FIRST FIVE-YEAR REVIEW REPORT FOR PALOS VERDES SHELF (OPERABLE UNIT 5 OF THE MONTROSE CHEMICAL CORPORATION SUPERFUND SITE)

LOS ANGELES COUNTY, CALIFORNIA

PREPARED BY

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Approved by: _____ Date: 8/28/14

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Executive Summary

This is the first Five-Year Review (FYR) for Palos Verdes Shelf (PV Shelf), Los Angeles County, California. PV Shelf is Operable Unit 5 of the Montrose Chemical Corporation Superfund Site, 20201 Normandie Avenue, Los Angeles, California. Montrose Operable Unit 5 encompasses a deposit of contaminated seafloor sediment about 88 square kilometers in size. The deposit sits on the continental shelf and slope off the coast of the Palos Verdes Peninsula, Los Angeles County, California, at water depths ranging roughly from 40 to 200 meters or greater. Sediment, ocean water, fish, and other ecological receptors at PV Shelf are contaminated due to discharged wastes from Montrose and other industries that entered the sanitary sewers and were released to the environment at the White Point ocean outfalls. The contaminants at Palos Verdes Shelf are DDT and its metabolites (referred to as "Total DDTs"), and congeners of polychlorinated biphenyls (referred to as "Total PCBs"). The quality of the wastewater discharge from the White Point outfalls has improved over the years – DDTs have not been detected in White Point discharge since 2002, and PCBs have not been detected since 1985.

In the Interim Record of Decision, the United States Environmental Protection Agency (EPA) selected an interim remedy for Palos Verdes Shelf to protect human health and the environment. This interim remedy consists of the following:

- Institutional controls component – Continue and strengthen the institutional controls program for PV Shelf that originated as a non-time-critical removal action.
- Monitored natural recovery component – Monitor the ongoing, naturally occurring processes that contain, destroy, or reduce the bioavailability or toxicity of contaminants in sediment.
- Isolation cap component – Place an in situ isolation cap over portions of the PV Shelf sediment bed that are erosive or are highly contaminated or both.

Currently, the interim remedy is progressing and remains protective of human health and the environment. The institutional controls program is well established and has been and remains effective in protecting human health. Site-specific processes of monitored natural recovery are evident and appear to be effective in reducing risk to human health and ecological receptors; these processes include biotransformation, burial, and mixing in place. In 2009, EPA conducted a baseline sediment sampling program which indicated lower than expected concentrations of DDTs and PCBs in the Palos Verdes Shelf sediment. The concentrations were so much lower than expected that the Palos Verdes Shelf Technical Exchange Group (PVSTIEG) initially expressed concern about relying on the results. However, PVSTIEG ultimately supported EPA's decision to postpone implementation of the isolation cap component of the interim remedy, with the understanding that EPA will validate the 2009 sediment results by conducting additional sediment, water, and fish sampling programs. Additional response actions that can accelerate recovery, e.g. capping, will be assessed after the data from these programs are evaluated. At this time, no information has become available that would call into question the protectiveness of the remedy.

Although uncertainty exists regarding the 2009 sediment sampling data, results of that study and additional sampling programs and research by EPA and others indicate that natural recovery processes are occurring. The combination of institutional controls and monitored natural recovery is effective and is making progress towards attaining the specific interim cleanup goals and timelines set forth in the Interim Record of Decision.

EPA is currently conducting additional studies of the sediment, water column, fish tissue, and outreach effectiveness to validate the 2009 sampling results and the protectiveness of the remedy. The results of these additional studies will be used to evaluate remedy protectiveness as part of the next Five-Year Review.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Palos Verdes Shelf, Operable Unit 5 of the Montrose Chemical Superfund Site		
EPA ID: CAD008242711		
Region: 9	**State:** California	**City/County:** Los Angeles/Los Angeles County

SITE STATUS	
NPL Status: Proposed	
Multiple OUs? No	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: EPA **If "Other Federal Agency" was selected above, enter Agency name:**
Author name (Federal or State Project Manager): Judy Huang, P.E.
Author affiliation: EPA
Review period: September 30, 2009 – March 31, 2014
Date of site inspection: N/A
Type of review: Statutory
Review number: 1
Triggering action date: September 30, 2009 – signature of the IROD
Due date *(five years after triggering action date)*: September 30, 2014

Five-Year Review Summary Form (continued)

Protectiveness Statement		
Operable Unit: OU 5 of Montrose Chemical Corporation Superfund Site	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*
Protectiveness Statement: The interim remedy at Montrose Chemical Corporation Operable Unit 5 (Palos Verde Shelf) is protective of human health and the environment. Institutional controls are in place and are effective in protecting users of PV Shelf. Results of sampling programs and research by EPA and others indicate that natural recovery processes are occurring. The combination of institutional controls and monitored natural recovery is effective and is progressing towards attaining the specific interim cleanup goals and timelines set forth in the Interim Record of Decision. .		

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List of Acronyms

ARARs	applicable or relevant and appropriate requirements
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeters
EPA	United States Environmental Protection Agency
FCEC	Fish Contamination Education Collaborative
FYR	five-year review
IROD	Interim Record of Decision
JWPCP	Joint Water Pollution Control Plant
µg/kg	micrograms per kilogram (parts per billion)
Montrose	Montrose Chemical Corporation
ng/L	nanograms per liter (parts per trillion)
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
OC	organic carbon
OEHHA	Office of Environmental Health Hazard Assessment
OU	operable unit
PCBs	polychlorinated biphenyls
PV Shelf	Palos Verdes Shelf
PVSTIEG	Palos Verdes Shelf Technical Information Exchange Group
RAO	remedial action objective
SAIC	Science Applications International Corporation
Sanitation Districts	Sanitation Districts of Los Angeles County
SCCWRP	Southern California Coastal Water Research Project
SMCA	State Marine Conservation Area

First Five-Year Review Report

for

Palos Verdes Shelf

1. Introduction

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy will continue to be protective of human health and the environment. The methods, findings, and conclusions of FYRs are documented in reports that identify issues found during the review, if any, and document recommendations to address them.

The United States Environmental Protection Agency (EPA) prepares FYRs pursuant to Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC §9621. Section 121 states:

> "*If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews."*

EPA interpreted this requirement further in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR §300.430(f)(4)(ii), which states:

> "*If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such actions no less often than every five years after the initiation of the selected remedial action*."

EPA conducted the FYR and prepared this report regarding the remedy implemented at Palos Verdes Shelf (PV Shelf), Los Angeles County, California. PV Shelf is operable unit (OU) 5 of the Montrose Chemical Corporation Superfund Site. EPA Region 9 is the lead agency for developing and implementing the remedy for the Site. The Department of Toxic Substances Control (DTSC) is the

support agency representing the State of California, and has reviewed supporting documentation and provided input to EPA during the FYR process.

This is the first FYR for PV Shelf, and is required due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that would allow for unlimited use and unrestricted exposure. The triggering action for this statutory review was the signing of the Interim Record of Decision (IROD) that occurred in September of 2009.

The Montrose Chemical Corporation (Montrose) Superfund Site consists of seven operable units:

Operable Unit 1: on/near property soil
Operable Unit 2: stormwater pathway
Operable Unit 3: ground water and dense non-aqueous phase liquids
Operable Unit 4: historic stormwater pathway-north
Operable Unit 5: PV Shelf
Operable Unit 6: historical stormwater pathway-south
Operable Unit 7: Jones Chemicals Inc.

This FYR only addresses EPA's response actions at PV Shelf; FYRs for the other Montrose operable units are being conducted separately.

PV Shelf is considered part of the Montrose Site because the source of the contamination is the former Montrose Chemical plant. Montrose discharged wastes containing DDT into the Sanitation Districts' sanitary sewer. Other industries also sent wastes containing PCBs and metals to the sanitary sewer.

The Sanitation Districts' sewer system carried wastes to the Joint Water Pollution Control Plant at Carson, from which treated wastewater containing contaminants including DDT, PCBs, and metals reached the Pacific Ocean via the Districts' White Point outfall system. The wastes were released through the diffuser portions of the outfall pipes, situated on the seafloor roughly 9 miles from the former Montrose Chemical Plant (see Figure 1). Likely sources of contaminants at PV Shelf other than the White Point outfall system include outfalls related to stormwater drains; ocean dumping of sediment from navigational dredging; ocean dumping of waste drums; and uncontrolled runoff from regional manufacturing and storage facilities.

Though metals including mercury have been detected in samples of fish caught at PV Shelf, metals were not addressed in this FYR. Several previous in-depth studies have indicated that metals are not significant risk drivers at PV Shelf, when compared to DDTs and PCBs (SAIC, 1999; CH2M Hill, 2003).

2. Site Chronology

Table 1 lists the notable events for PV Shelf.

Table 1. Site Chronology

Event	Date
Montrose operates a DDT-manufacturing plant on Normandie Avenue near Torrance, California.	1947 - 1982
Montrose discharges DDT-contaminated wastes from its Torrance plant to sanitary sewers operated by the Sanitation Districts. The sewers flow to the JWPCP at Carson. From JWPCP, treated wastewater containing DDTs and other industrial pollutants is released to the environment though ocean outfalls off White Point on the Palos Verdes Peninsula.	1953 - 1971
EPA adds Montrose's Normandie Avenue facility to the National Priorities List.	October 1989
EPA initiates Non-Time-Critical Removal Action to evaluate risks posed by DDT and PCB effluent-affected sediment at PV Shelf and the feasibility of response actions that could reduce threats to human health and the environment.	July 1996
EPA issues human health risk assessment and concludes that consumption of fish caught from PV Shelf poses a health risk due to high levels of chemicals of concern, i.e., DDTs and PCBs.	1999
EPA issues the Engineering Evaluation/Cost Analysis for PV Shelf identifying institutional controls as the preferred alternative.	March 2000
EPA conducts pilot study to assess the feasibility of using capping as a remedial alternative.	September 2000
EPA issues the Action Memorandum that initiates implementation of the institutional controls program.	September 2001
EPA conducts data gap studies including geotechnical study, large bioturbator study, resuspension study, and oceanographic study.	2004
EPA issues the final remedial investigation report for PV Shelf.	October 2007
EPA issues the final feasibility study report.	May 2009
EPA conducts pre-design studies including 2009 sediment sampling program and fish movement study.	2007-2013
EPA signs and issues Interim ROD.	September 2009

3. Background

3.1. Physical Characteristics

PV Shelf encompasses a bed of contaminated solids (sediment) that has settled on the seafloor in the Pacific Ocean at water depths varying from about 40 to 200 meters or greater. The bed of contaminated sediment is situated on the western edge of the North American continental shelf off the Palos Verdes Peninsula in southern California. The distance from the shoreline to the inshore edge of the sediment bed (water depth = 40 meters) is about 1.5 kilometers. Catalina Island, one of the Channel Islands, is the closest island to PV Shelf, at a distance of about 42 kilometers.

The sediment bed is about 1.5 to 4 kilometers in width and about 25 kilometers in length. The continental shelf in this area slopes in the seaward direction at about 1 to 4 degrees. A shelf break (i.e., the zone of transition from the relatively flat shelf to the steeper continental slope) occurs at water depths of 70 to 100 meters. The seafloor then drops sharply at a slope of about 13 degrees to a water depth of 800 meters (Lee, 1994). Figure 1 is a map showing the PV Shelf Study Area with bathymetry (depth) isobaths. The bed of contaminated sediment lies within the boundaries of the PV Shelf Study Area.

3.2. Geology

PV Shelf and the Palos Verdes Peninsula are parts of the California continental borderland that extends from Santa Barbara, California, to the Vizcaino Peninsula in Baja California, Mexico. The Palos Verdes Peninsula is a tectonic fault block of seafloor sediment and volcanic debris on a submerged mountain of metamorphic rocks that began rising out of the Pacific Ocean 1.5 million years ago. PV Shelf is a submerged continuation of the Palos Verdes Peninsula and extends approximately 4 kilometers offshore to the southwest (EPA, 2009b).

3.3. Land and Resource Use

Current Use

The contaminated sediment bed at PV Shelf is too deep for direct human contact. Fishing activities at portions of PV Shelf have been restricted by the California Department of Fish and Wildlife (CDFW) through its enforcement of the commercial catch ban for white croaker that was initiated in May 1990 (California Fish and Game Code § 7715(a) & (b) and California Code of Regulations Title 14, Section 104; see Figure 2). Recently in 2013, under the Marine Life Protection Act, CDFW designated two marine protection areas, the Abalone Cove State Marine Conservation Area (SMCA) and the Point Vicente No-Take SMCA, that are partially within the footprint of the PV Shelf Study Area (Figures 1 and 2). CDFW's marine protection areas are intended to protect natural habitats and marine life by protecting or limiting removal of wildlife from within their boundaries.

For the Abalone Cove SMCA, take (i.e., hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill) of any living marine resource is prohibited with the following exceptions: (1) recreational take of pelagic finfish, including Pacific bonito, and white seabass by spearfishing, and market squid by hand-held dip net is allowed; and (2) commercial take of coastal pelagic species and Pacific bonito by round haul net, and swordfish by harpoon is allowed. For the Point Vicente No-Take SMCA, take of any living marine resource is prohibited. For both the Abalone Cove and Point Vicente SMCAs, take pursuant to remediation activities associated with PV Shelf (Montrose OU 5) is allowed.

Other than these restrictions, the area at PV Shelf is open for other commercial and sport fishing. Sport fishermen angle from boats, rocky intertidal areas, and sandy beaches. Sport fishing also includes shell-fishing for lobsters and crabs in the near-shore, shallow waters of the Palos Verdes Peninsula. Other activities that occur in this coastal area include boating, swimming, windsurfing, surfing, scuba diving, snorkeling and shell-fishing.

3.4. History of Contamination

From 1953 until 1971, Montrose discharged DDT-contaminated wastes from its manufacturing operations at the Normandie Avenue facility to the sanitary sewer collection system operated by the Sanitation Districts. These sewers conveyed the wastes to the Sanitation Districts' Joint Water Pollution Control Plant in Carson, California, where the wastes received primary treatment. Treated wastewater was discharged to the Pacific Ocean through the Sanitation Districts' White Point outfalls located on PV Shelf. Montrose ceased discharges to the sanitary sewer in 1971. The estimated mass of DDTs

discharged from the White Point outfalls from the 1950s through 1971 was 1,000 metric tons. The IROD (EPA, 2009) reported that masses of DDTs and PCBs remaining in sediment at PV Shelf had been estimated at 110 and 10 metric tons, respectively.

In 1989, trustees of the natural resource damage assessment for PV Shelf determined that DDT and PCB contamination of the marine environment off the southern California coast, including PV Shelf, could be causing significant damage to natural resources.

Since Montrose ceased discharges in 1971, the quality of the wastewater discharge from the White Point outfalls improved – DDTs have not been detected in White Point discharge since 2002, and PCBs have not been detected since 1985.

3.5. Initial Response Actions

Based on the findings of the natural resource damage assessment, EPA initiated a removal action assessment in July 1996 to investigate possible impacts to human health due to contaminants at PV Shelf. EPA subsequently issued an Action Memorandum that recommended institutional controls to address the human health risks associated with consumption of contaminated fish (EPA, 2001).

3.6. Basis for Taking Action

DDTs and PCBs are regarded as probable human carcinogens, and their presence at PV Shelf provided the basis for EPA taking action under CERCLA. The primary threat to human health was due to consumption of contaminated fish bought at commercial outlets and caught by local anglers. DDTs and PCBs also were associated with harmful impacts to birds throughout the Southern California Bight (shown on Figure 1), and risks to sea lions near PV Shelf and on the Channel Islands. Sampling events conducted in 1997 indicated that concentrations of DDTs and PCBs in samples of ocean water collected at PV Shelf exceeded EPA's National Recommended Water Quality Criteria[1] for human health (for salt water). All water samples except for one exceeded EPA's recommended ecological criterion for DDTs. The ecological criterion for PCBs was not exceeded in any of the samples (EPA, 2009b

4. Remedial Action

4.1. Remedy Selection

EPA's interim remedy was selected in the September 30, 2009, Interim Record of Decision (IROD). The remedy consists of institutional controls, monitored natural recovery, and containment (outfall area cap). The RAOs summarized from the IROD are as follows:

- Reduce to acceptable levels the risks to human health from ingestion of fish contaminated with DDTs and PCBs.

[1] The National Recommended Water Quality Criteria list was formerly known and referred to in the IROD as the EPA ambient water quality criteria (AWQC) list. It can be found at http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm.

- Reduce to acceptable levels the risks from DDTs and PCBs to the ecological community (i.e., benthic invertebrates and fish) at PV Shelf.
- Reduce concentrations of DDTs and PCBs in water at PV Shelf to acceptable levels that meet ambient water quality criteria set by EPA for human health and ecological health.
- Minimize potential adverse impacts to sensitive habitats and biological communities on PV Shelf during remedial action.

Cleanup goals for sediment, presented in Table 2, are "normalized for organic carbon", meaning that the analytical results reported by the laboratory for DDTs and PCBs are each divided by the reported value of total organic carbon for the particular sample. Two interim cleanup goals were selected in the IROD. The first interim cleanup goal was to be achieved upon placement of the cap which would decrease immediately the average concentrations of DDTs and PCBs when the highest concentration areas were capped. The second interim cleanup level was set for the first Five Year Review which assumed the cap would be in place and natural recovery processes would continue to reduce concentrations post cap placement.

Table 2. Cleanup Levels for PV Shelf

Medium	DDTs	PCBs	Related RAO
White croaker	400 µg/kg	70 µg/kg	Reduce risks to human health due to ingestion of contaminated fish.
Sediment – immediate achievement of interim cleanup levels after cap placement	78 mg/kg OC Mean Concentration	7 mg/kg OC Mean Concentration	Reduce risks to human health due to ingestion of contaminated fish.
Sediment – interim cleanup levels to be achieved by the first FYR	46 mg/kg OC Mean Concentration	7 mg/kg OC Mean Concentration	Reduce risks to human health due to ingestion of contaminated fish.
Sediment – final cleanup levels by 2039	23 mg/kg OC Mean Concentration	-	Reduce risks to human health due to ingestion of contaminated fish.
Water	0.22 ng/L within 30 years	0.064 ng/L	Reduce risks to meet EPA's salt water criteria for ecological health and human health (human health criteria have been adopted because they are more stringent).

Abbreviations
FYR – Five-year review
µg/kg – Micrograms per liter (parts per billion)
mg/kg – Milligrams per liter (parts per million)
ng/L – Nanograms per liter (parts per trillion)
RA – Remedial Action

Each of the three components of the interim remedy is described below.

Institutional Controls

Institutional controls are "non-engineering instruments such as administrative and legal controls that minimize the potential for human exposure to contamination and protect the integrity of the remedy" (EPA, 2009b). The components of the institutional controls program are:

- **Public outreach and education** – to increase awareness and understanding of the existing fish consumption advisories and fishing restrictions.

- **Monitoring** – to evaluate and track contaminant concentrations in fish (i.e. white croaker) caught at or near PV Shelf, as well as those sold in retail fish markets and served in restaurants,
- **Enforcement** – to prevent commercial catch and sale of contaminated fish caught at and near PV Shelf based on restrictions established by CDFW.

Monitored Natural Recovery

The natural recovery processes at PV Shelf include biodegradation (for DDTs), burial, and dispersion, all processes that have been observed by investigators at PV Shelf. Monitoring will be used to evaluate the effectiveness of the cap and the natural recovery processes. The monitored natural recovery (MNR) component of the remedy includes additional studies to improve modeling of contaminant fate and transport. Studies included under MNR are transformation of DDE, rates of contaminant loss, and a fish tracking study to identify habitat usage by fish species.

Cap

The third component of the selected remedy at PV Shelf is placement of an in situ isolation cap (e.g., layer of clean sand) to prevent erosion and eliminate exposure to high concentrations of contaminants in sediment. The capping component consists of the following:

- Delineation of the proposed cap area by conducting sampling and analysis to better define horizontal and vertical boundaries of the deposit. This includes the collection of data on sediment characteristics (grain size, bulk density, shear stress) necessary for cap design. Modeling and treatability studies to pilot low-impact techniques are part of the cap placement component.
- Based on conceptual design work conducted by EPA, a 45-centimeter (cm)-thick layer of fine sand/silt will be placed over approximately 300 acres of the sediment bed to stop flux (movement of dissolved-phase contaminants from pore water into the open water column) and transport, and to provide a barrier for benthic invertebrates feeding in the most contaminated area of sediment. The cap was estimated to require 864,000 cubic yards of material. Cap construction will follow assessment of modeling and treatability studies. These design criteria will be reassessed during the formal remedial design.
- During cap construction, monitor any plume of resuspended sediment, measure turbidity, and collect samples of sediment and water column.
- Post-construction, monitor the cap to assess cap thickness and cap movement. To verify effectiveness and stability of the cap, collect samples of cap material and pore water to test for compaction and contaminant flux.

4.2. Remedy Implementation

Institutional Controls

As previously indicated, institutional controls were initiated in December 2001, when EPA issued a draft Implementation Plan (EPA, 2001b).

Public outreach and education. EPA coordinates a variety of federal, state and local agencies, along with community-based organizations, to implement outreach and education activities, including sponsoring the Fish Contamination Education Collaborative (FCEC). EPA also sponsors the Angler Outreach Program, which has been implemented by Heal the Bay and Cabrillo Marine Aquarium. This

program targets anglers at selected piers, shorelines and bait shops. FCEC meetings are held routinely (usually semi-annually) to update stakeholders on recent developments. EPA issues periodic updates to the FCEC website www.pvsfish.org (offered in English, Spanish, Vietnamese and Chinese).

Monitoring. EPA entered into formal agreements with the City of Long Beach, Los Angeles County Environmental Health, and the Orange County Healthcare Agency, to evaluate commercial availability of contaminated white croaker. A list of 57 fish retail markets initially was identified based on previous studies, with additional input from community based organizations and county health departments. The list of markets continues to evolve, and currently includes a rotating list of 256 markets and restaurants in Los Angeles County and Orange County (Figures 3-A and 3-B). The schedule for market monitoring is listed below.

- Orange County Markets – 12 times per year (monthly)
- Los Angeles markets – two times per year
- Long Beach markets – three times per year

Enforcement. Under a Cooperative Agreement with EPA, CDFW conducts inspections of local wholesalers/distributors and fish landing locations on a monthly basis. Furthermore, CDFW enforces a commercial catch ban for white croaker in the area between Point Vicente and Point Fermin and from the shoreline out approximately 3 miles. CDFW also implements a daily bag limit of 10 white croakers for recreational anglers fishing along the shoreline of the Palos Verdes Peninsula shoreline. CDFW conducts its enforcement patrols monthly. Figure 2 shows the CDFW enforcement areas.

Monitored Natural Recovery

The remedy includes a monitoring program to evaluate the effectiveness of the natural recovery processes, and additional studies to improve modeling of contaminant fate and transport. These studies address the biotransformation of DDT, rates of contaminant loss in the sediment bed, and movement patterns of white croakers and barred sand bass.

In 2009, EPA conducted a sediment sampling program including a baseline event (Figure 5) related to the natural recovery processes, and an outfall sampling event (Figure 6) related to possible design of the isolation cap. Results of the sediment sampling program are reflected in the concentration maps for DDTs and PCBs (Figures 7 and 8, respectively). EPA also conducted a water column sampling event in 2010 to assess contaminant concentrations in open water at PV Shelf, and a flux study event in 2011 to assess movement of contaminants from the pore water in the sediment bed to the open water column above.

Currently, EPA is conducting or is planning studies of characteristics of specific environmental media. These include sediment, water column, and fish tissue.

Cap

Currently, the cap component of the interim remedy has been postponed, pending data analysis from ongoing sediment sampling and analysis event, and the sampling programs for ocean water column and fish planned for 2014-2015.

4.3. Operation and Maintenance (O&M)

The selected interim remedy, consisting of institutional controls, monitored natural recovery, and outfall area cap (postponed), currently has no operation and maintenance requirements. Monitoring programs related to the remedy were described in Section 4.2 above.

5. Progress Since the Last Five-Year Review

This is the first FYR for PV Shelf.

6. Five-Year Review Process

6.1. Administrative Components

EPA's FYR team was led by Judy Huang of EPA, Remedial Project Manager for PV Shelf, with contractor support provided by Gilbane, Walnut Creek, California. On January 30, 2013, the team held a scoping meeting to discuss items of interest as they related to the protectiveness of the remedy currently in place at PV Shelf. A review schedule was established that consisted of the following:

- Community notification
- Document review
- Data collection and review
- Site inspection
- Local interviews
- FYR report development and review

6.2. Community Involvement

On February 11, 2014, EPA published an FYR public notice in the *Daily Breeze* (Torrance, California), announcing the commencement of the FYR process for PV Shelf, providing EPA's contact information, and inviting community participation. A copy of the press notice is included in Appendix B.

The FYR report will be made available to the public once it has been finalized. Copies of the document will be placed in the designated public repositories: (1) San Pedro Public Library, 931 South Gaffey Street, San Pedro, California 90731 (tel. 310-548-7779); (2) Redondo Beach Public Library, 303 North Pacific Coast Highway, Redondo Beach, California 90277 (tel. 310-318-0675); (3) Palos Verdes Peninsula District Library, 701 Silver Spur Road., Rolling Hills Estates, California 90274 (tel. 310-377-9584); and (4) Superfund Record Center, 95 Hawthorne Street, Suite 403S, San Francisco, California 94105 (tel. 415-972-3128).

Upon completion of the FYR, a public notice will be made in the *Daily Breeze* to announce the availability of the final FYR report in the document repositories. EPA will also post the FYR report with other PV Shelf documents at the EPA website www.epa.gov/region09/superfund/pvshelf.

6.3. Document Review

This FYR included a review of relevant, site-related documents including the IROD and recent monitoring data reports. A complete list of the documents reviewed can be found in Appendix A.

ARARS Review

Section 121(d)(2)(A) of CERCLA, 42 USC §9621(d)(2)(A), specifies that remedial actions conducted under EPA's Superfund program must meet any federal standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements (ARARs). ARARs are those standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Superfund site (applicable) or that address problems or pertain to circumstances similar to those encountered at a Superfund site (relevant and appropriate).

Table 3 lists the chemical-, location-, and action-specific ARARs from the IROD. Also included are the regulatory basis, current status, and regulatory changes, if any. In summary, there were no changes to any of the ARARs. There have been no revisions to laws and regulations that affect the protectiveness of the remedy.

Table 3. Evaluation of Applicable or Relevant and Appropriate Requirements

Requirement	Citation	Document	Description	Affects Protectiveness	Comments
Protection of aquatic life and human health.	Clean Water Act Section 304, 33 USC. §1314 (National Surface Water Quality Criteria	2009 IROD	Establishes surface water criteria for protection of fish-eating birds, birds feeding at higher trophic levels, and marine aquatic life.	There have been no changes to this law that affect protectiveness.	Protective of sensitive aquatic species and achievement of the Food and Drug Administration's tolerance level of 5,000 µg/kg in fish after bioaccumulation (protection of human health).
Any response action should not jeopardize listed species or adversely modify critical habitat at PV Shelf.	Endangered Species Act of 1973, 16 USC. §1531-1544	2009 IROD	The goal of the Endangered Species Act is the conservation and recovery of species of fish, wildlife, and plants that are threatened with extinction.	There have been no changes to this law that affect protectiveness.	Endangered/threatened species are present at PV Shelf.
Selected remedy must be consistent with substantive requirements of the Coastal Zone Management Plan.	Section 307(c)(1) of the Coastal Zone Management Act	2009 IROD	Filling of surface waters is allowable only when (a) public benefits exceed public detriment from the loss of water areas, (b) the filling is for a water-oriented use, and (c) no alternative upland location is available.	There have been no changes to this law that affect protectiveness.	On-site activities are not subject to administrative review or permitting processes related to the Coastal Zone Management Act.

Requirement	Citation	Document	Description	Affects Protectiveness	Comments
For the purpose of constructing a cap, placement of material on the PV Shelf will comply with substantive requirements of these Sections.	Marine Protection, Research, and Sanctuaries Act of 1972 and Ocean Dumping Regulations, 33 USC. §§1411-1414, 40 CFR Parts 220-238 Section 404 of the Clean Water Act and Section 10 of the Rivers and harbors Act, 33 USC. §1344, 33 USC. §401, 40 CFR Part 230.	2009 IROD	Dredged material must meet federal testing guidelines to meet approval for disposal of material in the ocean.	There have been no changes to this law that affect protectiveness.	Establish dredge material reuse standards. Applies to capping material selection.
Taking of fish species	California Ocean Fishing regulations. CCR Title 14 §§28.05, 28.10	2009 IROD	Forbids the taking of garibaldi and giant (black) sea bass from California ocean waters.	There have been no changes to this law that affect protectiveness.	Applies to fish sampling activities undertaken under monitoring.
California Fish & Game (CDFG) Requirements	California Endangered Species Act California Fish & Game Code §2080	2009 IROD	Conserves, protects, restores, and enhances any endangered or threatened species and its habitat.	There have been no changes to this law that affect protectiveness.	Requirements of the Act may be applicable due to the presence of endangered/threatened species on the PV Shelf.
Protection of mammals.	California Fish & Game Code §4700	2009 IROD	Prohibits the take of any of the listed fully protected mammals, including the Northern elephant seal and Guadalupe fur seal.	There have been no changes to this law that affect protectiveness.	Areas at PV Shelf that will be impacted by the remedy are within the population range of the Northern elephant seal and the Guadalupe fur seal.

Review of Human Health Risk Assessments

There have been no changes to the exposure pathways that would affect the potential risk to human health due to fish consumption. The human health risk evaluation conducted in 1999 addressed potential health risks due to consumption of various species of fish by recreational anglers. The results indicated that the fish species presenting the highest estimated cancer risk and non-cancer health hazard (due to ingestion) was the white croaker (SAIC, 1999). The human health risk evaluation was updated in 2007. The results indicated that DDTs are the primary contributors to the cumulative cancer risk estimates, while PCBs are the primary contributors to the cumulative health hazard estimates.

In 2014, the human health risk evaluation was again updated to assess risk due to consumption of skin-off filets from white croakers (ITSI Gilbane, 2014). Fish were collected at near-shore locations from Santa Monica Bay to the Port of Long Beach (Figure 2) from March 2009 to May 2010. Whereas the 2007 data showed that DDTs were the primary contributors to the increased likelihood of cancer and PCBs were the primary contributors to non-cancer health effects, the 2014 evaluation showed that PCBs were the primary contributors to the increased likelihood of both cancer and non-cancer effects in the consumption of white croaker. Furthermore, the results show that the risk and hazard index estimates in 2014 were lower than the risk and hazard index estimates in 2007. Table 4 presents the risk estimates based on the reasonable maximum exposure scenario for recreational anglers, which incorporates the more health-protective high-end consumption rate of white croakers.

Table 4. Summary of Health Risks due to Consumption of White Croakers

Exposure Scenario and Pathway	Cancer Risk Estimate		Non-Cancer Hazard Quotient	
	DDTs	PCBs	DDTs	PCBs
Consumption of white croaker by recreational boaters (SAIC, 1999)	1×10^{-3}	6×10^{-4}	17	32
Consumption of white croaker by recreational Asian anglers (CH2M Hill, 2007)	4.6×10^{-3}	2.3×10^{-3}	63.4	134
Consumption of white croaker by recreational Asian anglers (ITSI Gilbane, 2014)	4×10^{-5}	2.4×10^{-4}	0.5	13.9

In December 2010, EPA expanded the monitoring efforts by collecting lobster samples from August to September 2011 to address concerns expressed by recreational fishermen. Ten lobsters were collected from each of four areas near PV Shelf, namely Rocky Point, Long Point, White Point, and the Los Angeles Harbor breakwater (Figure 4). The Los Angeles Harbor breakwater was considered representative of an area that was not affected by the historical discharges of DDTs and PCBs from the White Point outfalls.

Table 5 shows that the health risks associated with consumption of lobster tails and tomalley are extremely low. However, these results are based on only 10 lobster samples from each location, and conclusions based on these limited data have a considerable amount of uncertainty.

Table 5. Summary of Health Risks due to Consumption of Lobster Tails and Tomalley

Exposure Scenario and Pathway	Cancer Risk Estimate		Non-Cancer Hazard Quotient	
	DDTs	PCBs	DDTs	PCBs
Consumption of lobster tails by recreational boaters (ITSI Gilbane, 2014)	4.7×10^{-9} to 5.3×10^{-9}	1.6×10^{-7} to 1.9×10^{-7}	0.0001	0.01
Consumption of lobster tomalley by recreational Asian anglers (ITSI Gilbane, 2014)	5.3×10^{-8} to 2.1×10^{-7}	2.3×10^{-6} to 3.6×10^{-6}	0.0003 to 0.001	0.057 to 0.091

Toxicity Values

EPA's Integrated Risk Information System is a program that provides updated toxicity values (when newer scientific information becomes available) to be used in risk assessment. In the past 5 years, there have been no changes to the toxicity values for the contaminants at PV Shelf.

Ecological Review

An ecological risk assessment was completed for PV Shelf in November 2003 to evaluate the likelihood of adverse effects on marine biota that are present at the SCB and at PV Shelf (EPA, 2003). The assessment indicated that primary exposure pathways are from the sediment to resident invertebrates and bottom-dwelling fish. Benthic and water-column invertebrates, water-column fish, and fish-eating consumers are potentially exposed through the food web due to bioaccumulation of chemicals of potential ecological concern. Bald eagles were assessed for exposure and risk through consumption of sea lion carcasses, and bald eagles and peregrine falcons were assessed for exposure through consumption of seabirds.

The 2003 assessment concluded that there was a gradient of ecological risk with the greatest risk in the vicinity of the PV Shelf outfalls and along a band extending up the coast to the northwest. Intermediate risks were found in the immediate PV Shelf vicinity and the lowest risks were estimated for the more distant SCB locations. DDTs posed greater risks to fish and invertebrates than PCBs, and the immediate area of the outfalls posed the highest risks to fish and invertebrates. Birds were also shown to have higher risk due to DDTs than to PCBs.

Since the 2003 ecological risk assessment, a decrease of DDT concentrations has been observed in sediments at PV Shelf, coupled with an increase in concentrations of known breakdown ("daughter") products of DDT, i.e., DDT appears to be undergoing dechlorination. The breakdown of DDT to less toxic metabolites could mean changes to site conditions that could mitigate or reduce hazards to ecological receptors.

6.4. Data Review

This FYR includes a review of historical data generated from various investigators and data generated from EPA's remedy-related programs, including the 2009 sediment sampling program, 2010 water sampling program, and the institutional controls program from 2009 through 2012.

Sediment

Investigations that preceded the IROD indicated that natural processes, including sediment transport, biological mixing, desorption from sediment to water, and biodegradation (dechlorination of DDTs) are contributing to lower concentrations of contaminants in surface sediment at PV Shelf (Drake, et al., 1994; and Eganhouse, et al, 2008).

In 2009, EPA retrieved sediment cores from 34 locations for the baseline program, and from an additional 25 locations in the area near the Sanitation Districts' outfall diffusers (Figures 5 and 6). The data analysis focused on sediment COCs in the 0-to-8-cm bed depth interval, that encompasses the biodiffusive mixing layers reported by previous investigators (SAIC, Santschi et al., 2001; SAIC, 2005a). The COCs present in bed intervals deeper than 8 cm are unlikely to enter into the food chain due to the lack of bio-mixing, and the depositional nature of the most-contaminated portions of PV Shelf.

Similar to previous investigations, the 2009 sediment results indicated a widespread pattern of DDT and PCB contamination, with areas of high concentrations near the diffuser portions of the White Point outfalls (Figures 7 and 8). However, contaminant concentrations decreased significantly compared to results from previous investigations. Table 6 presents a data subset comparing the 2009 results with previous data sets (values indicated are averaged for the 0-8-cm sediment bed interval).

Table 6. Comparison of EPA's 2009 Sediment Data to Previous Investigations

Year	Station/core name	Investigator	Total DDTs (mg/kg)	Total PCBs (mg/kg)
Location 1				
1994	522/124-B1	USGS	4.2	0.52
2009	3C/BA3C	EPA	0.60	0.031
Location 2				
1994	556/131-W1	USGS	11	1.4
2009	6C/BA6C	EPA	0.73	0.063
Location 3				
1991	8C/not available	Sanitation Districts	183	Not available
2009	8C/BA8C	EPA	100	2.5

Table 7 presents the calculated Site-wide mean concentrations for DDTs and PCBs based for the 2009 data set.

Table 7. Site-Wide Mean Contaminant Concentrations in Sediment (with Cleanup Goals)

Parameter	Total DDTs (mg/kg OC)	Total PCBs (mg/kg OC)
Surface (0-8-cm) interval (2009 data set)	56	0.23
Cleanup interim level - immediate achievement of interim cleanup levels after cap placement	78	7
Cleanup interim level - interim cleanup levels to be achieved by the first FYR	46	7
Cleanup level - final cleanup levels by 2039	23	-

Abbreviations

cm Centimeter

OC Organic carbon

Notes

1. Values are in milligrams per kilogram normalized for organic carbon.

The mean concentrations of DDTs and PCBs placement in surface sediment based on the 2009 data set are less than the cleanup levels for surface sediment identified in the IROD related to cap placement; however, did not achieve the interim cleanup levels for total DDTs set to be achieved by the first Five Year Review. The remedy relied on two components, a cap and natural recovery processes, and as of this first Five Year Review, the cap has not been installed as was anticipated in selecting the interim cleanup levels. Early indication is that the natural processes may be able to achieve final cleanup goals without implementation of the interim cap component.

The regulatory agencies reviewed EPA's sediment data report for the 2009 sampling event and commented that more sampling needed to be conducted. EPA collected sediment samples in fall 2013 and is currently analyzing the samples. A report will be published in 2015.

Water Column

In September 2010, EPA used passive sampling devices to conduct a baseline water sampling event at 11 stations along PV Shelf and at a background station with historically low contaminant concentrations (Fernandez et al., 2012). Sampling depths were 5 m above the ocean floor, mid-column, and 5 m below the ocean surface. The sampling devices were collected after 32 days at sea and analyzed in a chemistry laboratory. Sample locations are shown in Figure 9.

The analytical data showed that *p,p*- DDE, DDMU, and *o,p'*-DDE were present in the water column, with decreasing concentrations from the 5 m above the seafloor to 5 m below the ocean surface. The DDT form with the highest dissolved concentrations was *p,p'*-DDE, with concentrations ranging from 0.036 nanograms per liter (ng/L) at the sampling location "up-current" (i.e., southeast) of the sampling location at the outfall diffusers to 0.99 ng/L at the station down-current of the outfall. The highest concentrations of DDTs and PCBs were "down-current" (i.e., northwest) of the deployment location at the outfall diffusers, and that concentrations decreased as distance from the Palos Verdes Peninsula (north towards Santa Monica Bay) increased. Concentrations of *p,p'*-DDE exceeded the human health National Recommended Water Quality Criteria (for salt water) at all stations, and exceeded the aquatic life National Recommended Water Quality Criteria at several locations.

The results supported the theory that reductive dechlorination of DDTs is occurring in the sediments, and the more water-soluble DDT forms (e.g., DDMU) are being transported into the water column. Also promising is the fact that the time trend for dissolved concentrations of contaminants indicates that concentrations may be decreasing (see Table 8; it should be noted that different sampling methods and sampling intervals were used - future sampling events will use the 5-meter standard).

Table 8. Site-Wide Average Concentrations of Dissolved Contaminants in Seawater (with Cleanup Goals)

Parameter or source	Depth of collection	Total DDTs (ng/L)	Total PCBs (ng/L)
1997 (Zeng et al., 1999)	1 meter above ocean floor	3.7	0.33
2010 (Fernandez et al., 2012)	5 meters above ocean floor	1.6	0.18
Cleanup level (IROD)*	-	0.22	0.064

Notes

*Based on National Recommended Water Quality Criteria

Pore Water in Sediment Bed

In July-August 2011, EPA deployed flux study platforms at five stations along PV Shelf and at one less contaminated station off site (Fernandez et al., 2014). The platforms were outfitted with passive adsorption-type sampling devices to assess concentrations of dissolved contaminants in the pore water in the sediment bed and in the water column immediately above the bed. Platforms were retrieved after 43 to 44 days at sea and the sampling devices were analyzed in a chemistry laboratory; platform locations are shown in Figure 10.

The study indicated that sediment at PV Shelf is a source of contamination to the water column, and that the stations with the highest historical contaminant concentrations in sediment showed the greatest flux from sediment to the water column. No noticeable flux was reported at the reference (off-site) location. The study also indicated that a layer of clean sand (cap) would be effective in isolating the contaminants from the environment, assuming methods for cap placement that would avoid resuspension and resettling of contaminated sediment on the clean cap material.

Institutional Controls Program – Monitoring Component

Prior to issuance of the 2009 IROD, the fish market study for PV Shelf was conducted from July 2004 through January 2005 (CH2M Hill, 2005), and consisted of purchasing 30 white croakers from six Los Angeles fish markets and analyzing fish tissue samples (skin-off filets) for DDTs and PCBs. Results from the study indicated that concentrations of Total DDTs ranged from 58 µg/kg to 12,000 µg/kg, and concentrations of Total PCBs ranged from 27 µg/kg to 1,000 µg/kg (CH2M Hill, 2005).

EPA entered into agreements with local environmental health agencies and the California Department of Fish and Wildlife (formerly Department of Fish and Game) to conduct inspections at retail and wholesale markets, and at in-water, dockside, and shoreline locations in late 2008. Since November 2010, no white croakers have been observed in any of the local markets, including markets where white croakers had been previously identified.

Table 9 is a summary of data from white croaker samples collected during the Phase 2 PV Shelf Fish Market Study. The data indicate that DDT concentrations were below the IROD cleanup goal of 400 µg/kg, but PCB concentrations were still higher than the corresponding cleanup goal of 70 µg/kg.

In 2010, the monitoring program was expanded to include the collection of lobsters from four areas near PV Shelf, namely White Point, Rocky Point, Long Point, and the Los Angeles Breakwater. The Los Angeles Breakwater is considered the non-impacted reference location. As indicated in Table 10, contaminants were detected in lobster tail (edible tissue) and the tomalley; however, the risk of cancer due to consumption of lobsters is below EPA's normal range of concern.

Table 9. Ranges of Contaminant Concentrations in White Croakers (Skin-Off Filets) – Institutional Controls Program 2008-2012

	Minimum	Maximum	Mean	Cleanup Goal
Near-Shore/In-Water				
Total DDTs	40	257	138.5	400
Total PCBs	28	254	129.7	70
Markets				
Total DDTs	5	90	34.7	400
Total PCBs	2	15	8.85	70
Piers				
Total DDTs	10	294	96.9	400
Total PCBs	6	516	104.4	70

Notes

1. All concentrations are in micrograms per kilogram = µg/kg = parts per billion.
2. Results for individual croaker filets are available in *Risk Evaluation of Fish Monitoring Results and Lobster Data – Palos Verdes Shelf* (ITSI Gilbane, 2014).

Table 10. Ranges of Contaminant Concentrations in Lobsters – Institutional Controls Program 2011

Analyte	Minimum	Maximum	Mean	Cancer Risk Estimates (based on Reasonable Maximum Exposure Conditions)
Lobster Tails				
LA Breakwater (reference point)				
Total DDTs	0.3	0.9	0.4	8×10^{-9}
Total PCBs	1.9	4.2	2.7	3×10^{-7}
Other Areas				
Total DDTs	0.3	0.9	0.3 – 0.4	5×10^{-9}
Total PCBs	1.7	4.2	1.9 – 2.1	2×10^{-7}
Lobster Tomalley				
LA Breakwater (reference point)				
Total DDTs	1.7	37	9.2	3×10^{-7}
Total PCBs	18.8	229	75.7	1×10^{-5}
Other Areas				
Total DDTs	0.6	27.1	5.1	5×10^{-8} to 2×10^{-7}
Total PCBs	6.3	59.2	24	2×10^{-6} to 4×10^{-6}

Notes

1. All concentrations are in micrograms per kilogram = µg/kg = parts per billion.
2. Results for individual lobsters are available in *Risk Evaluation of Fish Monitoring Results and Lobster Data – Palos Verdes Shelf* (ITSI Gilbane, 2014).

Institutional Controls Program – Enforcement and Outreach Components

Overall, data collected between early 2008 and the end of September 2013 have demonstrated the absence of white croakers in local markets, restaurants, and commercial fishing facilities. Of the 1,607 market inspections conducted during that time period, white croakers were observed on only 12 instances. White croakers have not been observed in any local markets or restaurants since 2011.

However, data suggest that white croakers still are commonly caught (and released) by recreational anglers fishing along the shoreline of the Palos Verdes Peninsula. Of the recreational anglers contacted

since 2008, up to 86 percent of them reported being aware of existing fish contamination issues (SGA 2012, 2013, 2014). Other "do not consume" fish, such as barred sand bass, also were commonly caught during enforcement and monitoring efforts.

The most recent data suggest a high awareness level of the fish contamination issue among market operators and employees; over 90 percent of the market/restaurant employees surveyed for Los Angeles and Orange County and 83 percent for Long Beach demonstrated awareness (SGA, 2014), although the most commonly reported sources of information varied between different jurisdictions. In Los Angeles County (including Long Beach), health inspectors were reported as the most common sources of information, while in Orange County the most common reported sources were FCEC materials.

The data demonstrate that contaminated fish are not reaching the local markets and also validate the continued effectiveness of the institutional controls program in reducing the presence of contaminated fish in local markets.

Fish Movement

EPA conducted a fish movement study at PV Shelf from 2010 to 2012 using acoustic telemetry methods. Objectives of the study included assessment of movement patterns, degree of site fidelity, habitat use, and migration patterns of white croakers and barred sand bass. Arrays of acoustic receivers (including a fine-scale array covering the White Point outfalls) were deployed at PV Shelf, and small arrays were installed at the breakwater gates to Los Angeles Harbor (Angels Gate and Queens Gate). Ninety-seven white croakers and 55 barred sand bass were caught using hook and line, transmitters were surgically implanted, and the "tagged" fish were released and tracked using the receiver arrays.

Results of the study showed that many white croakers exhibited "transient" behavior and spent only about 1 percent of their time in the vicinity of the White Point outfalls; other croakers exhibited foraging/refuging behavior, spending about 10 percent of their time near the White Point outfalls. The study concluded that these behavioral patterns could be a reason for wide-ranging COC concentrations historically detected in tissue samples of white croakers. Another conclusion of the study was that barred sand bass exhibited site fidelity for PV Shelf, and returned there after seasonal spawning migrations (Lowe, C.G., 2013).

6.5. Site Inspection

For practical reasons, typical site inspections at PV Shelf are not possible. The selected remedy consisting of institutional controls, monitored natural recovery, and containment (outfall area cap – postponed at this time) did not necessitate a physical site inspection.

6.6. Interviews

As part of the FYR process, interviews were conducted with regulatory agencies, community organizations, and members of the PV Shelf technical advisory group. Interview questions were sent out via e-mail to the list of interviewees below in January 2014. Those interviewed were also given the

option of conducting the interviews via phone. A summary of the interviews is presented below. Full transcripts of the responses are included in Appendix C.

Regulatory Agency Interviews

The following individuals representing regulatory agencies were interviewed regarding their knowledge of and/or concerns about the RA at PV Shelf.

- Robert Brodberg – Chief, California Office of Environmental Health Hazard Assessment (OEHHA)
- Rebecca Hartman – Boat Captain, CDFW
- Michael Lyons – Staff Environmental Specialist, Los Angeles Regional Water Quality Control Board
- Tayseer Mahmoud – Project Manager, California DTSC
- Salwa Mina – Environmental Health Specialist, Los Angeles County Public Health
- Mozhgan Mofidi – Supervising Environmental Health Specialist, Orange County Environmental Health Division
- Patty Velez – Environmental Scientist, Superfund Program, CDFW

Overall, representatives from local and state regulatory agencies have indicated that the ICs component of the remedy has had a positive impact in protecting the public through outreach and education about risks associated with consuming contaminated fish from PV Shelf.

With regard to the monitored natural recovery component of the remedy, most agreed that the remedy was functioning as expected. Most were also aware of the decreasing contaminant mass and concentrations based on the 2009 sediment monitoring data. However, some parties questioned whether reductions in mass and concentrations were attributable to chemical transformations or biodegradation, or whether the contaminants had merely migrated to other locations. It was agreed that additional sampling of various environmental media, notably sediment, will prove valuable in addressing these questions.

Some particular concerns included the lack of participation from Hispanic and community-based organizations during meetings among the different stakeholders, and the need for continued outreach to market and commercial fishing entities.

Community Interviews

The following individuals representing community organizations were interviewed regarding their knowledge of and/or concerns about EPA's response actions for PV Shelf.

- James Alamillo – Heal the Bay, Urban Programs Manager
- Stephen Groner – S. Groner Associates, Inc.

Overall, these community representatives indicated that the institutional controls component of the remedy was functioning as expected, and is effective in reaching its outreach and educational goals. There was consensus that outreach and educational efforts need to continue, and there may be a need to

re-evaluate the program to better target specific audiences (e.g., recreational and sport-fish anglers, and vulnerable populations – notably women of child-bearing age and children).

With regard to the MNR component of the remedy, both of these representatives were aware of the decreasing mass and concentrations of DDTs and PCBs based on the 2009 sediment monitoring data. Heal the Bay expressed reservations as to whether the MNR was functioning properly without first addressing key issues regarding the site, such as: (1) a defensible explanation for the significant reduction in concentration of DDT and PCB in sediment; (2) an explanation of how PCBs are showing significant concentration reductions given their highly stable nature; and (3) an explanation for why the reduction in sediment concentrations is not reflected by an equally significant reduction in fish tissue concentrations.

Other particular concerns included the need for development of a descriptive food web model of that demonstrates the fate and transport of DDT and PCB within the PV Shelf ecosystem (to include the water column and sediment); addressing contamination in other areas hydrologically and ecologically linked to PV Shelf (i.e. Santa Monica Bay and San Pedro Bay); improving coordination between the stakeholders and PVSTIEG members; and addressing uncertainties with regard to risk associated with anglers fishing for barred sand bass.

Interviews with the PV Shelf Technical Advisory Group

The following individuals representing the PV Shelf technical advisory group were interviewed regarding their knowledge of and/or concerns about the RA at PV Shelf.

- Robert Eganhouse – United States Geological Survey, Research Chemist
- Mark Gold – UCLA Institute of the Environment and Sustainability, Associate Director
- Joseph Gully – Sanitation Districts of Los Angeles, Supervising Environmental Scientist
- Guangyu Wang – Santa Monica Bay Restoration Commission

Overall, representatives from PVSTIEG expressed that the ICs component of the remedy was functioning as expected, and has been the most successful aspect of the Superfund effort. Many also indicated that the project is taking adequate steps to protect public and environmental health, and is generally moving in the right direction. Several concerns raised by the interviewees are:

- Overall slow pace of the project
- Uncertainties in the results of the 2009 sediment data set
- Inexplicable reduction in the magnitude of contamination over a short period of time
- Need to replicate and expand 2009 sediment study
- Need for greater transparency and better communication among all parties involved with PV Shelf, a need for periodic project updates
- Need to revisit the institutional controls program to assess which aspects of the program have been and will be most effective

Specific concerns raised include:

- Recognition that reductive dechlorination of dominant DDT 'parent' compounds (i.e. DDE and DDD), can generate metabolites (e.g., DDMU, DDNU) that may exhibit toxicity
- CDFW's commercial catch ban on white croaker has not changed in 20 years; expanding the regulatory component of ICs program is overdue,
- Need for clean fish certification program for fish caught in the Southern California Bight (Figure 1 shows the Southern California Bight)
- Need to re-assess current fish consumption message (with regard to certain populations consuming fish contaminated with mercury, which is not a chemical of concern at PV Shelf)
- Need for fish monitoring data to correspond with and support sediment data

6.7. Institutional Controls

The institutional controls program for PV Shelf was described in Section 4.1, *Remedy Selection*. Implementation of the program was described in Section 4.2, *Remedy Implementation*.

From 2008 through 2013, 1,607 market and restaurant inspections were conducted. White croaker was observed only 12 times, suggesting that outreach and monitoring efforts have been highly successful in preventing contaminated fish caught at PV Shelf from reaching local food facilities. White croaker has not been observed in any local markets or restaurants since 2011.

Recent data also suggest a high level of awareness regarding fish contamination issues among market operators and employees, with positive responses from over 90 percent of the market/restaurant employees for Los Angeles and Orange County locations, and 83 percent for Long Beach locations. The most commonly reported sources of information were materials and information disseminated by FCEC and local health agency partners. Similarly, recreational anglers contacted at piers and other shoreline locations on the Palos Verdes Peninsula have expressed a high level of awareness regarding fish contamination issues, with the most commonly reported sources of information being game wardens and signage.

CDFW continues its enforcement activities through patrols related to the commercial catch ban area and the daily catch limit restrictions for recreational anglers. CDFW has expanded its efforts to include inspection of wholesale fish retail businesses.

No improvements to the program are needed at this time.

7. Technical Assessment

7.1. Question A: Is the remedy functioning as intended by the decision documents?

<u>Institutional Controls</u>

The ICs component of the remedy is functioning as intended by the decision documents. The ICs program has been successful in limiting human exposure to contaminated fish through aggressive

outreach and education programs performed by EPA in partnership with other federal, state, and local agencies, and community-based organizations.

Based on data from recent years, the ICs program has been effective in preventing contaminated fish from reaching local markets and restaurants. Given this trend, the frequency of the market monitoring for Long Beach and Orange County markets could be reduced to a semi-annual schedule for all monitored areas (frequency of monitoring of Los Angeles markets is already semi-annual) and focus more efforts on the outreach efforts in the pier areas.

Monitored Natural Recovery

The MNR component of the remedy for PV Shelf is functioning as intended. As previously noted, concentrations of contaminants detected in sediment samples at PV Shelf derived from cores collected in fall 2009 showed significant decreases compared to results from pre-remedy sediment sampling events. Based on the significant decrease in concentrations of DDTs and PCBs detected in sediment samples, the design and installation of a clean sediment cap were suspended. Additional sediment monitoring data are being collected to determine if remedial action objectives can be achieved without the cap. The Sanitation Districts have reported a temporal decline in levels of contamination in sentinel fish species caught at PV Shelf (including white croaker) since the 1990s (Sanitation Districts, 2012). Limited fish tissue analyses indicate that the remedial action objective for DDTs in fish tissue is being achieved in white croaker. At this time the data set to evaluate compliance with applicable water quality objectives is insufficient. EPA is currently analyzing water column data from passive samplers that were deployed in fall 2013.

The standard sediment sampling approach established by the Sanitation Districts (and used by EPA) for PV Shelf is to process the sediment cores into samples by freezing them and then cutting them into slices 2-cm thick. . For the 2009 event, this approach generated more than 1,000 samples that were analyzed for physical and chemical parameters; the 2013 event generated about 1,500 samples that are currently being analyzed. The sampling approach could be optimized by analyzing only the samples that represent the top 8 cm of the sediment bed, i.e., the biologically active zone where contaminants present a risk to human health by entering the food web. Sediment samples representing the deeper bed layer could be archived for possible future analysis if data from deeper zones become important to the remedy.

Cap

As previously described, the cap component of the interim remedy for PV Shelf has been postponed pending analysis of data sets for sediment, ocean water, and ecological receptors (fish). No statement regarding the effectiveness of the cap can be made at this time.

7.2. Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives (RAOs) Used at the Time of Remedy Selection Still Valid?

A review of the exposure assumptions and RAOs used at the time of remedy selection and the current understanding of the site indicate that they remain valid, as explained below.

- There has been no change to the standardized risk assessment methodology that could affect the protectiveness of the remedy.
- There have been no changes in the ARARs that would affect the protectiveness of the remedy.
- Uses of the area at or near PV Shelf have not and are not expected to change.
- No new human health or ecological routes of exposure or receptors have been identified, and none of those previously identified have changed.
- There are no newly identified contaminants or contaminant sources, nor any unanticipated toxic byproducts of the remedy not previously addressed by the decision documents.
- Neither physical site conditions nor the understanding of these conditions has changed.

Currently, the remedy is progressing as expected, and remains protective of human health and the environment. The ICs program is well established and has been and remains effective in protecting human health. The physical, chemical, and biological mechanisms of MNR appear to be effective in reducing contaminant levels in the sediment bed. The isolation cap as described in the IROD is postponed pending results of an ongoing sediment sampling program (samples were collected in fall 2013 and currently are being analyzed for chemicals of concern). The need for the cap will be re-evaluated after sediment results are examined.

7.3. Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

There is no information that could affect the evaluation of protectiveness of the remedy.

7.4. Technical Assessment Summary

Currently, the interim remedy is progressing and functioning as expected, and remains protective of human health and the environment. The ICs program is well established and has been and remains effective in protecting human health. Site-specific processes of MNR are evident and appear to be effective in reducing risk to human health and ecological receptors; these processes include biotransformation, burial, and mixing in place. EPA has postponed the isolation cap component of the interim remedy because the 2009 sediment sampling program indicated lower-than-expected contaminant concentrations. Additional response actions that can accelerate recovery, e.g., capping, will be assessed after the data from EPA's ongoing sediment, water, and fish sampling programs are evaluated.

8. Issues

There were no issues identified for PV Shelf that affect current or future protectiveness.

9. Recommendations and Follow-up Actions

Although there were no issues identified in this FYR, the following are recommendations that will support the effectiveness of the remedy:

- The 2009 sediment sampling event represented EPA's baseline sediment event. Additional rounds of sediment sampling should be conducted approximately every 5 years to confirm the low contaminant concentrations reported in the baseline study. (A 5-year frequency for sediment sampling is appropriate for PV Shelf, as the shape and thickness of the contaminated sediment bed does not appear to undergo rapid change; there are no significant ongoing sources of contaminants; and the rates of contaminant biodegradation are low).

- The sediment sampling approach could be optimized by analyzing only the samples that represent the top 8 cm of the sediment bed, i.e., the biologically active zone where contaminants present a risk to human health by entering the food web. Sediment samples representing the deeper bed layer could be archived for possible future analysis if data from deeper zones become important to the remedy.

- Identification of a second indicator species of fish (in addition to white croaker) would help assess effectiveness. There has been a decrease over time in catch frequency of white croakers at PV Shelf, and currently the species demonstrates limited site fidelity. White croaker will continue to be used as an indicator species because traditionally they have been commonly caught in southern California and have shown high concentrations of PV Shelf contaminants.

10. Protectiveness Statement

The interim remedy at Montrose Chemical Corporation Operable Unit 5 (Palos Verde Shelf) is protective of human health and the environment. Institutional controls are in place and are effective in protecting users of PV Shelf. Results of sampling programs and research by EPA and others indicate that natural recovery processes are occurring. The combination of institutional controls and monitored natural recovery is effective and is progressing towards attaining the specific interim cleanup goals and timelines set forth in the Interim Record of Decision.

11. Next Review

This is a statutory site that requires ongoing FYRs as long as waste is left on site that does not allow for unrestricted use and unlimited exposure. The next FYR will be due within 5 years of the signature date of this FYR.