
Sediment profile camera photographs
Bathymetry (pending technical evaluation)
Sediment cores

Post Consolidation Monitoring

Subbottom profiling
Sediment profile camera photographs
Bathymetry (pending technical evaluation)
Sediment cores
Vane shear and relative density

Longer Term Questions

The monitoring scope that has been developed for the Pilot project does not include far field or long term monitoring, though this scope will be prepared when requested by the EPA project managers. TR EL-99-2 provides the outline for that effort, but briefly, it would include coring, sediment profile camera surveys, and sub-bottom profiles.

Several other items related to monitoring are not explicitly addressed in this plan. This includes determination of the abundance of deep burrowers, reductions in water column contaminant concentrations, verification of the diffusion model, and reductions in tissue levels in resident benthic or fishery species. If EPA decides to proceed with a full-scale capping remedy, a detailed monitoring program to address long term questions would be included.

Reports and Interpretation

Data reports from the monitoring contractor should be provided as data are collected.
A post-cap comprehensive report will be prepared (joint effort USACE/ Contractor).
An addendum following the 6 mos/ 1 year monitoring will be prepared (joint effort USACE/ Contractor).

References

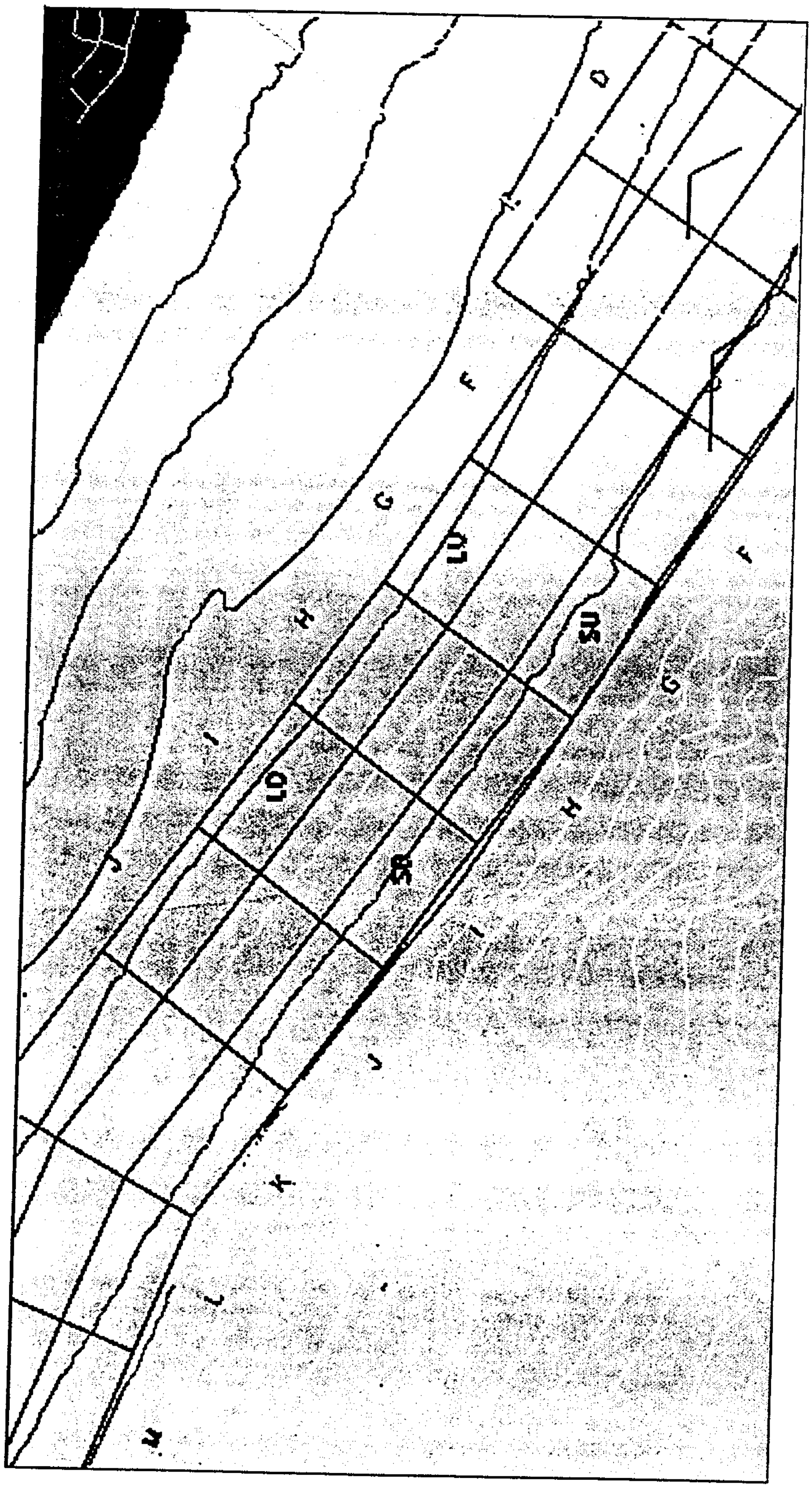
USACE Los Angeles District. "Project Management Plan (PMP) For U.S. Environmental Protection Agency, Region IX on Palos Verdes Shelf Superfund Site, Los Angeles County, California," Prepared by U.S. Army Corps of Engineers Los Angeles District.

Palermo, Michael, Paul Schroeder, Yilda Rivera, Carlos Ruiz, Doug Clarke, Joe Gailani, James Clausner, Mary Hynes, Thomas Fredette, Barbara Tardy, Linda Peyman-Dove, and Anthony Risko. 1999. "Options for In Situ Capping of Palos Verdes Shelf Contaminated Sediments," Technical Report EL-99-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. **http://www.wes.army.mil/el/elpubs/pdf/trel-99-2.pdf**

Table 1. Sequence of Placement Operations

Event #	Location	Placement Activity
0	off-site	Verifying Release Rates
1	LU	Single Conventional Discharge
2	LD	Single Spreading Discharge
3	LU	Full Cap Thickness - Conventional Discharge
	LD	Small Volume - Spreading Discharge
4	SU	Single Conventional Discharge
5	SD	Single Spreading Discharge
6	SU	Full Cap Thickness - Conventional Discharge
	SD	Small Volume - Spreading Discharge

Figure 1.



Heal the Bay

2701 Ocean Park Blvd., Suite 150
Santa Monica CA 90405
310.581.4188 fax 310.581.4195
htb@healthebay.org
www.healthebay.org

May 9, 2000

Fred Schauffler, Environmental Engineer
USEPA Region IX
AZ/CA Cleanup Section, Superfund Programs
75 Hawthorne Street
San Francisco, CA 94105

Dear Mr. Schauffler:

On behalf of Heal the Bay, I have the following comments on the Field pilot Study of In-Situ capping of Palos Verdes Shelf Contaminated Sediments:

1) As Heal the Bay has stated on numerous occasions, we believe that a pilot study should include more alternatives for cap thickness. The norm around the country for a contaminated sediment capping project is a one meter cap. Capping projects in nearby San Pedro Bay for sediments far less contaminated than the Palos Verdes shelf have used caps of five feet or more. This is supposed to be a pilot study that investigates the feasibility of a number of alternatives. To ignore a thicker cap option in a pilot is inexcusable and scientifically indefensible. We have concerns about the depth of bioturbation and strongly disagree that a 45 cm cap is anything close to an "isolation" cap.
2) The sediment drops should be scheduled around tidal conditions to test for worst-case conditions related to cap material loss during the drop. Since building the caps will take months, the contractor should be able to easily schedule drops during a period of slack tides and a period of large tidal swings (greater than 5 foot changes). The tidal conditions should have the largest impact on the fate of the cap material containing the largest percentage of fines, so the pilot project should be designed accordingly. There needs to be a greater focus on the precision and accuracy of the sediment drop process.
3) The monitoring program for the cap is far too narrow and short term. The project needs to include a component to assess the structural integrity of the cap. Will the cap erode over time? Does the structural integrity of the cap remain over time? Does bioturbation have a significant impact on cap integrity?
4) EPA needs to determine the impacts of deep borrowers on cap integrity. They should assess the population of deep burrowers in the capping material and in the local benthic infauna. If there are deep burrowers in the area and/or in the capping material, then EPA needs to monitor the impacts of

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these organisms on cap integrity and contaminant resuspension. Also, one of the cells in the pilot should be an area where deep burrowers are prevalent.

5) Heal the Bay is very concerned about the short-term impact of soft bottom habitat loss and the potential long-term impacts of capping on local benthic community structure. Impacts to local demersal fish populations and nearby kelp beds should be monitored as well. High turbidity and sedimentation can have a major detrimental impact on kelp beds. In addition, recolonization of the capped material needs to be closely monitored in order to assess the long-term biological impacts of capping.
6) EPA needs to design a monitoring component to assess the impacts of dropping capping material on contaminant resupsension. This concern has been voiced by nearly everyone on the TAC.
7) We strongly agree with recommendation 8 on page 4 of the operations and monitoring plan. Heal the Bay has voiced its concern about the delineated southeastern boundary for the contaminated sediments for nearly 8 years.
8) The document should better describe how the capping material will be placed in the cells. Have placement techniques been effectively used at these depths before?

Heal the Bay supports EPA's decision to move to a pilot capping approach in order to provide additional information before final remediation decisions are made. Also, the organization supports the utilization of local Queen's Gate material for the cap if feasible as a cost-effective method to provide capping material for the pilot project.

Please call me at 310-581-4188 x119 if you have any questions about my comments.

Sincerely,

Mark Gold, D.Env.
Executive Director

Table 4. Summary of EPA Screening Evaluation for Palos Verdes Shelf

	No Action	Institutional Controls	In Situ Containment	Removal and: CDF Disposal	CAD Disposal	Treatment & Disposal	Ocean Disposal	Upland Landfill Disposal
Description		Notification & outreach on fish advisories; enforce restrictions.	Cap areas of contamination with a layer of clean material.	Dredge contaminated sediment and place in a CDF.	Dredge contaminated sediment and place in a CAD cell.	Dredge contaminate d sediment and treat in land-based unit.	Dredge contaminated sediment and dispose in deep ocean.	Dredge contaminated sediment and place in an upland landfil.
Effectiveness	Will not reduce existing risks to human health & the environment.	Limited reduction of human exposure. No reduction in ecological impacts. Will not achieve response objectives or meet ARARs.	Effectively isolates contaminants. Cannot cap sediments on the slope. Cap size & thickness determine ability to achieve response objectives.	Short-term impacts on water quality and benthos. Loss of habitat. Will achieve risk reduction response objectives, but would not meet State and possibly federal legal requirements.	Short-term impacts on water quality and benthos. Short-term loss of habitat. Will achieve risk reduction response objectives, but would not meet State and possibly federal legal requirements.	Short-term impacts on water quality and benthos due to dredging. Would require treatability studies. Will achieve response objectives.	Short-term impacts on water quality and benthos due to dredging. Will not meet federal legal requirements for open disposal.	Would effectively isolate contaminants.
Implementability	n/a	Difficult to enforce fishing restrictions.	Can be implemented with existing technology. Requires large volume of cap material. May require permits for off-site borrow area.	Would require innovative dredging equipment. May be difficult to obtain permits.	Would require innovative dredging equipment. May be difficult to obtain permits.	Would require innovative dredging equipment. May be difficult to obtain permits. May require temporary CDF.	Would require innovative dredging equipment. Not expected to meet permit requirements.	Technology is available. Pretreatment and/or dewatering needed prior to disposal. Capacity is very limited.
Cost	$0	very low	$<318 Million*	$>607 Million*	$>287 Million*	$>2.2 Billion*	$>153 Million*	$>1 Billion*
Overall Evaluation	N/A	Retained (but not as stand alone)	Retained	Not Retained	Not Retained	Not Retained	Not Retained	Not retained

*cost figures derived from Trustees' Feasibility study (Palermo 1994)

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