

APPENDIX BB
EPA RESPONSES TO PVSTIEG COMMENTS

EPA RESPONSES TO PVSTIEG COMMENTS

DRAFT FIRST MONITORED NATURAL RECOVERY REPORT (DATA COLLECTIONS 2013-2016)

PALOS VERDES SHELF (OPERABLE UNIT 5 OF THE MONTROSE CHEMICAL CORP. SUPERFUND SITE) LOS ANGELES COUNTY, CALIFORNIA NOVEMBER 2017

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<i>Comments from Dr. Naoko Munakata, Supervising Engineer, Sanitation Districts of Los Angeles County, letter dated 31 January 2018</i>					
<i>General comments</i>					
<p>The draft report provides a comprehensive characterization of the PV Shelf sites, as well as detailed analyses for surveys of sediment, water column, and fish tissue. The Sanitation Districts agree with the basic conclusions of the report:</p> <ul style="list-style-type: none"> • Conditions on the PV Shelf appear to be improving for Chlorinated Organic Carbon (COC), with concentrations in the 0-2 cm bed-depth interval of the sediment continuing to decrease. • Concentrations in the 0-8-cm bed-depth interval met the performance objectives related to the interim cap described in the IROD, even without the cap. • However, significant areas of sediment remain highly contaminated, and COC concentrations in samples of water and fish tissue exceeded the associated cleanup goals for both DDT and PCBs in the Interim Record of Decision. 					Comment acknowledged.
<i>Specific comments – sediment</i>					
1a	-	-	-	Comparison only between 2009 and 2013 may misleadingly suggest increasing contamination during the past 4 years. We recommend including the 2002/2004 results from the earlier surveys.	<p>The 2002/2004 data set was generated from samples collected using a different type of sediment sampler, to a different depth, and at a different number of locations; also, the sediment samples were processed differently. It would not be appropriate to conduct a direct comparison between the 2002/2004 data set with the 2009 and 2013 data.</p> <p>Though results show apparent increases in values of COC average concentrations and mass between 2009 and 2013, the overall comparison to historical estimates of mass of DDTs shows a decrease, as is discussed in the report, as indicated</p>

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					by trend analysis using the 2002/2004 data set presented in Figures 4-1 and 4-3 (see Section 4.1.2.2).
1b	6	-	-	<p>The report states that the EPA baseline sediment survey was based on the Sanitation Districts' program for sediment chemistry and benthic infauna. However, differences in the two sets of samples should be noted: EPA used transects 1-10 at depths ranging from 40 m to 150 m, and the Sanitation Districts collects samples from transects from 0-10 at depths ranging from 30 m to 305 m.</p> <p><i>Follow up comment (received 01 May 2018):</i></p> <p>Technically, the stations sampled by EPA included NPDES sediment stations (not coring stations) and some additional locations (not a subset). Suggest revising as follows: "For the core locations in the MNR sediment program, EPA used a subset of the Sanitation Districts' stations typically used for the JWPCP NPDES compliance programs for sediment sampling, along with a few additional stations. The Sanitation Districts typically..."</p>	<p>Upon further review, it was revealed that there were competing and conflicting statements regarding the sediment sampling grid. The text in question (on Page 6) has been moved to Section 2.1.1 on Page 10. The text there has been edited to incorporate comments, as follows:</p> <p><i>Figure 2-1 shows the locations of sediment cores planned for the 2013 shelf-wide sampling event. As described in the Field Sampling Plan (FSP; ITSI Gilbane, 2014), these locations were collocated with EPA's baseline program conducted in 2009. For both events, EPA used a subset of the Sanitation Districts' stations typically used for the JWPCP National Pollutant Discharge Elimination System (NPDES) compliance programs for sediment sampling (California Regional Water Quality Control Board, Los Angeles Region [Water Board], 2017). The Sanitation Districts have established shore-normal Transects 0 through 10, numbered north to south. Transect 0 is located north of Palos Point near Bluff Cove (Figure 1-1), and Transect 10 is located near Point Fermin at San Pedro. Transect 8 is aligned along the White Point outfalls. Along these transects, the Sanitation Districts have established stations along the following main isobaths (water depths): A (305-m); B (150-m); C (60-m); and D (30-m). For locations between main isobaths, the convention is to combine the names of the two nearest isobaths (e.g., isobath BC is at a depth of 100 m, and DC is at a depth of 40 m). For EPA's 2013 MNR shelf-wide program, primary cores were planned for 34 locations using Transects 1 through 10 and along the B, BC, C, and DC isobaths. Replicate cores were planned for locations 2B, 4C, and 5B (Figure 2-1).</i></p>
1c	-	-	-	Several maps (Figure 3-x and 4-x) mislabeled the "D" depth label at the 40-m water depth. The correct water depth for "D" is 30 m.	The corrections have been made. Also, the Sanitation Districts' isobaths and transects have been added to several figures to assist the reader.

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Specific comments – water column					
2a	-	-	-	The two methodologies used for collecting water samples at various depths generated inconsistent results, even at the same depth/station. We recommend that future studies use a single sampling technique.	Comment noted. For future water sampling events, EPA at the present time plans to use both sample collection/analytical techniques (i.e., the passive method [with preparation, deployment, and lab analysis of PSDs], and the direct-to-bottle collection method [with high resolution analytical tests]. This approach will allow EPA to continue to evaluate both methods and allow for additional time trend analysis.
2b	-	-	-	Some of the hi-res water sampling video clips are either not provided or incomplete in Appendix P2 (missing: BA7B, BA8C and W2 at some water depths; incomplete: BA2C at 55m, BA2DC: no sampling device).	For locations BA2B, BA2DC, and BA4C, the video camera was inadvertently pointed away from the sampler device – aural recordings confirmed the sample collections. For locations BA7B and W2, there are no video/aural records. For location BA2C, the video memory card filled up, and only a partial record was recovered. A note was added to the cover of Appendix P2 to specify the missing videos and the reason for their absence.
Specific comments – fish tissue					
3a	ES-5	-	-	The report states that the Sanitation Districts do not publish data for Barred Sand Bass (BSB). However, the Sanitation Districts submit analytical results for BSB contamination to the Los Angeles Regional Water Quality Control Board every other year to fulfill the biennial seafood safety bioaccumulation monitoring program under the JWPCP NPDES permit; these data are available to the public.	The fish comparison tables (Tables 4-6 and 4-7) have been revised to add the Sanitation Districts' BSB data from 2012 (Local Seafood Safety Survey). Section 6.0, <i>References</i> , has been edited to add the report citation (Sanitation Districts, 2014). The text in the executive summary and in Section 4.3.2.3, <i>Time Trends</i> , has been revised to note the Districts' typical biennial collection of BSB, and to discuss comparisons of the data sets.
3b	-	-	-	When comparing results between EPA and the Sanitation Districts for White Croaker (WC), the report should note variances between the two studies, e.g., fish specimen preparation (individual vs. composite) and sample size for Zone 2 (30 vs. 10 fish).	To reflect the comment, the following note has been added to Tables 4-6 and 4-7: <i>7. Sanitation Districts' 2012 results for BSB and 2015 results for WC are from fish surveys typically conducted as part of JWPCP NPDES permit compliance. Those results are from analyses of composited samples of 10 fish specimens (one composite from Zones 1, 2, and 3; Sanitation Districts, 2014, 2016).</i>

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					<p>The text in Section 4.3.2.3, <i>Time Trends</i>, was revised as follows:</p> <p><i>Tables 4-6 and 4-7 show summaries of DDT and PCB data respectively, generated from: NOAA's 2002/2004 study (NOAA/EPA, 2007); recent EPA studies from shallower pier fishing locations related to the ICs program (WC only; Gilbane, 2016b, 2017); the Sanitation Districts' 2012 (BSB) and 2015 (WC) data (Sanitation Districts, 2014, 2016); and this MNR study. An attempt was made to align locations of fish collections from these various efforts to examine time trends.</i></p> <p>Additional edits to text in Section 4.3.2.3 have been made to reflect trends of BSB concentrations using the added 2012 data from Sanitation Districts, and to add months of collection for each main study.</p>
3c	-	-	-	On the fish collection map (Figure 2-5), fish caught within the Sanitation Districts' fishing zones are not limited to the 1 km x 5 km rectangle areas; these areas should be removed.	<p>On Figure 4-5, the EPA collection areas in question have been re-labeled "EPA Zone 1", "EPA Zone 2", and "EPA Zone 3". The boundaries of Sanitation Districts' fish tissue bioaccumulation sampling zones will be retained for informational purposes. Text in Section 2.3.1, <i>Design of Sample Collection</i>, has been revised as follows:</p> <p><i>The MNR fish collection areas and numbers of samples were derived by consensus during a scoping discussion at the PVSTIEG meeting held January 2014. Seven collection areas were selected, each 1 km x 5 km. They are as follows (from north to south): Ventura Flats; Redondo Flats; three areas within the Sanitation Districts' NPDES bioaccumulation zones (EPA Zones 1, 2, and 3); an area near the breakwater of Los Angeles Harbor; and Huntington Flats (Figure 2-5). These areas are described as follows:</i></p> <p>The third bullet in this section has been revised as follows:</p> <p><i>EPA Zones 1, 2, and 3, are subareas within the boundaries of the respective Sanitation Districts' three Fish Tissue Bioaccumulation Sampling Zones used in the JWPCP NPDES compliance programs for fish. The EPA zones were</i></p>

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					<i>located along the 60-m isobath, where the Sanitation Districts' outfall diffusers, the former source of release of COCs to the environment, are located. BSB and WC collections were planned for each of these three EPA zones.</i>
3d	-	-	-	A typo found in Appendix T needs correction. The standard length and total length for a BSB collected at Zone 2 in 2015 (ID#: Z2BSB-2014-06) should be 331 mm and 409 mm, respectively.	Edits have been made to Appendix T to reflect the comment.
<i>Sanitation Districts comment from Dr. Naoko Munakata received via e-mail dated 01 May 2018</i>					
-	-	-	-	It seems more technically sound to use a single year as a baseline for the sediment, water column, and fish tissue. It would be a clear disconnect to use sediment data from 1980 and water/fish data from 2013; the same concept applies to 2009 and 2013, though these years are much closer together. Also, I understand that the 2009 results are considered valid and therefore reasonable to use as a baseline, but at the same time, it seems odd to use outliers (values at the edge of observed data) as the baseline, even if the values are within the natural heterogeneity. The 2009 data are very important as in indicator of the variability in measurements, but 2013 seems more appropriate to use as the baseline.	Comment acknowledged. As recognized by the comment, EPA considers the 2009 data set a valid data set in that all procedures for sediment core collection, sample generation, and laboratory analyses for both physical and chemical tests, passed all quality control and quality assurance checks and requirements. The 2009 and 2013 sediment events are currently the only two events for PV Shelf that used near-identical approaches for collection, handling, and analysis of samples. After EPA generates a new sediment data set (using the procedures developed during the 2009 and 2013 sediment events), EPA will reconsider the usefulness of the 2009 data set as a "baseline".
<i>Comments from Mssrs. Daniel Cordero Jr., and Ted Peng, P.G., California Department of Toxic Substances Control, letter dated 08 March 2018</i>					
<i>General comments</i>					
1	-	-	-	The 2013 sediment sampling results should be considered as the baseline for all future sediment, water column and fish tissue sampling activities. Due to the complex nature of the PV Shelf environment, heterogeneity of the sediment bed and overall dynamic deposition condition, DTSC believes that establishing a reliable time trend analysis of sediments based on concentrations will be extremely difficult and inconclusive. This is due to, but not limited to, the difficulty in reproducing the same	EPA considers the 2009 sampling event for sediment as the baseline event. As described above, procedures for sediment coring, sample generation, and laboratory analyses for both physical and chemical tests, passed all quality control and quality assurance checks and requirements. EPA has concluded that the results are valid. EPA considers the 2013 water column and fish tissue events as baselines for water column and fish tissue sampling activities.

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				sediment sampling depths and locations. The MNR Report states that the total sediment mass of chemicals of concern (COCs) increased from the 2009 sediment sampling event. The stated reason was the heterogeneity of the sediment bed. DTSC recommends that sediment sampling be focused on determining mass of COCs over time, since various factors prevent a point by point concentration comparison.	
2	-	-	-	<p>a. DTSC believes that reliance on both water column and fish tissue results will allow EPA to better understand when contaminants in the PV Shelf will fully attain the cleanup goals. Also, an effort to coordinate fish tissue sampling should be made with the Sanitation Districts.</p> <p>b. COC concentrations (<i>in fish</i>) reported by the Sanitation Districts in 2015 are much higher than those reported by EPA in this MNR report. This could cause undue alarm from the public when trying to reach final resolution of mitigation measures occurring at PV Shelf.</p>	<p>In the future, EPA will collect water column samples and fish specimens using collection methods established during this MNR study. The high resolution analytical techniques used here will also be used in the future, to allow meaningful data comparisons and time trend analyses.</p> <p>EPA looks forward to continuing to work closely with the Sanitation Districts in the future. A statement regarding the Sanitation Districts’ participation in this MNR program, done as Special Studies related to the JWPCP NPDES permit, has been added to Section 7.0.</p> <p>b. The data sets noted in the comment were generated from two separate fishing programs. Differences between the programs include: the Sanitation Districts’ typically analyze composites of filets of 10 specimens, whereas EPA analyzed filets from individual specimens; the Sanitation Districts apply a size standard for WC, by which smaller fish are rejected, whereas EPA applied no such standard; different laboratories were used for preparing and analyzing samples.</p> <p>Though the Sanitation Districts’ results for DDTs in WC are higher than EPA’s results, the Districts, in reporting temporal trends of COCs in fish, state that the data show “significant declines” of COC concentrations in WC over time (Sanitation Districts, 2016). No edits to the text have been made as a result of this comment.</p>

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3	-	-	-	DTSC recommends that EPA continue to research possible avenues for mitigation in the areas of highest contamination around the discharge pipes (i.e. hot spot diffuser area) other than cap placement. During discussions with EPA, DTSC discovered that a pilot study cap was constructed per IROD. The pilot study cap was determined to be less than successful because it did not mitigate the dissolution of COCs to the water column or effectively contain the impacted sediments (some contaminated sediments billowed onto the cap). While the test cap was not entirely effective, it partially cut off an exposure pathway (direct contact) to sensitive receptors from high concentration COCs beneath the cap. As for the COCs that migrated to the top of the cap, those concentrations would tend to be much more susceptible to the MNR process.	In the near future, EPA will issue a focused feasibility study (FFS) report that will again examine and evaluate a burial (chemical isolation) cap as a remedial alternative. Cap placement techniques other than the hopper techniques used during the 2001 pilot study are available. The fact remains, however, that a significant portion of the contaminants is present at or near the diffuser portions of the 350-mgd active outfall system; these areas are and will continue to be off-limits to capping, severely limiting the effectiveness of the capping option. The full report of EPA's pilot study is entitled, <i>Field Pilot Study of In Situ Capping of Palos Verdes Shelf Contaminated Sediments</i> , T.J. Fredette, et al., September, 2002, and is available on the EPA website for PV Shelf.
Comments from Alan Tsao and Bruce Joab (California Department of Fish and Wildlife), received by e-mail dated 26 February 2018					
General comments					
1	ES-7	-	-	<p>1. Summary of IROD Compliance Table.</p> <p>a. The Interim Record of Decision (IROD) for Palos Verdes Shelf (EPA, 2009) established the remedial action objective (RAO) for DDD in water also, which is 0.31 ng/L. Please list this interim cleanup goal for DDD in water in the subject table. CDFW-OSPR recommends that the RAO for DDD in water be added globally to other places in the subject document where it discusses the RAOs (example, Section 1.3, <i>Description of Interim Remedy</i>).</p>	<p>a. In consultation with PVSTIEG, EPA has determined that, for assessing human health risk related to ocean water at PV Shelf, the federal AWQC value for p,p'-DDE (0.22 ng/L) is the cleanup objective, per Sections 1.3 and 4.2.4. This criterion is justified because, in terms of frequency and magnitude of detections, p,p'-DDE is the most prevalent DDT form in the water column (and in other media) at PV Shelf, and its AWQC value is more conservative than that for p,p'-DDD (0.31 ng/L) and equally conservative to that for p,p'-DDT (0.22 ng/L). This will be clarified in the upcoming final Record of Decision. For this MNR report, the human health AWQC for p,p'-DDD and for p,p'-DDT (0.31 ng/L and 0.22 ng/L, respectively) have been removed from the tables in Appendix Q, and the following notes have been added:</p>

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				<p>b. Please clarify whether the 0.31 ng/L specified in the IROD is for p,p'-DDD or the sum total of o,p'-DDD and p,p'-DDD. Revise as appropriate to be consistent with the IROD.</p> <p>c. It would be helpful to clarify that the “representative value” is the arithmetic mean for the 0-8 cm interval from the shelf-wide and outfall area combined based on the 2013 data set; and that these values do not encompass data from total sediment bed.</p> <p><i>Follow-up comment to response for Comment 1c (received by e-mail on 14 May 2018):</i></p> <p>On p. 44, the subject report states, “For the 2013 data set, the mean value of Total DDTs OC in the 0-8-cm bed depth interval was 77 mg/kg OC (77,000 ug/kg OC) [underlined emphasis added by CDFW-OSPR].” Also, on p. ES-4, the subject states “the respective values of OC</p>	<p>7. Shaded cells show p,p'-DDE greater than its AWQC for human health (0.22 ng/L). This criterion has been adopted as the cleanup goal because, in terms of frequency and magnitude of detections, p,p'-DDE is the most prevalent DDT form in the water column at PV Shelf, and its AWQC value is more conservative than that for p,p'-DDD (0.31 ng/L), and equally conservative to that for p,p'-DDT (0.22 ng/L).</p> <p>8. Underlined cells show Total DDTs greater than the DDTs AWQC for saltwater aquatic life (1 ng/L). This criterion has been adopted as the cleanup goal, per the IROD (EPA, 2009).</p> <p>b. Please see response to Comment 1a above.</p> <p>c. The reported “representative value” is based on results of samples from the 0-8 cm bed-depth intervals from the shelf-wide and outfall cores combined. That value does not represent the arithmetic mean, because it is derived from the MVS geostatistical model. As described in Section 3.2 of Appendix C, <i>MVS Modeling Report</i>, the average COC concentrations for the PV Shelf model were derived by summing the modeled concentrations at all nodes and dividing by the total number of nodes. Note 2 to the table on ES-7 indicates, “For sediment, all values are for the 0-8 cm bed-depth interval (the bioactive zone at PV Shelf). The representative values are the mean (average) OC normalized concentrations as generated by the current output of the geostatistical model.”</p> <p>Comment acknowledged. To clarify, the “average” COC concentrations <u>are</u> the arithmetic means of the modeled sediment data set – the modeled set included the actual lab values at the sample locations, and the kriged results at the grid nodes between the actual sample locations. The method</p>

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				<p>normalized concentrations averaged over the shelf were 56 mg/kg OC and 77 mg/kg OC [underlined emphasis added by CDFW].” Given that EPA does not believe that the 77 mg/kg is an average (or mean) value, and that the 77 mg/kg OC DDT is only a geostatistical output, please rectify the document by either revising the sentences quoted above or revise Note 2 to the table on p. ES 7 to ensure consistency.</p> <p>d. Given the heterogeneity of the data collected, CDFW-OSPR recommends that EPA consider adding a range of values such as the 95% Upper Confidence Limit on the mean and the 95% Lower Confidence Limit on the Mean to “bracket” the “representative value” for outfall area and for the full model area (i.e. shelf-wide and outfall area combined).</p> <p><i>Follow-up comment to response for Comment 1d (received by e-mail on 14 May 2018):</i></p> <p>The response partially addresses the comment. CDFW-OSPR would like to clarify that we are not stating that the site is not well characterized. CDFW-OSPR is in agreement with EPA that the site is heterogeneous. CDFW-OSPR maintains our recommendation that a measure of variability to indicate the dispersion of</p>	<p>of deriving these mean values is described in Appendix C, Section 3.2. EPA confirms that the computed value for the mean (average) concentration of Total DDTs OC in the 0-8-cm bed-depth interval is 77 mg/kg OC. EPA will paraphrase from “the mean (average) OC normalized concentrations as generated by the MVS model output”, both in the executive summary and in the report text and tables.</p> <p>d. As described in the response to 1c above, the representative values (average COC concentrations) for sediment, as presented in the <i>Summary of IROD Compliance</i> table, are values from the MVS (kriging) model output. As a measure of statistical robustness, Section 3.3 of the MVS report (Appendix C) indicates that the model was used to calculate values of “confidence” by first computing the standard deviation (SD) for each sample location and estimated point, then using the SD values to compute a “model confidence.” These confidence values are presented in Tables C.3 and C.4 of Appendix C. EPA concluded that the overall PV Shelf is “reasonably well characterized” both for Total DDTs and Total PCBs, with predicted values falling within a factor of 2 of actual values 67.5% of the time for Total DDTs, and 70% of the time for Total PCBs. The outfall area is “well characterized”, with predicted values falling within a factor of 2 of actual values 75.6% of the time for Total DDTs, and 78% of the time for Total PCBs.</p> <p>Comment acknowledged. EPA looks forward to continuing to work closely with CDFW-OSPR, and will consider presenting measures of variability such as the upper and lower quartile range of the MNR sediment data in future reports.</p>

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				modeled (or measured) sediment concentrations be added to the IROD Compliance Table so that the variability of the underlying data is conveyed in the beginning of the subject document. Besides the 95% lower confidence and upper confidence values, another approach would be to add other measures of variability (e.g., standard deviation, variance, upper and lower quartile range).	
2	50	4.2.4	-	CDFW-OSPR recommends that a bullet be added to specify that the human health Ambient Water Quality Criteria (AWQC) for DDD is 0.31 ng/L. Provide a brief description that the surface water samples did not exceed this RAO.	<p>Comment noted. Text edits have been made to Section 4.2.4, as follows:</p> <p>4.2.4 Comparison of High Resolution Water Data to Cleanup Goals</p> <p><i>For assessing possible risks to human and ecological health resulting from exposure to COCs in the water column, point-by-point sample results (concentrations) were listed and compared to applicable cleanup goals, as described below.</i></p> <p>4.2.4.1 DDTs</p> <p><i>The IROD established cleanup goals for DDTs in water, citing EPA's AWQC. AWQC as they apply to DDTs at PV Shelf are as follows:</i></p> <ul style="list-style-type: none"> <i>The human health AWQC is 0.22 ng/L for p,p'-DDE.</i> <i>The ecological (saltwater aquatic life) AWQC is 1 ng/L for Total DDTs.</i> <p>A footnote for the first bullet has been added, as follow:</p> <p><i>For assessing possible human health impacts related to DDTs in the water column, the EPA used the AWQC for p,p'-DDE of 0.22 ng/L. Use of this criterion is justified because, in terms of frequency and magnitude of detections, p,p'-DDE is the most prevalent DDT form in the water column (and in other media) at PV Shelf, and its AWQC value is more conservative than that for p,p'-DDD (0.31 ng/L) and equally conservative to that for p,p'-DDT (0.22 ng/L).</i></p>

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					This approach may be refined in the upcoming Final ROD.
3	-	-	-	<p>The subject document defines upper 8 cm as the bioactive zone (see pp. ES-3, ES-7, 14, 41, and various figures). However, the IROD appears to define the bioactive layer as the top 15 to 20 cm. Under Surficial Sediment, the IROD states:</p> <p><i>Surficial Sediment – These sediments in the upper 15 to 20 cm are characterized by lower concentrations of DDTs and PCBs, they are more uniform, and have higher bulk densities, and slightly elevated organic carbon concentrations. The properties of the surface layer are consistent with lower deposition rates of less contaminated material and physical reworking by waves, currents and benthic invertebrates. This is the most biologically active layer of sediment.</i></p> <p>We assume that the “bioactive layer” or the “bioactive zone” is functionally equivalent as the biologically active layer. If this assumption is correct, please explain the apparent discrepancy on the depth used between the subject document and the IROD.</p>	<p>As presented in the <i>Study Report for the Summer 2004 Bioturbation Measurement Program on the Palos Verdes Shelf</i> (SAIC, 2015a), a study of excess thorium in sediment indicated that biodiffusive mixing occurred to a sediment bed depth of approximately 6 cm. SAIC also stated that the PV Shelf sediment appears to have a low abundance and low biomass of large bioturbators, including species such as ghost shrimp, that represent a potential source of deep-mixing bioturbation. Wheatcroft (1994) and Stull et al. (1996) both reported that for PV Shelf sediment samples, 40 to 60% of the infaunal organisms counted occurred in the upper 2-cm layer. Santschi et al. (2001), in another thorium study, reported no excess thorium below a bed depth of 7 cm, indicating no measurable bioturbation below that depth.</p> <p>In view of these findings, EPA and PVSTIEG chose the 0-8 cm bed-depth layer as the bioactive zone for PV Shelf sediment. It is acknowledged that there are inconsistencies in the definition of surface sediment in the IROD. This issue will be clarified in the final ROD.</p>
4	-	-	-	<p>Appendix Q, DDT Results – Water Samples (High Resolution), Tables 4, 5, 6, and 12. Please shade those cells that exceed the ecological AWQC for Total DDTs of 1 ng/L.</p>	<p>The exceedances of ecological AWQC have been <u>underlined</u> instead of shaded (exceedances of human health criteria were shaded). A new note has been added as follows: “8. <i>Summation values that are underlined indicate concentrations of Total DDTs that exceed the IROD ecological AWQC (1 ng/L). This criterion has been adopted as the cleanup goal, per the IROD (EPA, 2009)</i>”</p>
Comments from Christopher Sherwood, Ph.D. (United States Geologic Survey Woods Hole), received by e-mail dated 29 January 2018					
General comments on Appendix AA – MVS Modeling Verification Report (Sundance)					

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<p>I have two important comments on the Sundance results:</p> <p>1) These results support the hypothesis that the 2009 sampling effort was somehow biased, and provided an unrealistically low estimate of contaminant masses at PV.</p> <p>2) The Sundance approach to kriging estimates is fundamentally flawed and has not produced a reliable estimate of the contaminant mass for the 2013 samples.</p>					<p>EPA acknowledges that the MVS model does not accurately model the contaminant mass at PV Shelf and there are potential flaws in the Sundance MVS model assumptions and methodologies. However, for the purpose of trend analysis, EPA elected to use the MVS model in order to conduct a valid analysis.</p>
<i>Specific comments on Appendix AA</i>					
1	-	-	-	<p>Despite my criticism of the kriging methodology below, this report provides clear evidence that the 2009 sampling effort produced an unrealistically low estimate of the contaminant masses at PV. This is clear from Figure 21, which compares the p,p'-DDE mass estimates for 1992, 2009, and 2013 sample years using the same methodology over comparable areas. Assuming the mass is slowly decreasing, we would expect that the 2009 mass would fall between the 1992 and 2013 values; instead, the mass is about half that. The reason for the low mass in the 2009 sampling effort is not addressed by this report and, as far as I know, remains unexplained. It may simply be a statistical outlier.</p>	<p>Based on quality control evaluations of the sampling approach, types of chemistry involved, the procedures for core collection and sample generation, and chemical and physical analyses, EPA has concluded that both the 2009 and 2013 sediment results fall within acceptable ranges and that both data sets are valid. Based on these evaluations, EPA has further concluded that the heterogeneous nature of the sediment bed is the main contributing factor to the incongruities noted by the comment.</p>
2	-	-	-	<p>The kriging estimates are flawed and unreliable.</p> <p>The Sundance report develops estimates of the total mass of DDE and other contaminants in PV sediments using ordinary kriging. Kriging is a way of interpolating between sampled data, and is popular because, under certain conditions, it provides an unbiased estimate with associated statistical uncertainties. One of the conditions</p>	<p>EPA looks forward to working with USGS and the PVSTIEG in the future to develop the optimal method for kriging the chemical and physical results for sediment samples at PV Shelf.</p>

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				<p>is that prior knowledge of the spatial distribution of covariances of the underlying (unsampled) population is known, which is not usually possible. That required input is usually estimated by plotting the covariance of the samples as a function of spatial separation and fitting a curve to that plot. The plot is usually made in the form of a semivariogram, and the curve is a model of that distribution...some function (linear, spherical, exponential) with a few parameters (usually called the nugget, range, and sill) that provide a best fit to the data. The kriging estimates are completely dependent on this model and the data, and so any kriging interpolation is no better than the semivariogram model on which it is based.</p> <p>The semivariogram model(s) can ignore directionality (isotropic) or can accommodate data that have spatial relationships that depend on direction (anisotropy). In a 3D world, it is possible (and not uncommon) to have data with different spatial relationships along three different axes. When this occurs, the semivariogram model used in kriging must reflect these distributions, or it introduces incorrect assumptions that influence the final interpolated values.</p> <p>One shortcut that some kriging software provides is an anisotropy ratio, which scales either the semivariogram or underlying sampling coordinate system according to direction. In this case, Sundance has used a horizontal:vertical ratio, which assumes that the horizontal semivariogram is the same shape as the vertical semivariogram, but differs only by a scale factor. Sundance also assumes that the contaminant distribution fits the same semivariogram equally well in both horizontal directions (e.g., alongshore and cross-shelf).</p>	
				There are two significant errors in the methodology used by Sundance.	Please see response to General Comments #1 and #2.

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				<p>a. Variograms in the horizontal directions are not the same, and cannot be represented by a single semivariogram, as Sundance has done.</p> <p>b. The H:V ratio is not an unknown parameter that can be varied by a factor of 10. Each of these is discussed below.</p> <p>i. There is clearly anisotropy between the horizontal and vertical dimensions, and it is important to include this in the kriging estimates. However, there is lots of evidence (e.g., plots in Lee et al, 2002; Murray et al., 2002, Fig. 7) that there is also anisotropy in the horizontal distribution of physical parameters and contaminants on the shelf. This makes sense, because there are physical dimensions (shelf length, shelf width) and physical processes (mean alongshore currents, cross-shelf diffusion) that operate on different horizontal scales. The horizontal dimensions cannot be characterized by a single length scale, as Sundance has done here. None of the 2D H:V ratios captures the 3D covariance distribution of contaminants. All of them are biased by the incorrect assumption that the spatial correlations are the same in both alongshore and cross-shelf directions. Sundance should develop and use semivariogram models that incorporate the observed spatial covariances in all three axes. The kriging should have been done using 3D anisotropy, or data should have been integrated in one direction (e.g., summing mass over the 8-cm surface layer) to allow anisotropic 2D kriging.</p> <p>ii. The H:V ratio is not an unknown parameter that should be varied in some kind of ad hoc uncertainty analysis. The validity of kriging depends on making prior assumptions about the nature of the spatial covariance. These should be evidence-based (e.g., models of semivariograms). Sundance has avoided this issue by using a range of H:V ratios.</p>	

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				Because the mass estimates vary by more than a factor of two, it is possible that one of the numbers for p,p'-DDE mass (Fig 21) or total DDT compounds mass (Fig 16) is a good estimate, but there is no way to know which one it is.	Please see response to General Comments #1 and #2.
				There is no point in using kriging if the semivariograms are treated randomly. I strongly recommend that either: (a) a simpler method be used (e.g., 2D kriging by layers) or (b) fully 3D kriging be performed using spatial relationships derived from the data.	Comment acknowledged. EPA intends to evaluate and standardize mass and concentration modeling methodology as part of the upcoming Focused Feasibility Study and looks forward to discussing this issue with USGS.
Comments from C. Sherwood, Ph.D. (United States Geologic Survey Woods Hole), received by e-mail dated 29 January 2018					
General comments on Appendix C – MVS Model Report					
(1) For the reasons described below, the numbers (mass values, average concentrations) that are carried into the main report are likely to be less accurate than they could be if proper 3D kriging was used, or if 2D kriging was used on vertically integrated layers.					Comment noted.
Specific comments on Appendix C – MVS Model Report					
1	App C	-	-	These geostatistical inferences should be based on good fits to the semivariograms. We can't judge that if they are not shown.	<p>The anisotropy value used for the evaluation of the 2013 data is 20,000, which is the same value used for the evaluation of the 2009 data. The same value was used to replicate the 2009 data methodology for comparability. During the 2013 data evaluation, semivariograms were checked and 20,000 was confirmed to be reasonable.</p> <p>Again, EPA looks forward to working with USGS and the PVSTIEG in the future to develop the optimal method for kriging the chemical and physical results for sediment samples at PV Shelf.</p>

No.	Page	Section	Para-graph	Comment	EPA Response
2	App C	-	-	Using a single semivariogram for the XY dimensions obscures real differences in the along-shelf and cross-shelf spatial correlations, and results in a semivariogram that is a poor representation of the data.	<p>The samples within a transect (i.e., cross-shelf) are closer together than they are between the transects (i.e., along -shelf) and, because of this higher data density within the transects, changes in anisotropy have a minimal effect within this space. Consequently, assessing the interpolation results between the transects is more critical. Also, for comparability to the 2009 data evaluation, parameters were replicated in the 2013 data evaluation.</p> <p>Because anisotropy has a minimal effect in the cross-shelf direction and the anisotropy replicates the previous value for comparability, no change is recommended.</p>
3	App C	-	-	Arbitrarily adjusting the horizontal:vertical anisotropy is not a valid approach.	As indicated in Appendix C of the report, the anisotropy value was not adjusted. An anisotropy value of 20,000 was used for the 2009 data evaluation. To replicate the 2009 data methodology for comparability, the same anisotropy value was used for the evaluation of the 2013 data.
<p><i>References (not cited in the MNR report)</i></p> <p>Santschi, P.H., L. Guo, S. Asbill, M. Allison. A.B. Kepple, and L.S. Wen. 2001. Accumulation rates and sources of sediments and organic carbon on the Palos Verdes shelf based on radioisotopic tracers (^{137}Cs, $^{239,240}\text{Pu}$, ^{210}Pb, ^{238}U and ^{14}C). Marine Chemistry 73:125-152.</p> <p>Stull, J.K., D.J.P. Swift, and A.W. Niedoroda. 1996. Contaminant dispersal on the Palos Verdes continental margin: I. Sediments and biota near a major California wastewater discharge.</p> <p>Wheatcroft, R.A., W.R. Martin. 1994. Solid-phase bioturbation processes on the Palos Verdes shelf. In: Predictive modeling of the natural recovery of the contaminated effluent-affected sediment, Palos Verdes margin, southern California, D.E. Drake, C.R. Sherwood and P.L. Wiberg, (eds.), Appendix E, USGS Expert Report.</p>					
<i>End of comments</i>					