Honeywell

Honeywell
P.O. Box 1057
Morristown, NJ 07962-1057

October 16, 2013

VIA EMAIL AND REGULAR MAIL

Mr. Galo Jackson
US EPA Region IV
Waste Management Division
Superfund Program
61 Forsyth Street, SW
Atlanta, Georgia 30303

Re: LCP Chemicals Site, Brunswick, Georgia
Draft Feasibility Study Report for OU1 (Estuary)

Dear Mr. Jackson:

We are pleased to submit to the US Environmental Protection Agency (EPA) the draft Feasibility Study for Operable Unit 1 (OU1) of the LCP Chemicals Site, Brunswick, Georgia, which is being submitted in accordance with the 1995 Administrative Order on Consent (AOC) (EPA Docket No. 95-17-C). This FS addresses the comments provided by EPA and Georgia Environmental Protection Division (EPD) and enclosed with this letter are the responses from Honeywell, the Atlantic Richfield Company, and the Georgia Power Company to the comments received on the FS from EPA and EPD.

The enormous effort by all parties to clarify and resolve multiple complex issues has resulted in a high quality document that incorporates sound science and prudent risk management. We believe the biggest challenge, balancing ecological damage from the remedy against the long term benefit to the marsh, has been successfully met in several of the remedial alternatives. We are poised to move forward in the cleanup process and look forward to the Agencies' review and approval.

The submittal includes seven (7) hard copies sent to EPA and three (3) hard copies sent to EPD, along with compact disks (three for EPA and one for EPD) that include the report PDF file and electronic data.

Please feel free to call me at 973-722-1656 if you have any questions.

Sincerely,

Prashant K. Gupta
Remediation Manager

Enclosures

cc: Jim Brown, GAEPD
Jim McNamara, GAEPD
Brett Mitchell, Georgia Power
Paul Taylor, Atlantic Richfield Company
Victor Magar, ENVIRON
Adam Sowatzka, King & Spalding

Responses to USEPA's June 20, 2013 Draft Feasibility Study Comments

Draft Feasibility Study Report for the Estuary, Operable Unit 1: LCP Chemicals Superfund Site, Brunswick, Glynn County, GA

This document provides responses to United States Environmental Protection Agency (USEPA) June 20, 2013, comments on *Draft Feasibility Study Report for the Estuary, Operable Unit 1: LCP Chemicals Superfund Site*. The USEPA comments address a number of themes, as identified in Table 1.[1] These themes were discussed with the USEPA and the Georgia Department of Environmental Protection Division (GAEPD) in July 11-12, 2013. As discussed during the July 2013 meeting, the FS serves as the formal response to comments for the majority of comments (i.e., individual replies often refer to the FS). This letter begins with a brief overview of the themes and describes where these themes are addressed in the Draft Final Feasibility Study Report (FS). Following the discussion of themes in Section 1 of this letter, two additional sections of this letter provide responses to Agency comments for Attachment A and Attachment B of the June 20, 2013 comment letter, respectively.

1. Overarching Themes of Agency Comment and Overview of How Themes Are Addressed in FS

This section identifies each of the nine themes discussed during the July 11-12 (2013) meeting and identifies the resolution of these themes in the FS.

The following themes are addressed:

- Theme #1: Sediment Management Area Discussion
- Theme #2: Source Control
- Theme #3: Human Health Baseline Risk Assessment
- Theme #4: Threshold Criteria
- Theme #5: Data Issues
- Theme #6: Water Quality Standards (WQS)
- Theme #7: CSM and Surface Weighted Average Concentrations (SWACs)
- Theme #8: Hydrodynamic Model
- Theme #9: Remedy Alternatives

<u>Theme #1: Sediment Management Area Discussion</u>

Multiple comments are related to the presentation of sediment management areas (SMAs) and decisions made to define the SMA footprints. In addition, several comments are related to how SMAs address the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) Threshold Criteria of protectiveness of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs). The FS includes the following changes:

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[1] USEPA comments were provided in five sections of Appendix A. The nomenclature in this response-to-comment letter reflects the section and comment number (e.g., Comment 1.3 refers to Section 1, Comment Number 3).

- The SMA discussion from Section 3 was moved to Section 5 (*Development of Remedial Alternatives*) and a more detailed discussion of the SMA development is provided.
- Section 3 provides a new appendix (Appendix G - *Remedial Goal Option Correspondance*) which is a compilation of the five remedial goal option (RGO) letters. These letters describe the basis and protectiveness of the RGOs ultimately used to develop the SMAs in Section 5.
- Section 5 provides an overview of the SMA development approach (Figure 5-1) and addresses the topics of *Surface Weighted Average Concentration (SWAC) Derivation and SMA Development Details* (*Appendix K*).
- Sections 5 and 6 provide a discussion of the mid-range RGOs in the narrative, explaining how the full "range" of RGOs was addressed.
- Section 6 presents six new figures and five new tables addressing various aspects of how each of the SMAs address the NCP and threshold criteria.

Theme #2: Source Control

Multiple comments are related to source control issues. Revisions to the FS include the following:

- The conceptual site model (CSM) in Section 2 summarizes the source controls to date. Section 2 of the CSM also notes that the site-specific groundwater flux analysis demonstrated that "groundwater is only a minor contributor to sediment contamination."
- Appendix A presents additional analysis requested by the USEPA. Specifically, an analysis performed to estimate the dilution of groundwater as it enters surface water. It is noted that:
  - Despite the use of conservative metrics, the surface water-to-groundwater dilution ratio is approximately 1,800 (i.e., groundwater is diluted approximately 1,800 times when it enters surface water).
  - The groundwater dilution factor, combined with low groundwater concentrations and non-detect seep concentrations, strongly indicates that groundwater is not the cause of surface-water quality exceedances.
- ENVIRON provided USEPA and GAEPD the flux worksheets developed for OU1, along with worksheets used to calculate aqueous dilution from groundwater to surface water (July 29, 2013).
- Section 2 of the FS identifies that a groundwater remediation decision is not needed prior to marsh remediation.

Theme #3: Human Health Baseline Risk Assessment

There were several comments related to the human health risk assessment and a request was made to show risk reduction in a manner similar to that provided for wildlife. Based on discussions and decisions made during the July 11-12 (2013) meeting, the FS provides the following:

- Section 6 of the FS provides discussion of achieving threshold criteria for protection of human health (HH) and achieving SWAC-based RGOs for Aroclor 1268 and mercury.
- Section 3 of the FS refers to the RGO letters as a basis of the derivation and protectiveness of the SWAC-based RGOs.

- Sections 3 and 6 of the FS emphasize the protectiveness of the HH RGOs, particularly when considering HH-risk assumptions.

Theme #4: Threshold Criteria

Section 3 of the USEPA comments provided 8 comments related to the NCP threshold criteria and balancing issues. In addition, comments within other sections of the USEPA comments also addressed elements of the use or reference to threshold criteria. The FS provides the following with regard to overall protection of the environment:

- Sections 5 and 6 of the FS clearly state that each of the remedial alternatives must meet the threshold criteria to be considered viable.
- Section 6 clarifies that as long as the alternatives provide sediment concentrations within or below the SWAC and benthic community RGO range, the threshold criteria are met.
- Section 6 provides new tables and figures that clarify where the mid-range RGOs were met.
- The FS includes the RGO letters, the RGO range, and the basis for upper- and lower-end RGOs. Justification for the use of alternative RGOs was set forth in the RGO letters, and by providing the letters as a new appendix, this justification for application of the RGOs is set forth in the FS.
- The FS discusses isolated locations above the RGO range that are not remediated, in terms of residual risks and the tradeoffs associated with remediation between risk reduction and marsh/habitat-related impacts.

Theme #5: Data Issues

Comment 1.22 addresses data issues and resolution of these data issues that began on April 18, 2013 with email communications between USEPA and ENVIRON. In addition, on July 12, 2013 USEPA provided one set of notes on the data issues. The FS addresses these issues as follows:

- Section 2 of the FS includes a new Appendix (*Appendix E: Data Handling and Data Issues Resolution*).
- This new appendix provides the following:
    - Information that was previously presented in Section 2 or Appendix E2 of the Draft FS is consolidated (e.g., averaging approaches and the uncertainties associated with elevated detection limits).
    - A summary table is provided that identifies how each of the sample issues identified in Comment 1.22 are addressed in the FS (this table also identifies the April 18 and July 12 correspondence between USEPA and ENVIRON related to resolution of these issues).
    - Individual data decisions are documented.
    - Re-sampled locations are identified, including an explanation of why locations were resampled.
    - Updates to the FS Database are identified. The updated FS Database is provided as Appendix C.

Theme #6: Water Quality Standards (WQS)

Several comments raise the issue of how remedial alternatives will comply with ARARs related to mercury and polychlorinated biphenyl (PCB) state and federal WQS.

- The June 20, 2013, Agency Comments asked that dissolved phase mercury measurements not be included. After presenting and discussing dissolved-phase concentrations during the July 11-12 meetings, the Agencies agreed that this information could be presented. The FS discusses total and dissolved phase results as part of a conceptual model that explains ecological exposures. However the FS is clear that remedy effectiveness will be based on total phase and dissolved phase results.
- The June 20, 2013, Agency Comments asked that the "basis" for the Agency Water Quality Criteria not be discussed in the FS. After further discussion during July 11-12 meetings, the Agencies agreed that this information could be discussed and its relevance explained in the FS. This information will simply explain why EPA (federal) uses a less conservative mercury WQS, and where and when EPA allows the use of dissolved-phase results. The FS will include some narrative of how the observed WQS exceedances are predominantly related to analysis of whole water samples containing suspended sediment. Again, the FS is clear that remedy effectiveness will be based on total phase and dissolved phase results.

Theme #7: CSM and Surface Weighted Average Concentrations (SWACs)

Several comments ask questions about the remedy effectiveness because there is an incomplete description in the FS about ecological exposure pathways to chemicals of concern (COCs) in the creeks versus the marsh areas of OU1. In addition, comments raise issues about the uncertainties of SWACs. The following revisions are provided in the FS:

- Section 2 of the FS was revised for flow and CSM content. Section 2 presents a new section of the CSM that provides a comprehensive discussion of exposure pathways which explain the ecological uptake of chemicals into biological organisms. A new appendix provides supporting *Aquatic Organism Life History Information* (Appendix C). This information provides a basis of understanding how COCs move through the environment and the basis for understanding how remedial alternatives address these exposure pathways. The new section of the CSM explains that fish are exposed both in the creeks and the vegetated marsh beds and includes referenced discussions about biota feeding strategies, consistent with what was presented at the July 11-12 meetings.
- Appendix L (*Remedy Effectiveness Considerations*) provides a discussion of uncertainties that augment the CSM discussion in Section 2 with regard to ecological exposures in the creeks versus the vegetated marsh beds. The FS discussion of the exposure pathways in the CSM are consistent with assumptions made in the Baseline Ecological Risk Assessment (BERA) the Human Health Baseline Risk Assessment (HHBRA), and the USEPA approach to RGO development. Moreover, measurements of risk reduction are consistent with discussions between Mary Sorensen, Galo Jackson, and Sharon Thoms.
- With regard to uncertainties related to SWACs, Section 5 presents a new appendix (Appendix K) that explains the derivation of SWACs, including a description of the decisions made supporting the SWAC development (as was described for Theme #1). Appendix L (*Remedy Effectiveness Considerations*) provides a discussion of the

uncertainties in the use of SWACs and explains how SWACs are protective despite those uncertainties.

Theme #8: Hydrodynamic Model

The following revisions to Appendix B and Section 2 of the FS were made with regard to this theme.

- The conditions tested by the model and the basis for those conditions are described in Appendix B. A discussion of the model uncertainties and how the system might respond under higher frequency storm surge and flow conditions is provided in Appendix B.
- The conservatism of the various parameters employed in the model are explained in Appendix B so the reader has a clear understanding of the models overall protectiveness.
- Appendix B provides a real world description of the conservatism included in typical cap/armor design and associated modeling at other sites (e.g., capping in the lower Hackensack River for which the design basis was 100 years, and how the Hackensack River cap performed during Superstorm Sandy, almost a 500+ year event).
- Appendix B provides a discussion of sedimentation patterns, including EPA citations.
- Section 2 (in the hydrodynamic / sediment fate & transport CSM, Section 2.2.4), explains how the site is characterized as net-depositional and yet how there could be re-suspension in a net-depositional environment.

There are some comments regarding the hydrodynamic model that are not incorporated. As noted during the July 11-12 meeting, the model goal is to ensure an effective and protective remedy. Design-level detail is unnecessary and global warming scenarios are not evaluated. Thus, the comments that relate to design issues and global warming are not incorporated. The following sections of this letter identify the comments that are not incorporated.

Theme #9: Remedy Alternatives

A variety of comments address issues related to remedy effectiveness. The FS revisions include the following:

- Sections 4 and 6 of the FS address issues related to cap thickness and time to achieve remedy effectiveness.
    - Appendix J adds a discussion of bioturbation depths and how the thin-cover thickness is optimized to provide risk reduction and ecological protectiveness while minimizing impacts to the habitat including elevation changes and severe plant/animal burial.
- Section 6 of the FS provides general statements about the types of data collection that may be considered as part of the long term monitoring.
- Section 4 and Appendix I (*Review of Technical Issues: Thin-Cover Placement in Spartina Marsh and Potential Bioturbation Effects*) address a variety of topics on thin cover.
    - Case studies are added to describe where thin cover placement is used for sediment remediation.
- Appendix J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*) provides the following:
    - K_d and K_{oc} issues are clarified in the FS for cap design. K_d and K_{oc} values were selected to be conservatively applied to ensure cap protectiveness. A range of log K_{oc}

values for Aroclor 1268 will be presented as a sensitivity analysis in the revised FS. A sensitivity analysis of mercury partitioning is presented in Appendix J. Two new tables were added to Appendix J for the sensitivity analyses on partitioning of Aroclor 1268 and mercury.

- Appendix I presents one new figure since that appendix was expanded to also discuss effectiveness of thin-cover placement.
- One new table was added to Appendix J to provide additional detail on groundwater velocity calculations.
- A new attachment (Attachment J1) will be added to Appendix J to include model outputs in response to Comment 4.48.
- Individual comments 1.14 and 4.42 through 4.48 are clarified in a later response and through additional discussions in Appendix J.

- Some topics related to the hydrodynamics theme are not incorporated in the FS.
  - As was confirmed during the July 11-12 meeting, the most conservative groundwater value was used in the model and, therefore, a sensitivity analysis is not needed for this parameter.
  - The FS does not include a revised discussion of activated carbon. Technologies such as activated carbon and seeding of cap with clean sediments are not required for the LCP marsh, particularly given that the proposed cap would be highly effective in arresting contaminant migration in the absence of those technologies.
    - Further, activated carbon is too experimental and therefore, it will not be included among the remedy alternatives. The screening of activated carbon will be clarified in the FS.
    - Likewise, organoclay and the placement of a clean sand layer that is slowly released into the environment are experimental, and therefore, they will not be included among the remedy alternatives.
  - Monitored Natural Recovery (MNR) discussions are not added to the FS because consensus was reached during the July 11-12 meetings that because each of the remedies is able to achieve the RGOs, MNR is not integrated into the alternatives as a component of the remedies. It was agreed that there will be monitoring of the marsh, and recovery processes may be included in the monitoring program. However, monitoring habitat recovery alone does not constitute an MNR approach.
  - The FS does not specify the details associated with a long term monitoring plan (LTMP), as the LTMP will be developed separate from the FS.

2. Response to Individual Agency Comments

This section identifies each of the comments provided in Attachment A of the Agency June 20, 2013 comment letter. Attachment A of the Agency comments were divided into 5 sections, as follows:

- No. 1: Additional Analysis Required for Selection of a Preferred Alternative
- No. 2: Alternatives Analysis and Achievement of RGOs
- No. 3: Thorough Analysis of Threshold Criteria and Balancing Remedial Alternatives
- No. 4: Correction or Elimination of Technical Inaccuracies and Unsupported or Subjective Statements
- No. 5: Editorial Corrections and Clarification in Presentation

Sections 1, 2, and 3 within Attachment A of the Agency comments provide technical issues related to the FS. Throughout Sections 1, 2, and 3 of this response to comment (RTC) letter, the initial Agency comment is provided followed by the comment response. Sections 4 and 5 of the Agency letter identify edits of a less technical nature. Therefore, as identified at the beginning of Sections 4 and 5, those comments are addressed in the Revised FS unless otherwise noted with a more detailed response. Finally, Attachment B of the Agency comments are addressed with detailed responses to comments. Attachment B of the Agency comments provides the technical supporting information for several comments identified in Attachment A of the Agency comments.

ATTACHMENT A
No. 1 Additional Analysis Required for Selection of a Preferred Alternative

1. *General*: Chapter 2 should be reorganized to start first with a summary of the Remedial Investigation (RI) and an updated Conceptual Site Model (CSM) which describes the setting, the problems, the sources, the extent of contamination, contaminant release mechanisms, fate/transport processes, assumptions, uncertainties, exposure pathways, and risks. A discussion of operable unit 1 (OU1) and its relationship to the rest of the Site is needed to minimize confusion. More explanation early in the FS would provide a better context for understanding important information such as the source of the surface water and sediment contamination. Discuss potential for areas outside of OU1 to act as continued sources of contaminants.

   Response: Section 2 was revised to improve flow. Two new appendices were added to Section 2 to improve flow and improve data presentation details.

2. *General*: Conclusions regarding risk reduction and protectiveness appear to hinge upon the CSM with respect to where and how the contaminants enter the food chain, specifically mercury and Aroclor-1268. While the FS does not specifically state this, it is evident that the CSM for the bioaccumulation of mercury and polychlorinated biphenyls (PCBs) assumes that the sediment which is the exposure media to the food chain is primarily the in-channel bed sediments, which are the sediments with the highest contaminant concentrations. While this may be true, there is no evidence within the draft FS that conclusively demonstrates this assumption. It is plausible that a substantial

amount of bioaccumulation of Site contaminants actually occurs in the vegetated marsh surface. The draft FS should explain why in-channel exposure is the dominant mechanism for bioaccumulation at the Site. That is, whether or not the high contamination level in localized areas dominates the bioaccumulation of contaminants in the system or if large areas of low concentrations dominate the bioaccumulation.

Response: This topic is addressed through the discussion provided in Theme #7 (CSM and SWACs).

3. *General*: Although it is reasonable to use surface-weighted average concentrations (SWACs) to parcel the OU into manageable units for the purpose of remedial implementation, hazard quotient risk reduction estimates based on SWACs do not account for spatial variability of contamination in sediment/biota or for habitat considerations and primary exposure pathways. As a result, the incremental risk reduction of the various alternatives is minimized, making alternatives appear to result in nearly identical risk reduction in spite of varied footprints.

   Response: This topic is addressed through the discussion provided in Theme #7 (CSM and SWACs).

4. *General*: No estimates have been provided for how long it will take for remedial goals and risk assessment endpoints to be reached, aside from the 10-year monitoring value in the cost estimate.

   Response: For the dredge and cap remedy areas, as well as the thin layer cap areas, the remedial goals (NTE's, SWAC's) would be achieved immediately following remediation. Proposed 10 year monitoring is for further confirmation that the recovery remains on track over the longer term.

5. *General*: The document does not assess risk reduction to humans from consumption of fish, shellfish and clapper rail; it should reflect the results of the final human health baseline risk assessment (HHBRA) and baseline ecological risk assessment (BERA). At a minimum, the remedy effectiveness evaluation should estimate reduced risks from human consumption of contaminated biota. Furthermore, combining exposure areas (e.g., domain-wide, creek-wide and estuary-wide) is not relevant for many exposure scenarios, and serves to dilute the calculated risks and appearance of unacceptable exposure.

   Response: This topic is addressed through the discussion provided in Theme #3 (Human Health Baseline Risk Assessment).

6. *Section 2.3.2, page 11.* There is a statement that implies that contaminant exposure is a function of organism residence rather than activity time. Since dietary exposure is a substantial component of the exposure to fish and shellfish, the short period of time they are feeding in the marsh is more important than the residency time. The sampling at the Site indicates that feeding primarily occurs in the marsh surface for at least some of the species, including mummichogs. Further, shellfish, such as fiddler crabs, also spend

much of their time on the sediment during low tide. A thorough discussion of these CSM issues is essential to the review of remedy alternatives which reduce exposures during the tidal cycle.

Response: This topic is addressed through the discussion provided in Theme #7 (CSM and SWACs).

7. *Section 2.2.4, page 8.* It appears that statements in this section are based on the hydrodynamic model and assumptions made within the model, as well as inferences from studies on similar marsh systems, as opposed to site-specific data. Discussion of net sediment accretion rates and sediment material origin would aid in assessing how monitored natural recovery (MNR) will reduce residual contamination levels in the marsh. The same page of the section discusses "cohesive sediments" and "bed armoring processes". How are these statements to be reconciled with the concept that the remaining contamination in the marsh was transported to its current locations through sediment re-suspension and deposition? This concept must also be reconciled with the results of a literature review, which shows deposition rates in the area to be on the order of 2.5-3 mm/yr.

   Response: This topic is addressed through the discussion provided in Theme #8 (Hydrodynamic Model) and Theme #9 (Remedy Alternatives).

8. *Section 2.2.4, page 8.* The section states that, "Sediment transport processes within the site are controlled by tidal circulation and rare storm events (Appendix B). The dominant source of suspended sediment to the estuary is the Turtle River because no tributaries flow directly into the estuary." The EPA cannot find the information in Appendix B which supports these two statements and found no data on water column sediment load, evaluations of sediment source material, or sediment core dating. While the EPA is confident the water movement via tidal action and storms is the dominant transport mechanism, it is not convinced there is a net sediment movement from the Turtle River into the LPC Marsh.

   Response: This topic is addressed through the discussion provided in Theme #8 (Hydrodynamic Model).

9. *Section 2.4.1, page 14.* Add a discussion of contaminants of concern (COCs) in biota from the Site, relative to the reference areas. The contamination is not limited to sediment and surface water.

   Response: Section 2 provides a brief discussion of COCs in biota from the Site.

10. *Section 2.5.2, page 31.* This section discusses mercury and Aroclor 1268 contamination distribution as being, "consistent with the surface water CSM." However, this section conflates historic and current contaminant distributions. The current distribution may be related to reworking of previously-contaminated sediments, but historic sources of contamination included overland transport, direct discharge of waste and wastewater to the

marsh, and contaminated groundwater. This section should explicitly discuss removal and non-removal areas, pre- and post-removal.

Response: This topic is addressed through the discussion provided in Theme #2 (Source Control).

11. *Section 3.4, page 439.* This section develops sediment management areas (SMAs) that include risk management decisions which result in reducing areas that exceed RGOs. Development of SMAs in this chapter is premature as alternatives have not yet been developed. Detailed discussions will be needed in Sections 5 and 6 to explain how risk management decisions will achieve a remedy that meets the threshold criteria of protection of human health and the environment.

    Response: This topic is addressed through the discussion provided in Theme #1 (SMA Discussion).

12. *Section 4.2.3, page 49.* MNR is a remedial technology that relies on natural processes to reduce the concentrations, toxicity, or bioavailability of contaminants in sediments. MNR is discussed in Section 4 and last mentioned in Section 4.3. Continue the discussion of MNR in Section 5.2 on elements common to all remedial alternatives. MNR should also be discussed in Sections 6 and 7. Include a conceptual model for how MNR takes place in the estuary. The FS should discuss the suspended sediment concentration and whether there is sufficient sediment supply to provide the unconsolidated material necessary to cover contamination by natural processes. MNR could perhaps be enhanced by placement of erodible clean sediments in the marsh creeks on top of the armoring layer to be carried up onto the marsh flats by tides to foster marsh accretion. Discuss the fate of sediment in the creeks and whether placement of clean sediments in the creeks or marsh might enhance marsh flat recovery by natural processes. Additional discussion of MNR is provided in Attachment B of this letter.

    Response: This topic is addressed in Theme #9 (Remedy Alternatives). As noted in Theme #9, MNR discussions are not added to the FS because consensus was reached during the July 11-12 meetings that because each of the remedies is able to achieve the RGOs, MNR is not integrated into the alternatives as a remedy and is not a component of the remedies. It was agreed that there will be monitoring of the marsh, and recovery processes may be included in the monitoring program. However, monitoring habitat recovery alone does not constitute an MNR approach.

13. Regardless of the remedy selected, the long term monitoring plan (LTMP) must include a bio-monitoring component, as there are critical assumptions made within the CSM regarding the relative strength of the source of contaminants into the food chain. While a detailed discussion of the LTMP is not critical to the FS, it is clear the LTMP is necessary, particularly for bio-monitoring of mercury and Aroclor-1268 in biota. The

FS should add more information on bio-monitoring of mercury and Aroclor-1268 in biota.

Response: This topic is addressed in Theme #9 (Remedy Alternatives). As noted in Theme #9, it was agreed that there will be monitoring of the marsh, and recovery processes may be included in the monitoring program. However, the monitoring plan will be developed separate from the FS. The FS is revised to state that the LTMP may include sediment, fish, shellfish, and other biological tissues.

14. Section 4.2.4, pages 49, 50 and 51. How a thin cover can achieve remedial action objectives (RAOs) should be discussed because many of the sediment invertebrates are burrowing organisms (e.g., fiddler crabs) which will still be exposed to the subsurface contamination. While the depth of contamination in the vegetated marsh is relatively limited, it should be expected to be at least on the order of 10 cm. This would suggest a layer of 10 cm would be required if the sediment chemical specific goal was half of the current concentration. It follows that the amount of material placed onto the marsh surface will substantively impact the marsh elevation. A more thorough evaluation of the amount of material needed and the consequences should be conducted and presented for those areas for which thin layer capping is proposed.

   Response: The discussion of thin cover effectiveness is expanded in Appendices I (*Review of Technical Issues: Thin-Cover Placement in Spartina Marsh and Potential Bioturbation Effects*) and J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*). The issues raised in this comment are addressed. For the dredge and cap remedy areas, as well as the thin layer cap areas, the remedial goals (NTE's, SWAC's) would be achieved immediately following remediation. Proposed 10 year monitoring is for further confirmation that the recovery remains on track over the longer term.

15. Section 5, starting on page 61. Consider removing all references to SMAs in this draft FS, including in Table 5-1 and in Figures 5-1 through 5-5, to eliminate confusion in relating SMAs and the 6 different alternatives. Suggest renaming the alternatives to include the extent of acreage the alternative would remediate (i.e., Alternative 3: Sediment Removal, Capping and Thin-Cover Placement of 48 Acres).

   Response: This topic is addressed as discussed in Theme #1 (SMAs).

16. *Section 6.2.2, page 93*. This section assumes that all of the alternatives (except No Action) will achieve chemical-specific applicable relevant and appropriate requirements (ARARs), (presumably water quality standards [WQS] for surface water). Add a discussion in this section which compares the footprint of each remedial alternative to the locations of known ARAR exceedances.

   Response: This topic is addressed as discussed in Theme #6 (WQSs).

17. *Section 6.2.6, Page 100*. In the discussion about Domain 1A and Domain 2 Marsh, it is unclear why Alternative 4 is substantially different than Alternatives 5 and 6 with

respect to earthmoving equipment, temporary roads, staging areas, and short-term impacts. Revise to be more consistent with Alternatives 5 and 6.

Response: Appendix J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*) and Section 6 reflect revisions that address this comment.

18. *Section 7, page 106.* Explain how each alternative with different clean up goals can all achieve the threshold criteria. The conclusion regarding risk reduction and protectiveness appears to hinge upon the CSM with respect to where and how the contaminants enter the food chain, specifically mercury and PCBs.

Response: This topic is addressed with discussion in Theme #7 (CSM) and Theme #4 (Threshold Criteria).

19. *Section 7.1, page 107.* Text on Page 107 indicates that Alternatives 2 through 6 will each reduce ecological risks to benthic organisms exposed to contaminated sediment to levels that will result in self-sustaining benthic communities with diversity and structure comparable to that of the reference areas. No information is provided to back up this statement. Only three locations were sampled for benthic community structure (Figure E2-5) and these areas were not located in portions of the Site where contamination would be left in place by any of these alternatives. The text in this section should be modified or removed. The reason no adverse benthic effects were observed was because there was only a very limited study of this type of measurement. The limitations of the study are so severe that the only statement that can be supported is that there are effects on benthic communities in the most contaminated portions of the Site. Nothing can be concluded about portions of the Site where contaminant levels are relatively low. No benthic community studies were conducted in areas of the Site with concentrations in the range where risk management decisions are being considered. Add the information to support that Alternatives 2 through 6 will reduce the risk to benthic organisms or delete the statement.

Response: Section 7 was revised to exclude some of this comment and further support other elements of this comment.

20. *Section 7.1, Figures 7-1A through 7-1C.* The figures show the decline in the lowest observed adverse effect level (LOAEL)-based hazard quotient based on the estuary-wide average SWAC. The figures do not adequately distinguish between the alternatives. The median hazard quotients shown in the box as whiskers plots on Figure 7-1A do not make sense because they do not capture the varying sizes of management areas. Figure 7-1A is misleading in that Alternative 1 has a hazard quotient of roughly 3 for the LCP Ditch, but cleaning up the ditch was a portion of the costs. Costs in Figure 7-1A are presented as the total cost for the entire alternative, while the hazard quotients refer to specific creeks or domains of the Site that have separate costs to clean up. The figures should start out with the vertical bars for Eastern Creek, LCP Ditch, Domain 3 Creek, Domain 1, and Domain 4 East on the left for Alternative 1. Then the itemized cost to address the Eastern Creek portion of the alternative should be presented with a shortened bar to represent the decrease in the hazard quotient for the Eastern Creek after the

remedy is completed. The same should be done for the other areas and alternatives. Figure 7-1A should be redrawn to show the itemized costs in this manner.

Response: Figures 7-1A through 7-1C were retained in the document. Average HQ values and the range of HQ values for each remedy formed the basis of each remedy evaluation with regard to risk reduction and overall protectiveness of the environment. Hence, these are reasonable metrics to compare to cost and relative performance among the six remedies.

It is not possible to itemize costs for each sub-area, as all areas share substantial costs for mobilization, staging, demobilization, etc.

21. *Section 7.2, page 108.* Text indicates that remediation of the largest areas utilizing Alternative 2 or 3 does not provide a significantly greater overall risk reduction than using Alternatives 4, 5 or 6. However, the FS provides no information or evaluation to support the statement that risk reduction is essentially the same for all active alternatives. The FS should make a clear distinction between the levels of effectiveness achieved by each alternative. In addition, the FS should discuss the uncertainty associated with the risk reduction for each alternative and compare them. Attachment B of this letter develops one aspect of the uncertainty that should be discussed.

    Response: Section 6 of the FS provides clarity on issues related to remedy effectiveness. Responses for notations made in USEPA's Attachment B of the June 20, 2013 comments are described in the section of this letter focused on Attachment B.

22. *Appendix C.* The coordinates of sampling station 5-NOAA in the LCP database place the sample location above the LCP Ditch in the Domain 3 marsh. The table in Appendix C has different coordinates that place 5-NOAA in the LCP Ditch. The location of the station 5-NOAA should be discussed in the uncertainty section. Evidence that places the station in the LCP Ditch should be provided.

    Appendix C is a table in Microsoft Access® data base which includes the location identifier, domain name, coordinates, and COC concentration in sediment. The table in Appendix C is used to generate the figures in the FS and to calculate the SWACs. EPA identified certain samples in the LCP database that were not included in Appendix C. These should be added unless justification for omission can be provided. Explain why the following sample locations were not included on the figures showing the distribution of mercury and Aroclor-1268 in OU1 sediments (Figures 2-11 and 2-12). None of these samples were analyzed by the TEG laboratory. Include the top four stations (1011, 75, 77, and 82) in the averages in Appendix C. The other stations in the table do not need to be incorporated in the averages, but the rationale for their exclusion should be presented in the FS.

    The average concentrations shown in Figure 2-11 are averages over the years of sampling when a station was sampled more than once. Station PTI-E9 is essentially the same as Station E-9. The concentrations detected in June 1996 when the location was referred to as PTI-E9 should be averaged with the concentrations detected in 2002 at Station E-9. The location known as FS-AREA1 is the same location as Station C-200. When averaging data over all monitoring years, three sampling events at FS-AREA1 should be averaged with the data for Station C-200. Station C-31 is the same location as Station M-38. This comment was written because although some locations were included, not all the data at that location was included in the average concentration. Sample location M-D3-6A was collected in August 2012. The intention may have been to plot the three M-D3-6 samples as an average, but they did not get assigned correct coordinates in Appendix C. These samples should be located just north of the Main Canal in the Domain 3 marsh.

Location	Domain	Easting	Northing	Concentration, mg/kg	
				Mercury	Aroclor-
1011	1	860257.1	432038	34	–
75	1	860560.1	431723	29	5.2
77	1	860636.1	431297	55	27
82	1	860251.1	431507	39	5.9
94207-01	3 NS Ditch	861654.1	433097.9	15.3	–
94207-02	3 NS Ditch	861460.1	432744.9	6.4	–
94207-03	3	861116.1	432724.9	4.23	–
94207-04	3 NS Ditch	861737.1	433251.9	1.57	–
94207-05	3 NS Ditch	861790.1	433348.9	3.38	–
94207-08	Main Canal	860086.1	432454	6.27	–
97269-21	Main Canal	860380.4	432395.9	11.6	31
97269-43	Main Canal	860776.3	432364.5	36.1	230
97269-47	2A	860156.5	432414.4	10.6	11
97270-02	Main Canal	860724.8	432358.6	43.5	68
98106-RW-03	1	860896.1	430909	39.3	33
98142-MED-16	1	860776.31	432364.5	8.64	1.2
98142-MED-20	1	861240.06	431557.94	2.5	2.43 U
98153-MED-24	1	861203.56	431481.44	8.67	9.5
98153-MED-27	1	861235.06	431557.94	2.55	2.1
98153-MED-29	1	861241.06	431575.94	18.3	5.72
98153-MED-31	1	861247.06	431596.94	0.56	2.26 U
98156-MED-47	1	861259.06	431638.94	0.56	2.24 U
BM038	2A	860087.06	432105.19	14	4.2
BR069	Purvis Creek	858198.44	430846.19	1.8	5.2
PTI-E9	1	860327.13	432062.97	43.3	52
FS-AREA1	3	861513.75	434105.69	0.68-1.1	0.63-1.3
M-38	3	860957.44	432984.44	1.89-3.58	0.62-1.2
M-D3-6A	3	860352.88	432776.41	–	13
M-D3-6B	3	860343.13	432777.5	–	8.1
M-D3-6C	3	860362.31	432775.47	–	6.6

Response: This topic is addressed as discussed in Theme #5 (Data Issues).

ATTACHMENT A

No. 2 Alternatives Analysis and Achievement of RGOs

1. *General*: The remedial goals options (RGOs) presented at the low end of the RGO range in EPA's November 30, 2011 letter were determined in the HHRA and BERA for this OU to be the concentrations which are protective of human health and the environment. The EPA included some higher RGOs in the February 20, 2013 and subsequent letters in order to provide the responsible parties with an opportunity to justify why such numbers would be more appropriate. However, the draft does not sufficiently evaluate alternatives which would achieve the lower ends of the RGO ranges. The FS should include an analysis of residual risks (those areas not meeting the low end SWAC and benthic RGOs). There appears to be a broad assumption throughout the draft FS, that simply addressing the upper range of the SWAC RGOs would be sufficiently protective of all receptors, which is not scientifically supported. As the FS is currently written, the potential benefits of a mid-range alternative cannot be properly assessed. In addition, the extent of potential residual risks within the entire RGO range is not clear.

   Furthermore, CERCLA specifies that a range of alternatives should be developed, including at least one alternative which does not leave contaminants on-site above cleanup levels. At least one alternative that addresses the entire footprint of RGO exceedances through active remedies (not including MNR or "Risk Management Areas") should be developed and carried through the analysis. Inclusion of a comprehensive alternative will assist in determining whether the cost and short-term risks out-weigh the overall risk reduction. The revised FS will also need to describe how each remedial alternative meets the RGOs and ARARs or if exceedances of RGOs would remain. For example, Alternatives 4, 5 and, to a lesser extent, Alternative 6 leave contaminants in place in Purvis Creek above the RGO ranges. Describe how these residual COC concentrations may or may not be protective of Purvis Creek.

   Response: This topic is addressed as discussed in Theme #1 (SMAa) and Theme #4 (Threshold Criteria).

2. *Section 3.3, page 38 and 39.* Revise this section to address the following comments:

- In the first bullet on page 38, it is stated "SWAC RGOs are concentrations that are protective for humans that consume fish, shellfish, and wild game from the Site. In addition, SWAC RGOs are protective of the mammals, birds, and fish that nest, forage, and breed in the Site." Provide a definition of surface-weighted average concentration and explain how SWACs are protective, in spite of the fact that SWACs tend to dilute any localized high contaminant concentrations when averaged across a unit with a large area with lower concentrations.

  Response: This topic is addressed as discussed in Theme #7 (CSM and SWACs).

- The benthic community RGOs reported in the draft FS are greater than the "threshold for estimated adverse ecological effects" established by EPA in the OU1 BERA (Black & Veatch 2011) as shown below. For three of the COCs (mercury, PAH, lead), the lower range of the FS RGOs exceed the highest BERA values in the "thresholds".

COC	BERA RGOs (mg/kg)	FS RGOs (mg/kg)
Mercury:	1.4 - 3.2	4 - 11
Aroclor 1268:	3.3 - 12.8	6 - 16
tPAH:	0.8 - 1.5	4
Lead:	41 - 60	90 – 177

Response: The range of RGOs was agreed upon by the USEPA, as cited in the FS (USEPA 2013b, 2013c). In addition, the memorandum regarding "*Response to EPA's November 2011 Letter regarding Remedial Goal Option (RGO) Ranges for the Remedial Action Alternatives for OU1 (Estuary) – LCP Chemicals Site, Brunswick, GA*" (Honeywell 2012) explains why and how the proposed range of RGOs differ from the low end of the values and are still protective and useful for risk management decisions.

- The five RGO letters should be included in an appendix to aid in transparency for public review and the technical basis of the RGOs should be summarized in Section 3.3.

Response: Section 3 of the FS presents the five RGO letters as an appendix (Appendix G). The technical basis of the RGOs is described in Section 3.

- Develop and present RGOs for surface water regardless of whether surface water samples collected to date exceed the RGOs because State WQS are relevant and appropriate and RAO 6 refers to meeting and sustaining "WQS for protection of aquatic life".

Response: This topic is addressed as discussed in Theme #6 (WQS).

3. *Section 3.4, pages 39-41.* This section discusses various remedial footprints prior to development of any alternatives and is therefore premature. In addition, risk management applies only to alternatives that have been developed. It appears the purpose of this section is to show those areas that exceed the RGOs ranges and introduce the SWAC concept.

- Change the title of the Section 3.4 to "Extent of Media Exceeding RGOs." Replace the term Sediment Management Areas (SMAs) with "Extent of Sediment Exceeding RGOs." Add a Section to discuss Surface Water RGO exceedances.

Response: This topic is addressed as discussed in Theme #1 (SMAs) and Theme #6 (WQS). SMA nomenclature is retained in the FS. Section 6 discusses WQS/ARAR exceedances.

- Eliminate in its entirety the bullet labeled Risk Management Decisions and adjust the affected figures, tables, and volume calculations. It is premature to assume that "cleanup will cause more ecological harm than the current Site contamination" before technologies have even been screened or alternatives selected. The purpose of this section should be to document baseline conditions and should include all areas with RGO exceedances regardless of future accessibility issues or potential for habitat damage.

  Response: This topic is addressed as discussed in Theme #1 (SMAs).

- Table 3-5 shows that most of the domains exceed the low end of the SWAC RGOs for mercury (1-2 mg/kg) and Aroclor-1268 (2-4 mg/kg). Include discussions or maps showing those areas that exceed the low or high SWAC RGOs. The focus of the discussion and the development of alternatives in Section 5 is on protection of the benthic community, which is of lesser concern than bioaccumulation of mercury and Aroclor-1268 through the food web to top-level consumers. Add discussions and maps showing those areas that exceed the low and high ends of the SWAC RGOs.

  Response: This topic is addressed as discussed in Theme #1 (SMAs). Additional maps are provided to clarify how threshold criteria for benthic community RGOs and residual risks are met, as described for Theme #4 (Threshold Criteria). There is no new mapping provided for where areas exceed the low or high end SWACs because SWACs reflect average conditions, not individual point locations. However, additional tabular summaries and discussion of SWACs with regard to remedy effectiveness and threshold criteria is provided in Section 6 of the FS.

- Replace Figure 3-5 with a figure titled "Areas Exceeding the Low Benthic Community RGOs" and use one color to depict all 81 acres. Include separate figures showing the extent of area exceeding the low end of the range and the high end of the range.

  Response: The 81 acre remedy and the decisions used to carve out risk management areas are explained in detail resulting in the 48-acre SMA-1 footprint in Section 5.1.2. No change was made to the SMA-1 figure (aside from its new location in Section 5).

- Replace Figure 3-6 with a Figure titled "Areas Exceeding the High Benthic Community RGOs" and use one color to depict all 25 acres. Show separate figures showing the extent of area exceeding the low end of the range and the high end of the range.

  Response: This topic is addressed as discussed in Theme #4 (Threshold Criteria), with new figures provided in Section 6.

- Delete Figure 3-7 and all of Section 3.4.3 because this is a SMA and is premature in this section.

  Response: This topic is addressed as discussed in Theme #1 (SMAs).

- In Table 3-5, delete the three columns associated with post-remediation SWACs and their associated footnotes. Highlight those SWAC areas that exceed the low end of the range with one color and those SWAC areas that exceed the high end of the range with a different color. Also, add the other two COCs (lead and total polynuclear aromatic hydrocarbons [PAHs]).

  Response: This topic is addressed as discussed in Theme #1 (SMAs), Theme #4 (Threshold Criteria), and Comment 2.3 (Bullet 3). The additional information on exposure pathways provided as part of the revised CSM in Section 2 explains why SWACs are only provided for mercury and Aroclor 1268. As explained in Section 2, SWACs are not appropriate for lead and total PAHs, and therefore, are not provided.

- Modify the text of Sections 3.4.1 and 3.4.2 accordingly with the above comments.

  Response: This topic is addressed as discussed in Theme #1 (SMAs) or as noted to other responses to bullets associated with this comment.

4. Section 4.2, page 45. Include a brief discussion of the following technologies: 1) In-situ treatment such as reactive barriers and enhanced biodegradation; and 2) Immobilization/stabilization where sediment and chemicals are mixed to make COCs less mobile.

   Response: This topic is addressed as discussed in Theme #9 (Remedy Alternatives).

5. *Section 6, General.* This section should be rearranged in light of the above comments. A modified version of Table 3-5 can be presented in this section. However, those post-remediation areas that exceed the low and high ends of the SWAC RGO ranges must be highlighted to help the reader understand where potential residual risks occur. For example, mercury levels in Domain 3 Creek and the Western Creek Complex remain above the high end SWAC RGO under Alternatives 4, 5, and 6. Similarly, the levels of Aroclor1268 in Purvis Creek, Domain 3 Creek and the Western Creek Complex (≥ 3 mg/kg < 4 mg/kg) remain above the lower SWAC RGO under Alternatives 4, 5, and 6. The overall impacts from these residual RGO exceedances need to be evaluated in greater detail.

   Response: This topic is addressed as discussed in Theme #4 (Threshold Criteria).

6. *Section 6.2.1, page 92.* The FS should include alternatives which will achieve RGOs at the lower end of the range presented in the EPA's letter of November 30, 2011. While the EPA and Georgia Department of Environmental Protection (GA EPD) agreed that alternatives which achieve the higher end of the RGO range could be presented for consideration, the selections of such remediation goals would only be acceptable if they are adequately justified. The risk management criteria that can be used to support a selection of an RGO at the upper end of the range can be considered only after the threshold requirements are met. Furthermore, sole reliance on such consequences as habitat destruction to justify use of the high end of the RGO range is not sufficient justification.

The last sentence of the first paragraph should be modified because the upper end of the range is not understood to be protective according to the BERA. As indicated above, the EPA and GA EPD agreed to consider higher numbers where justification is provided. Other arguments presented in this section regarding the indigenous grass shrimp test and the benthic community studies were already rejected by EPA during the development of the BERA and should be deleted from Section 6.2.1. They can be discussed in the uncertainty section. Since the sediment cleanup goal of 11 mg/kg for mercury is equal to the apparent effects threshold (AET) for grass shrimp embryo development endpoint, all sediments above this concentration are expected to be toxic to grass shrimp.

Response: This topic is addressed as discussed in Theme #1 (SMAs) and Theme #4 (Threshold Criteria). As discussed in detail during the July 11-12 meeting, the upper end of the range is considered protective for the reasons described in communications with USEPA that are now added to Section 3 of the FS (Honeywell 2012). The Honeywell (2012) memorandum and Appendix L of the FS explains why both the BERA conclusion of 11 mg/kg as an AET and the alternative conclusion that 11 mg/kg is protective can both be accurate statements. The difference is based on how exposures occur in toxicity testing in comparison to how exposures actually occur in the natural environment of OU1.

7. *Appendix E2.* The FS remedy alternative evaluation methods focus on incremental SWAC reduction for reduction of risk to finfish and the green heron. However, these reductions seem to rely on a linear model based on a percent SWAC reduction to predict effectiveness (Appendix E2) and a human health evaluation based on SWAC reductions for total domains, total creeks and total estuary (Table 6-3). The FS omits an adequate demonstration and supporting information as to how these incremental SWAC reductions, and thus progress toward remedial goals and risk assessment endpoints, were determined. Add this analysis in the revision.

   Response: It is assumed that this topic is addressed as discussed in Theme #7 (CSM) and Theme #4 (Threshold Criteria). Furthermore, the approach presented in Appendix E2 (now Appendix L: *Remedy Effectiveness Considerations*) is consistent with the USEPA BERA and the USEPA-approved HHBERA, and is based on numerous conversations and agreements with the Agencies prior to the submittal of the FS. The incremental SWAC reduction for green heron is based on the USEPA's food web model from the 2011 BERA as detailed in Section 2 of Appendix E2 (now Appendix L). The incremental SWAC reduction for finfish is based on a linear model as detailed in Section 3 of Appendix L. The risk reductions for each Remedy Alternative are due to reductions in sediment concentrations that lead to reduced risks for the wildlife receptors. Appendix L shows the mathematical relationship between the reduced sediment concentrations for each Remedy Alternative and the reduced risks for the wildlife receptors.

8. Appendix E2. Risk reduction analyses were conducted only for mercury and Aroclor 1268, despite there being elevated sediment lead concentrations in the Dillon Duck, Domain 3

Creek and other areas. The risk reduction and remedy effectiveness evaluation should address all four COCs, including "hot spot" areas and where a particular COC is a remedial "driver."

Response: This topic is addressed as discussed in Theme #7 (CSM) and Theme #4 (Threshold Criteria). Appendix E2 (now Appendix L) supports information related to concepts presented in Section 6 for bioaccumulative compounds. Issues related to remedy effectiveness and lead or PAHs is provided directly in Section 6 (i.e., supporting information is not required).

ATTACHMENT A
No. 3 Thorough Analysis of Threshold Criteria and Balancing Remedial Alternatives

1. *General*: CERCLA and the NCP require that all of the alternatives except the No Action Alternative meet the threshold criteria, protection of human health and the environment and compliance with ARARs. Once the threshold requirements are met, or an ARAR waiver is approved, then it is appropriate to assess each alternative against the primary balancing criteria and against each other to determine their relative performance. The draft FS appears to state that incidental impacts to the environment or implementation difficulties can justify the selection of an alternative that fails to meet the threshold criteria. Further, risk management assumptions were used before analysis of any alternatives and with minimal supporting documentation. The premature risk management assumptions impacted the development of an objective FS. The revision to the FS should adhere to CERCLA and the NCP, as described above.

   Response: This topic is addressed as discussed in Theme #4 (Threshold Criteria).

2. *Section 3.2, page 35*. Simplify this section by removing the NCP criteria regarding each RAO. The NCP criteria are applied to the development of alternatives, not to RAOs. Also, remove all text associated with how the RAOs will be evaluated (e.g., references to monitoring of sediment and biota) as these become components of specific alternatives to be developed later in Sections 5 and 6.

   Response: Section 3 RAOs are revised to the extent applicable given the comments in this section.

3. *Section 3.2, page 36*. RAO2 needs to include the threshold criteria of being protective of human health and the environment. The final remedy for OU1 must ensure protection of human health and the environment. Practicability, short term risks (e.g., incidental impacts to the marsh), or other justifications do not substitute or replace the requirement to ensure protection of human health and the environment.

   Response: Section 3 RAO 2 is revised.

4. *Section 3.2, RAO 4 and RAO 5, pages 36 and 37.* As with the other RAO descriptions, the threshold criteria for protection of human health and the environment need to be stated.

   Response: RAOs 4 and 5 are revised to clarify that all remedies must be evaluated to meet the NCP threshold criteria.

5. *Section 3.2, RAO 7, page 37.* The description in this section suggests that the threshold criterion for protection of human health and the environment may be balanced against the other criteria. These statements are inconsistent with CERCLA, NCP, and existing EPA Superfund guidance. This RAO should be deleted. CERCLA provides two statutory requirements for the analysis of remedial alternatives, protection of human health and the environment and compliance with ARARs, unless they are waived. A remedial alternative must satisfy these two requirements before it is even eligible for further evaluation against the balancing and modifying criteria. Risk reduction, sustaining resources, practicability, implementability, and short term risk (e.g., incidental impacts to the marsh), considerations cannot supplant the requirement for protection of human health and the environment. FS language should not suggest they may be used as a reason for not meeting this statutory and NCP requirement for a final remedy.

   Response: This RAO is deleted from the FS.

6. *Section 5.1.1, pages 62 and 63.* The section reads, "In some marsh areas, potential short and long term ecological impacts may significantly outweigh environmental benefits of remedy implementation." If the statement is meant to refer to a management decision to leave "isolated contamination" within the marsh complex, this should be clearly stated. If however, the intent is to state that short and long term risks (balancing remedy criteria) may be used to substitute for meeting the threshold criteria, the statement must be removed as the threshold criteria must be meet as noted above.

   Response: This topic is addressed as discussed in Theme #4 (Threshold Criteria).

7. *Section 5.1.2, page 65.* The section states, "...and in some areas potential short and long-term ecological impacts significantly outweigh environmental benefits of remedy implementation." This statement should be removed, as it implies that the balancing criteria may be used to substitute for meeting the threshold criteria, as noted above.

   Response: This topic is addressed as discussed in Theme #4 (Threshold Criteria)

8. *Section 6.1.1, page 85.* There are several statements in this section that refer to achieving the balancing and/or modifying criteria. These criteria do not substitute or replace the requirement to ensure protection of human health and the environment, and the FS language should not suggest that they can be a reason for not meeting this statutory and NCP requirement for a final remedy. The text should be modified.

   Response: This topic is addressed as discussed in Theme #4 (Threshold Criteria).

ATTACHMENT A
No. 4 Correction or Elimination of Technical Inaccuracies and Unsupported or Subjective Statements

General Response: All comments in this section are addressed in the Revised FS unless otherwise noted in this section.

1. *General:* There are several statements in the FS emphasizing that Aroclor-1268 is less toxic than Aroclor-1254 because it contains less dioxin-like PCB equivalents and dioxin/furan toxicity equivalents than other PCB Aroclors. Based on the information presented in Attachment B, EPA believes the particular type of weathered Aroclor-1268 that ended up in OU1 sediments is only about one-third as toxic as Aroclor-1254 instead of ten or more times less toxic, contrary to description on page 20 of the draft FS. The uncertainty discussed in the FS should state that Aroclor-1268 may be less toxic than Aroclor-1254 by a factor ranging between 1/3- to-1/10 as toxic. Supporting Information for this comment is provided in Attachment B of this letter. Use the 1/3-to-1/10 as a range, rather than solely the 1/10 used throughout the document.

   Response: A detailed response to this comment is provided in Attachment B.

2. *Figure 2-5.* The figure's caption reads "Healthy Marsh." Delete the word "healthy" from the text associated with photos F, G, and H because a visual representation of habitat does not equate to a healthy habitat. Delete the phase ".. located at the LCP marsh..." associated with photo K and replace it with the location of the place where the photo was taken.
3. *Section 2.2.1, page 5.* The section states that, "...marsh sediments provide confined conditions." This is contradicted by the draft groundwater remedial Investigation (RI) and addendum, the thermal infrared study and the seep study. Revise the sentence to read "semi-confined."
4. *Section 2.2.1, page 5.* The 1997 unapproved draft Groundwater RI is cited. However, it appears the language was taken from the also unapproved 2002 Groundwater RI Addendum. The latter report describes the cemented sandstone as having a hydraulic conductivity of 10E-4 centimeter per second (cm/sec) or less, not the 10E-5 cm/sec mentioned in the draft FS report, including page A-3 of Appendix A. There is ample documentation of hydraulic communication and contaminant migration across the cemented sandstone. Note that Figure 2-2 diagrammatically shows leakage through the sandstone. Revise the discussion.
5. *Section 2.2.2, page 6.* The flowpath description in the section suggests that groundwater follows discrete horizontal paths; however, there is a known upwards component to groundwater flow in the marsh. Figure 2-3 shows upwards flow paths. Text should be modified.
6. *Section 2.2.4, page 8.* The major sediment fate and transport properties should include physical mixing and bioturbation, both of which may affect contaminant distribution. The assertion that marsh areas are "net depositional" is frequently used throughout the FS despite the fact that many areas of the marsh are subject to erosion. This assertion is not

relevant in determining remedial response actions for individual areas and the text should be revised.

7. *Section 2.3.1, page 9.* This section reads, "An undisturbed community and species diversity are characteristic of a healthy marsh. Based on visual observations from a January 2012 visit, the Site appears to be a functioning habitat with an undisturbed plant community." This statement is irrelevant because Site COCs are not phytotoxic. See comment #2 above. Therefore, it is not anticipated that the Site plant community would be affected by the marsh contamination. Additionally, observational evaluations are not a rigorous means of assessing ecological risk or ecosystem health. Delete this statement.
8. *Section 2.3.2, page 12.* The final paragraph of the section states that seeps only flow after heavy rainfall events and are "diffuse", and are a "small discharge." The data does not support any of these characterizations. Remove this sentence.
9. *Section 2.4.1, OU1 -Surface Sediment COC Concentrations, Page 15.* Lead is present in Dillon Duck sediments at concentrations above 100 mg/kg in most locations and is present in concentrations above 1,000 mg/kg in some locations. The text should be modified to reflect these numbers instead of "greater than 50 mg/kg."
10. *Section 2.3.4, page 13, last paragraph.* Clarify that the BERA did not evaluate marsh grass function or the microbiotic community as assessment endpoints and that no lines of evidence were presented. It is not known whether there are any differences between functions in OU1 and in other marsh habitats. Clarify that the BERA focused on the potential effects to fish and wildlife because the primary COCs (Aroclor 1268 and mercury) are known to be more bioaccumulative and toxic to upper-level consumers in the food web.
11. *Section 2.4.1, page 15.* Describe the three historical sampling locations which were re-sampled in 2012 and provide rationale for excluding these or any other historical sampling results.
12. *Section 2.4.1, page 16.* The text states that beyond a depth of one foot below the estuary surface, Aroclor-1268 concentrations typically were non-detect. Sixteen of the 62 vertical profiles presented in the RI report show Aroclor-1268 data deeper than one foot below the surface of the estuary. Of those 16 plots, four did not show non-detect concentrations at depths greater than one foot below the surface of the estuary. Please refer to Section 4.3.3 of the approved RI for a full discussion of the location, depth profiles and contaminants identified to date below one foot. Revise the text to reflect this.
13. *Section 2.4.1, page 17.* The section reads, "Whereas the toxicity studies that are the basis for the NRWQC are readily available, the basis of the Georgia WQS is not readily available. Therefore, the exceedances of the Georgia WQS are difficult to interpret. "Delete this statement. The Georgia WQS should be included as chemical-specific ARARs.
14. *Section 2.4.2, page 18.* Delete the word "very" from each of bulleted paragraphs since their use may be misinterpreted to be dismissive of the risk assessment exposure assumptions. Also, the section says, "USEPA has not developed CSFs or RfDs specific to Aroclor 1268," which is misleading. The EPA has developed CSFs for PCB/Aroclor mixtures instead of for a specific Aroclor. Modify the language. Furthermore, delete the text in the fifth bullet indicating that clapper rails are not commonly consumed. The Georgia Department of Natural Resources web site indicates that they are commonly hunted.
15. *Section 2.4.2, page 19.* The second paragraph reads, "ELCR estimates greater than 1 x 10E-4 may require further characterization, but not necessarily remedial action or other risk

reduction measures (USEPA 1991)." This statement should be modified or removed since cancer risk greater than 1 x 10E-4 *does* require an action.

16. *Section 2.4.4, Finfish, page 28.* In the first bullet, add that several unfiltered water samples analyzed for Aroclor-1268 exceeded the State of Georgia water quality standard of 0.03 µg/L for total PCBs. In the 3rd bullet, in the last sentence insert "methymercury" after the word "modeled," and add that modeled Aroclor-1268 tissue concentrations were within the range of measured tissue concentrations, except for the striped mullet.
17. *Section 2.5, Conceptual Site Model, page 30.* Discuss or reference sections in the RI regarding re-suspension of creek sediments as a release mechanism.
18. *Section 2.5.3*, page 32. This section suggests that the potential for sediment recontamination by groundwater was evaluated and resolved in the RI; it was not. The OU1 RI states that the flux model results are to be reported in the FS.
19. *Table 3-1.* Make Table 3-1 (Chemical-Specific ARARs) media specific and add text to the table or the body of the document clarifying the appropriateness or applicability of the ARAR/TBC. For example, State of Georgia Water Use *Classifications* and Water Quality Standards 391-3-6-03 are listed as a chemical-specific ARAR applicable to surface water. Depending on how OU1 is defined, WQS may also be relevant and appropriate for groundwater discharging (i.e., seeps) to the OU. This table also lists the Safe Drinking Water Act MCLs as an ARAR, but it is not clearly stated which media or how this ARAR would apply. Neither were MCLs considered during RGO development in Section 3.3 nor are groundwater exceedances discussed in Section 3.4. These issues need to be developed so there is clarity regarding the groundwater pathway.

    Response: The comment to make ARARs media-specific is unclear. MCL criteria are not sediment-specific ARARs and have been removed from Table 3-1; specifically, MCLs are not relevant to sediment and surface water. Water quality criteria are addressed in Remedial Action Objective (RAO) No. 6 in Section 3 of the FS. Because RAO No. 6 requires compliance with the WQC ARARs, surface-water-specific RGOs are unnecessary and were not developed. Furthermore, the FS clarifies that the Remedial Alternatives must meet the threshold criteria to be considered viable, which includes compliance with ARARs.

20. *Section 3.2, RAO 6, page 37.* Eliminate the following text from the RAO, "using total or dissolved phase mercury and PCB measures." This RAO should simply state the goal of protecting aquatic life in the estuary.

    Response: As discussed during the July 11-12, 2013 meeting, this RAO would be edited to state that the RAO would be based on total <u>and</u> dissolved phase mercury and PCB measures.

21. *Section 5.4.2, page 73.* Monitoring of chemical concentrations should not just be limited to fish. At a minimum, add shellfish to the monitoring component because they are critical in the COC food transfer to humans, fish, and herons.
22. *Section 6.2.1, page 90, 1st paragraph.* The fourth sentence of the paragraph mentions concentration reductions in most species over time. Appendix F portrays a more nuanced

picture with regards to Zone H. While Figures F-3D through F-3W show decreasing mercury concentrations in six of the 10 species monitored (two species not collected in 2011), Aroclor-1268 is shown to have increased in six of the 10 species monitored (two species also not collected in 2011). Revise the text to reflect this.

23. *Section 6.2.1, page 91, and Figures 6-2A, B.* Figures were drawn that discussed the risk reduction to the green heron from exposure to mercury. Similar figures should be included that show the risk reduction to the river otter from exposure to Aroclor-1268. The river otter has a large home range and had no-observable-adverse-effect level (NOAEL) risk from exposure to Aroclor-1268 in the larger domains, such as Domains 2 – 4 and Blythe Island.

    Response: NOAEL baseline risks are provided in Appendix L (*Remedy Effectiveness Considerations*) and Blythe Island is provided on that figure. However, risk reduction estimates for mammals and birds for Aroclor 1268 are not provided because the LOAEL risks are below the threshold value of 1.

24. *Section 6.2.1, pages 91-92.* The text indicated that the hazard quotients (HQs) are below 1 for the green heron. It should be stated that the HQs below 1 were based on the LOAELs and not on the NOAELs. Figure 3-5 should show the footprint for the lower end of the range of SWAC RGOs in addition to the upper end of the range. Figure 6-2B should plot on the y-axis the estimated daily dose and draw a horizontal line to indicate the NOAEL and the LOAEL. In the alternative, a double-y plot could be used to show the NOAEL hazard quotient on the right y-axis to compare to the LOAEL hazard quotient on the left y-axis. Given that the impact is proportional to the area over which the reproductive decline occurs, the width of the bars on Figure 6-2B should be adjusted to widen the width of the bars in proportion to the total area of the creek or domain they represent.

    Response: The Section 6 figures indicate that they are based on LOAEL HQs and that NOAEL HQs are provided in Appendix L (*Remedy Effectiveness Considerations*). However, alternative graphics using double plots are not provided. Furthermore, the proportional relationships are not provided by adjusting bar widths.

25. *Section 6.2.1, page 92, second whole paragraph.* The third sentence states, "The need to remediate to the lower end of the RGO must be balanced against the physical impacts of the remedy, so that the remedy itself does not do more harm than good." This indeed is a management goal; however, the FS needs to explain the impact of residual risks that lie between the low and high RGO range. Also, delete the very next sentence that proclaims the benthic community is not negatively impacted by the low-range RGOs. Based on a detailed analysis of over 200 toxicity tests performed by Honeywell and its contractors, Table 7-29 in the BERA provided concentrations protective of benthic invertebrates, which indicates some negative impacts could occur at concentrations above the low-end RGO range.

Response: This comment is related to Theme #4 (Threshold Criteria).

Also in the middle of the second whole paragraph it is stated that "Alternatives 2 through 6 all capture areas where differences were observed in grass shrimp and the benthic community, when comparing OU1 and reference locations; so all are protective against levels where measurable differences have been observed." Delete this sentence because the uncertainty and variability in the two "snap-shot studies" conducted over a decade ago do not indicate protectiveness relative to sediment concentrations and the studies tend to conflict with the sediment toxicity results (that should be summarized in Appendix E-2).

26. *Section 6.2.1, page 91, 5th paragraph.* Delete the first sentence that proclaims that a water quality standard would be met if dissolved-phase PCB data were considered, as filtered sample data is irrelevant. Also, in the 2nd full paragraph it is stated "However, Georgia WQS does not state that dissolved phase data are the appropriate values from comparison but rather identifies that total phase data should be used for the comparison." Delete this statement and revise to read "The No Action alternative does not meet Georgia WQS for total mercury."
27. *Section 7.2.1, page 108.* Sentence in third paragraph, "All five alternatives ..., which is well below where adverse benthic effects were observed in the marsh," should be revised because benthic community studies were conducted at only four locations and do not provide data of sufficient quality to support the absence of effects within the RGO range as shown on Figure E2-5. Also, the bioaccumulation of contaminants in the food-chain is a more serious threat.
28. *Section 7.2.1, page 108.*The text indicated that Alternatives 2 and 3 are disproportionately expensive compared to Alternatives 4, 5, and 6. However, the incremental cost of thin cover in Alternative 3 is relatively low for the risk reduction achieved.
29. *Section 7.2.4, page 110.* The first sentence states "Based on all the remedy selection criteria, including the ecosystem impact analysis, marsh recovery analysis, and cost effectiveness analysis discussed above, Alternatives 5 and 6 are the most effective remedial alternatives for OU1." While Alternatives 5 and 6 may represent the best balance between implementability and cost, it has not been adequately demonstrated to be the most effective in achieving the site-specific RGOs.
30. *General: Appendix A.* The hydrologic differences between the marsh removal area evaluated by the Appendix A Flux Model and the areas from which the model parameters were derived should be evaluated for impacts to the model. The model should be run with a range of hydrologic parameters to assess the sensitivity of the model to these parameters. In addition, the flux model does not account for the contaminant input from large-scale intermittent seeps to the marsh surface that have been witnessed by the regulators and a contactor to the responsible parties.

Response: Appendix A of the FS provides revised information related to the groundwater flux model per the comments as a whole. However, the flux analysis does not and is not intended to consider hydraulic properties of the marsh. The flux analysis represents the concentrations present and water flux outward prior to entry into the marsh area. This calculation is taken from the water table to the bottom of the aquifer. The method computes the mass flux over the entire aquifer thickness. Since it includes the water table it includes all groundwater discharge towards the marsh including any and all groundwater seepage before marsh sediments are encountered, and any and all groundwater seepage out into the marsh itself.

31. *Appendix A, pages A-10.* Contrary to footnote 2, the actual model calculations have never been provided. Remove the footnote. In addition, the data used to evaluate the levels of contamination in the remediated marsh are not provided. Identify which samples are being cited in the section.

    Response: Footnote Removed; files were sent to the Agencies during revision of the FS.

32. *Appendix A, page A-11.* The conclusion drawn by Analysis 2 of the Flux Model is that groundwater is not a significant contributor to surface water contamination. Further, Section 2.4.1 of the draft FS provides no explanation or source for identified surface water exceedances. Provide an explanation for how surface water has become contaminated in excess of ARARs.

    Response: Information relative to COC sources is now provided in Section 2 of the FS. This information is not provided in Appendix A.

33. *Appendices A and B.* Varying flowrates have been used for the estuary and portions thereof that need to be reconciled (App A, pg.A-10, 1st and 5th paragraphs, App. B, pg. B-3, 4th paragraph).

    Response: Appendices A and B of the FS provide revised information according to Agency comments. However, with regard to this specific comment, the following notes are provided.

    Model values for hydraulic conductivity are taken from location-specific measurements at wells distributed along the transect, and are the appropriate values to use in the analysis. Flow rates for the dilution analysis in Appendix A have been taken from specific internal modeling points (at the causeway) in the calibrated hydrodynamic flow model. Text was modified to clarify this point.

    The statements related to flow rates on p. A-12 (Appendix A) are:

    - "... the hydrodynamic model was employed to estimate the flow water through the marsh, south of the causeway, due to tidally influenced flows. These tides equate to an effective flow of 130 cfs."
    - "Based on the hydrodynamic modeling, the comparable stream size for entire marsh system being evaluated here is approximately 500 cfs."

    On p. B-3 (Appendix B), the average flow rate for the Turtle and South Brunswick rivers (190 cfs) corresponds to the tributary inflow to the estuary from the surrounding watershed. This flow rate was used as a boundary condition inflow to the hydrodynamic model. Thus, the flow rates discussed on p. A-12 and p. B-3 represent different quantities and are not comparable.

34. *Appendix B.* Storm surges have been under-estimated by as much as an order of magnitude; see http://www.georgia.org/SiteCollectionDocuments/Industries/Tourism/VICs/2010/2010%20Georgia%20Hurricane%20Readiness%20Plan.pdf (pg. 9 of pdf) and http://www.chathamemergency.org/documents/EOP%20INCIDENT%20ANNEX%20A%20APPENDIX%205%20HISTORIC%20STORM%20TIDE%20ELEVATIONS%20REV0709.pdf (pg. 13 of pdf).

Response: Appendices A and B of the FS provide revised information according to Agency comments. However, with regard to this specific comment, the following notes are provided.

The first document (2010 Visitor Information Center, Hurricane Readiness Plan) is a non-technical document that is not relevant to the hydrodynamic modeling study. The second document (Chatham County Emergency Operations Plan, Incident Annex A, Appendix A, Historic Storm Tide Elevations, U.S. Army Corps of Engineers, July 2009) presents information and data on historical storm surges in the vicinity of Savannah, Georgia. In addition, this report presents numerical model predictions of storm surge heights for Category 1 to 5 hurricanes. The USACE report provided the following information about storm surges in the vicinity of Savannah:

- Based on observer descriptions, storm surges in 1854, 1881, 1893 and 1898 ranged between about 10 and 13 feet NAVD88.
- Based on tide gauge records, storm surges 1947 and 1979 were between 6 and 7 feet NAVD88.
- Based USACE model predictions, storm surges ranged from about 10 feet NAVD88 for a Category 1 hurricane to 24-28 feet NAVD88 for a Category 5 hurricane. No information was presented in the report about the recurrence intervals (i.e., annual probability) for Category 1 to 5 hurricanes. The USACE modeling results were hypothetical scenarios and the likelihood of these types of hurricanes occurring in the vicinity of Savannah was not discussed in the report.

The storm surge simulation presented in Appendix B was based on analysis of historical tide gauge data at Fort Pulaski, Georgia. The storm surge height (6.8 feet NAVD88) corresponds to a 100-year event (i.e., 1% probability of occurring in a particular year). Similar to the 100-year flood simulation, evaluating the potential effects of a 100-year storm surge is appropriate for this study and consistent standard practice at Superfund sites.

35. *Appendix B.* Explain the difference in estuary extent shown on Figure 2-4 of the FS and Figure B2-1 of Appendix B. Figure B2-22 of Appendix B shows measured flood velocities double those predicted by the model; explain.

Response: Appendix B provides revised information. In addition, the following explanation is provided:

On Figure 2-5, the yellow line represents the extent of the "approximate Turtle River Estuary," which includes inter-tidal and floodplain areas that are infrequently inundated and have minimal effect on large-scale tidal circulation within the estuary. The numerical grid shown on Figure B2-1 was designed so that the geometry and bathymetry of the estuary system were adequately incorporated into the hydrodynamic model. Figure B2-1 was not intended to show the extent of the Turtle River Estuary system, which contains areas that are not incorporated into the numerical grid for the model.

The model tended to under-predict peak current velocity at this location during flood tide. This under-prediction was primarily caused by: 1) uncertainty in geometry and bathymetry of the tidal channel and marsh area in the vicinity of Station E1; and 2) limitations of numerical grid resolution in the area surrounding Station E1. However, the model accurately predicted current velocity during ebb tide at this location. Peak current velocities during ebb and flood tides are approximately equal at Station E1. Thus, model reliability for evaluating bed stability is not affected by under-prediction of peak current velocity during flood tide.

36. *Appendix B.* It is unclear if the calibration applied to the marsh surface in Sections 2.4 and 2.5 of Appendix B carried over to the inundation evaluation in Section 2.3.2 and Figures 2-6A & B of the FS.

Response: Hydrodynamic model predictions were not used for the inundation evaluation in Section 2.3.2 and Figures 2-6A and 2-6B. The inundation evaluation discussed in Section 2.3.2 was an empirical analysis based on tidal elevations at mean lower low water (MLLW) and mean higher high water (MHHW) which were used in conjunction with measured bed elevations.

37. *Appendix B, Section 2.3, page B-4.* Since peak stream flow for the Little Satilla River was 27,000 cubic feet per second (cfs) in April 1948 and 38,000 cfs in October 1930, 20,700 cfs is not a reasonably conservative choice for the 100-year flood for stability evaluation by hydrodynamic modeling. At a minimum, the second highest recorded flood event (27,000 cfs) should be modeled. The uncertainty section should describe the results of the model for the 38,000 cfs flood event and how the results of the hydrodynamic simulation depend on the 100-yr flood event assumption. Discuss the uncertainty in this assumption and how it affects the results of the sediment cap stability analysis.

Response: EPA guidance recommends evaluating bed stability during episodic storm events with return periods of 100 years (i.e., 1% probability of the event occurring in any particular year), which is standard practice at Superfund sites. A standard statistical approach (i.e., Log-Pearson Type 3) was used to analyze the 60-year period (1951 through 2010) of USGS flow rate data collected for the Little Satilla River. That analysis yields a flow rate of 20,700 cfs for the 100-year flood. The flow rates for the 1930 and 1948 floods (i.e., 38,000 and 27,000 cfs, respectively) are not appropriate for use in the bed stability analysis because: 1) these flow rates were estimated, so their accuracy is uncertain; 2) return periods of the 1948 and 1930 floods are 300 and greater than 500 years, respectively; and 3) 100-year flood analysis is standard practice at Superfund sites.

38. *Appendices E1 and E2.* There is no discussion, nor any references, in Appendices E1 and E2 regarding long-term effectiveness of thin layer capping in the reduction of COC concentrations and the attainment of remedial goals and risk assessment endpoints. The only information provided regards the recovery rate of marsh vegetation.

    Response: Appendix E1 is now Appendix I (*Review of Technical Issues: Thin-Cover Placement in Spartina Marsh and Potential Bioturbation Effects*) and Appendix J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*) provide information about long-term effectiveness. An overview of this information is also provided in Sections 4, 5, and 6 of the FS.

39. *Appendix E2, Section 2, Mammal and Bird Remedy Effectiveness Evaluation.* The SWAC calculations in Appendix E2 and Figure 6-1B in the main report do not consider the contribution to the NOAEL risks to the piscivorous mammal from Blythe Island. The NOAEL hazard quotient for piscivorous mammals (river otter) exposed to Blythe Island was 3.7 for Aroclor-1268 (Table 4-30 of BERA). Provide a rationale as to why Blythe Island was not included in the SWAC estimations or in Figure 6-1B.

    Response: Blythe Island is now provided on Figure 6-1B. NOAEL risk estimates are provided in Appendix E2, which is now Appendix L (*Remedy Effectiveness Considerations*).

40. *Appendix E2, Section 3.2, Finfish Remedy Effectiveness.* The uncertainties section should briefly discuss the estimate of the biota sediment accumulation factor (BSAF) for fish from Burkhard *et al.* (2005) for PCB180 of 10 (mg/kg lipid)/(mg/kg oc) relative to the bioaccumulation factors used in the finfish remedy effectiveness evaluation.
41. *Appendix E2, Section 4, Sediment-Dwelling Community.* There is no mention in this section about the general results of the numerous toxicity tests conducted over several years at many locations in the estuary that were presented in the BERA. Honeywell and its contractors expended substantial resources on the toxicity tests in order to evaluate a major line of evidence for COC effects on benthic test organisms. Toxicity was evident at many stations over the several-year period. Include a summary of the tests. Also, explain how the test results potentially conflict with the two *in situ* studies that were presented in this section and provide a discussion of uncertainty similar to Sections 2.3 and 3.3 of this appendix. Because benthic community monitoring was not routinely conducted over the BERA study period, no trends or effects can be predicted.
42. *Appendix H, Table H1.* The assumed value for the distribution coefficient (Kd) for Aroclor-1268 is not provided. It may be calculated from the organic carbon absorption coefficient (KOC) and the fraction of total organic carbon, but this is not explained. The higher value used in the appendix may overstate the ability of the organic carbon in sediment to bind with Aroclor-1268 and immobilize it in sediments of a cap and thereby provide an overly optimistic estimate of the long-term effectiveness of the capping remedy. EPA estimated a lower log K_{OC} value of 6.3 L/kg (as compared to the text value of 7.4 L/kg) using the site-specific congener composition of the Aroclor-1268 found in OU1. The table below explains EPA's calculation. Also, site-specific porewater data from the TIE study can be used to

estimate a site-specific log K_d value. For example the Aroclor-1268 concentration in sediments was 26 mg/kg in sediment sample C-6 and the porewater concentration of Aroclor-1268 was 1 µg/L, leading to an estimated site-specific log K_d of 4.4 L/kg. The lower log Kd could reflect colloidal transport or other vehicles for mobilizing PCBs, such as cosolvency. Given the uncertainty in the estimate of Kd, the model should be run to cover a range of Kd values and the text of Appendix H should be expanded to include a separate sub-section explaining the estimation of Kd values.

PCB Congener IUPAC_NUM	Fraction in Aroclor-1268 Mixture	E^a	S^a	V^a	Log KOC (L/kg-oc)[b]
153	0.0026	2.2	1.61	1.8846	5.41
154	0.0024	2.27	1.48	1.7977	5.40
180	0.015	2.34	1.75	2.0070	5.71
187	0.053	2.42	1.61	1.9201	5.71
195	0.004	2.57	1.74	2.0425	6.02
202	0.066	2.62	1.55	1.9556	6.00
206	0.640	2.72	1.87	2.1649	6.33
207	0.046	2.78	1.66	2.0780	6.32
209	0.160	2.94	1.77	2.2004	6.65
Sum	0.989			Mass-weighted log KOC	6.24 + 6×0.01=6.3

Abraham solvation parameters from van Noort *et al.* (2010). Parameters A and B are zero for PCBs.

b Log KOC linear solvation energy relationship from Kipka and Di Toro (2011): log KOC = c + eE + sS +vV, where c = 0.724, e = 1.198, s = –0.080 and v = 1.155 a Abraham solvation parameters from van Noort *et al.* (2010). Parameters A and B are zero for PCBs.

b Log KOC linear solvation energy relationship from Kipka and Di Toro (2011): log KOC = c + eE + sS +vV, where c = 0.724, e = 1.198, s = –0.080 and v = 1.155

Response: Former Appendix H is now Appendix J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*). The calculation of K_d for the organic compounds in the chemical isolation modeling analysis is explained in the text of Appendix J, although the values of K_d were not provided, as noted by the comment. Therefore, the following explanation is provided.

As described on page 4 of Appendix J, the K_d for Aroclor 1268 was calculated from the K_{OC} and the f_{OC}. The K_d was not reported because it reflects an area-specific value, and not a chemical-specific value because the f_{OC} differs between the various components of the model domain. For instance, the initial f_{OC} assumed in the isolation layer of the cap is 0.1 percent, and increased as necessary to achieve the RAOs. The bioturbation zone, however, has an assumed f_{OC} equal to that measured in the surface sediments, which differs among the areas modeled. Rather than report eight K_d values, the text reported the chemical-specific property of K_{OC} and along with the f_{OC} values for the various components of the cap and different areas evaluated. Clarifying text will be added to the revised FS Appendix J to discuss the above.

The example provided by EPA in which it suggests that the lower log K_d (4.4) calculated from one sample could be a result of colloidal material or co-solvency is speculative and potentially problematic, for the following reasons:

- The log K_d was estimated from one sample collected from one location as part of the TIE Study. That data is too limited to draw any conclusions regarding PCB partitioning.
- The porewater sample was not truly paired with the sediment sample (i.e., they were collected as separate samples). This presents additional uncertainty in estimating a partition coefficient because small-scale heterogeneity could result in different concentrations between the two samples.
- The porewater sample was prepared by centrifugation. Experience from other PCB projects has shown that, when not followed by a filtration step, this method can cause the porewater sample to contain particulate matter that biases the PCB concentration high (and estimated partition coefficient low).

Therefore, given the uncertainty associated with the calculated K_d value, it is speculative to suggest that colloidal transport or co-solvency are affecting the distribution of PCBs in the porewater.

The above notwithstanding, the alternate K_{OC} value for Aroclor 1268 suggested by the comment (106.3 L/kg) is evaluated and presented as a sensitivity analysis in the FS.

43. *Appendix H, Table H3*. Provide the calculations for the Darcy flow velocity and run the model over a range of velocities. This will help determine whether the cap design will be effective in preventing migration of contamination through the cap.

Response: Additional details on the Darcy velocity calculations are presented in the FS Appendix J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*).

As discussed on page 8 of Appendix J, "[t]he most conservative groundwater seepage fluxes resulting from the range of Darcy velocities calculated from the range of hydraulic conductivities and hydraulic gradients were used in the cap model for each respective area modeled, as listed in Table 3." Because the Darcy velocity values used in the model are already the most conservative from the range of estimated values, there is no utility in conducting simulations for a broader range of groundwater velocities.

44. Appendix H. Include model runs for at least three different scenarios with a separate table of the input parameter assumptions for each in order to evaluate the uncertainties in the model outputs. Bloom et al. (1999) reported a log Kd for mercury in sediments of Lavaca Bay as 4.89±0.43 for inorganic mercury and 2.70±0.78 for methylmercury. Since most of

the dissolved mercury in porewater will likely be methylmercury, the model should be run assuming a log Kd for mercury of 3 L/kg as one of the scenarios.

Response: A sensitivity analysis of mercury partitioning is presented in the revised FS Appendix J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*)., by evaluating alternate values for the K_d of 10^3 L/kg and 10^5 L/kg.

45. *Appendix Table H4.* This table gives the average sorbed-phase concentration of Aroclor-1268, lead, and mercury in the bioturbation zone as 0 (zero) after 100 years. This conclusion is unreasonably optimistic. It appears as if something is missing. Provide the numbers in the table even if several places to the right of the decimal point are needed to display numbers less than 0.5.

Response: The model-predicted concentrations within the bioturbation zone for the chemicals referenced in the comment are extremely low (e.g., 4.99E-16 mg/kg), and therefore were reported as zero in Table J4. The model predicts that no significant mass would accumulate in the bioturbation zone at the end of the 100 year simulation. Nonetheless, the (extremely low) model-reported values are presented in the revised FS Appendix J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*).

46. *Appendix H.* Section 3.3.1.3 of Appendix H uses a hydraulic conductivity value that is inconsistent with the value used in the Flux Model in Appendix A. Reconcile these differences. Further, the infrared survey has indicates that there is significant groundwater flow through the marsh mud that is not factored into the diffusive seepage rate used in this model.

Response: Appendix J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*) presents revised information. However, the hydraulic conductivities used in the Flux Model and Cap Model were not intended to be consistent; they are based on the properties of the relevant hydrologic unit being evaluated in each respective model. The relevant hydrologic unit for the flux modeling presented in Appendix A is the sand aquifer, and appropriately used the properties of the aquifer derived from well tests along the transect (see response to Comment 30). Alternatively, the cap modeling presented in Appendix H (now I) appropriately used properties of the marsh sediments to calculate Darcy velocity because the cap model is simulating flow through the marsh sediments.

EPA refers to significant groundwater flow through the marsh mud that is not factored into the diffusive seepage rate used in the model. The infrared thermographic study conducted on June 15, 2009 provides only qualitative information about groundwater flow inferred from temperature differences. The survey does not provide measurements of groundwater flow through the sediments, but indicates areas where groundwater flow may be relatively high or low. In addition, only two areas targeted by the thermal imaging study appear to coincide within areas for which capping was evaluated. The rate of seepage through marsh sediments is dependent on hydraulic properties of the sediments; the most conservative value of hydraulic conductivity in the marsh sediments was used in the calculation.

47. *Appendix H.* Section 3.3, second bullet of Appendix H shows that the cap model was run using a 10-cm. bioturbation depth; run the model using 15 cm. bioturbation.

    Response: The approach presented in the March submittal of the FS, which assumed a 15-cm bioturbation zone, is conservative. Although bioturbation will be restricted to occur within the cap's armor layer, the chemical isolation modeling presented in Appendix J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*) assumed that bioturbation was occurring within the upper 10 cm of the chemical isolation layer material (i.e., bioturbation occurred in the upper 10 cm of the overall 15 cm simulated in the model). Therefore, it is unnecessary to evaluate an alternate bioturbation thickness in the model.

48. *Appendix H.* All data derived from the model should be presented.

    Response: A complete listing of model outputs are included in an Attachment to Appendix J (*Effectiveness Evaluations for Thin Cover and Chemical Isolation Cap*).

ATTACHMENT A
No. 5 Editorial Corrections and Clarification in Presentation

All comments in this section are addressed in the FS unless otherwise noted.

1. *General*: Reorganize Section 2 to first summarize the RI, update the CSM to discuss the setting, the problem, sources, extent of contamination, contamination release mechanisms, fate and transport processes, exposure pathways, and risks.
2. *General:* Section 2.4.3, pages 20-30. The Summary of the Baseline Ecological Risk Assessment section presents a great deal of information which is not relevant to the remedy selection and repeatedly refers the reader to the BERA. Suggest that most of the text in this section be eliminated and replaced by a concise set of risk-based conclusions and a summary table which depicts which assessment endpoints are at risk in which domains of OU 1 and sediment concentrations at which the assessment endpoint NOAEL and LOAEL HQ were calculated to equal 1. This table would contain most, if not all, of the relevant information for remedy option comparisons.
3. *Section 1, fourth bullet, page 1.* Specify that alternatives should be compared to both the CERCLA statute and NCP.
4. *Section 1.1, Objectives, page 1.* Include language "to protect human health and the environment and to comply with applicable and/or relevant and appropriate requirements (ARARs)."

5. Combine Section 2.5.2 Chemical Distribution with Section 2.4.1 and Section 2.5.4 with
1. Sections 2.2.3 and 2.2.4 to make a smooth transition to RAOs and RGOs.

Response: Section 2 was revised to improve transitions.

6. *Section 2.4, page 13.* The term "regulatory" in the last whole sentence should be deleted because all benchmarks with a risk assessment are not regulatory in nature. Delete the whole first sentence on page 14 since it is unnecessary and appears dismissive of involuntary incremental risk at the Site.
7. *Section 2.4.1, page 14.* In the first sentence of this section, the citation USEPA 1995 does not appear in the references section. Add "US EPA – ERT Final Report Ecological Assessment Ecological Risk Evaluation of the Salt Marsh and Adjacent Areas at the LCP Superfund Site Brunswick, GA. April 1997" to the reference section.
8. Section 2.4.1, page 17, last sentence. Change the word "detections" to exceedances.
9. *Section 2.4.2, Table 2-4.* Clarify the title of Table 2-4 to indicate that the COCs pertain only to the human health.
10. *Section 2.4.2, page 20.* Modify the 2nd bullet under Noncancer effects to read: "...since all COCs do not share the same mode of action, summing across all COCs is overly conservative. When HI values for individual chemicals are considered, there are HI values exceeding 1 both for consumption from recreational fishing and for high quantity fish consumption."

11. *Section 2.4.2, page 20.* Modify the 4th bullet under Characterization of Uncertainty to read "...using the upper-bound CSF for high risk/persistence PCBs such as Aroclor-1254, when one published study suggests the tumorigenic potency of Aroclor-1268 may be at least 10-times lower."

    Response: An alternative edit was made to this uncertainty discussion because the requested revision does not correctly reflect the degree of analysis behind the Warren et al. (2004) review, which was a thorough evaluation of available carcinogenicity data for various Aroclors that took into account 24 studies and reviews both the relative carcinogenicity of various Aroclors including Aroclor 1268 and the mechanism of action to draw the conclusion that Aroclor potency was "likely to be 1-2 orders of magnitude less potent than Aroclor 1254." In addition, a separate analysis by Simon et al. (2007), which was not cited in the EPS (2011) HHBRA reviewed available chemistry, mode of action, and toxicity data and derived a reference dose for Aroclor 1268 for non-cancer effects (neurotoxicity), associated with Aroclor 1268 that was 20 times lower than the RfD derived by Simon et al. (2007) for Aroclor 1254.

12. *Section 2.4.4, page 29.* In the second sentence of the first bullet under Uncertainty Analysis, add the words "acute and" before the word 'chronic' because many toxicity tests had either 0% survival and/or reproduction.
13. *Section 3.2, RAO 1, page 35.* Delete the word "potential" since releases have been well demonstrated. Also, reword RAO 1 to include not only in-stream sediment deposits but also the contaminants in the marsh flat sediments.
14. *Table 3-3.* The following changes should be made to page 2 of the table: 1) Air Pollution Act – add "requirement" after "specific", 2) Hazardous Waste Management Act & Hazardous Site Response Act – strike 12-8-200 (not applicable to NPL sites), add 391-3-11, 391-3-19, note that 391-3-4 are rules for the Comprehensive Solid Waste Management Act, 12-8-20, and 3)Water Quality Control Act – 391-3-6-.06. The EPA will provide more thorough input on Table 3-3 in the future.
15. *Table 3-4* is not associated with RAO 3 that pertains to hazard indices and cancer risks and should be deleted from this section. If Table 3-4 is retained elsewhere, then in the table footnotes, add a statement describing the meaning of the values 0, 1, and 4.
16. *Section 4.3, page 60.* MNR is retained in the text but not in Figure 4-7. Change the MNR notation on Figure 4-7 from NR to R2.

    Response: Changes are not made for reasons described in Theme #9 (Remedy Alternatives).

17. *Figure 4-7.* Define "R^1" technology in the figure.
18. *Section 6.2.1, page 91.* The paragraph that begins with "RAO 6 in Section 3.2..." should be revised to simply say that the No Action Alternative would not meet the State water quality standards.

19. *Figures 6-1A and 6-1B.* In the captions, delete the phrase "upper confidence limit estimates" as these HQs are not confidence limits. In addition, these two figures only evaluate the LOAEL or high end of the risk range. Include the NOAELs.

    Response: Figures 6-1A and 6-1B were edited per Agency comments. NOAELs are provided in Appendix L (*Remedy Effectiveness Considerations*).

20. *Section 6.2.3, page 94. The monitoring will be conducted to ensure long-term protectiveness of the remedy and compliance with ARARs, in addition to structural integrity and effectiveness. Revise text.*
21. *Section 6.2.6, Page 100, Table 6-4. In the Limitation/Constraint Column, with respect to* the creeks, change the wording to refer to short-term impacts to creeks, rather than marshes.
22. *Section 6.2.7, page 103 and Table 6-5.* Costs quoted in the text are for total Capital Costs (Indirect and Direct), but Table 6-5 presents these costs separately (plus contingency). Add a column to Table 6-5 to clearly show Total Capital Costs.

    Response: The FS text has been revised to present total costs.

23. *Section 6.2.7 and Appendix G.* Total Estimated Recurring Costs are provided only in present day dollars and are not presented in sufficient detail to allow a reader to understand how these costs were estimated. Provide a table or tables with estimated costs for years 1, 3, 5, 10, 15, 20, and 30 broken out for each alternative. Additionally, include separate line items for major cost components (e.g., physical monitoring of capped area, physical monitoring of marsh restoration, etc.).
24. *Section 7.1, Figures 7-1B and 7-1C.* The data used to generate the graphs in Figures 7-1B and 7-1C are not correctly referenced in the figure captions. Figure 7-B is referring the reader to Section 6-3 of the FS when the FS lacks a Section 6.3. Figures 7-1B and 7-1C should be redrawn to keep the clusters of bars showing the hazard quotients for individual fish species separate to clarify how the figures show hazard quotients for different fishes. The median hazard quotient for the sundry fish species assessed is not a particularly useful indicator. Box and whisker plots should not be used in 7-1 series figures, because plots based on a "median" fish are not meaningful.
25. *Figures 6-1A through 7-3C.* The figures should specify that they refer to the LOAEL hazard quotient. Both the NOAEL and LOAEL hazard quotients should be shown on the figures. The FS needs to show that the Site risks are within a range of discretion (i.e., the NOAEL to LOAEL range or can be above the LOAEL in limited areas with sufficient justification) before a risk management decision may be made.

    Response: This comment was addressed via the addition of a new set of tables in Section 6 of the FS showing where each Remedial Alternative falls on the range of NOAEL to LOAEL SWAC RGOs.

26. *Table E2-2.* Curve fit types, Power equation in footnote needs the b in "y = a xb" to be made into a superscript.

ATTACHMENT B: SUPPORTING INFORMATION

This section provides supporting information relative the comments provided in Attachment A. Following each Agency comment is a response.

Comment: Supporting Information for Comment #1 (Category 4): The EPA compiled the available information on the toxicity equivalents for the specific type of Aroclor-1268 used at the Site, based on congener analysis of OU1 sediments in 1996. The EPA estimated the number of dioxin/furan toxicity equivalents (TEQ) in the site-specific Aroclor-1268 to be roughly 2.4E-06 kg/kg. The breakdown was 2.29E-06 kg/kg in Purvis Creek and 2.47E-06 kg/kg in Domain 3. This means that the Aroclor at the Site is about 30 percent, or roughly one-third, as toxic as Arcolor-1254, which has a reported dioxin TEQ composition of 7.87E-06 kg/kg (Burkhard and Lukasewycz 2008). The BERA uncertainty section relied upon Burkhard and Lukasewycz (2008) for evaluation of the relative potency of Aroclor-1268 relative to more common Aroclors. The HHRA relied on congener composition data for Aroclor-1268 from Anderson (1991) for its analysis of relative potency. Anderson (1991) measured a laboratory standard of Aroclor-1268, as opposed to the PCBs found at the Site. Rushneck *et al.* (2004) indicated that different lots of Aroclors could have slightly different compositions. Although weathering in the environment can alter the composition of PCBs, the degree of weathering that occurred was so slight that the Aroclor-1268 at the Site did not change to another PCB Aroclor. Any changes that occurred only affected the composition of the PCB congeners by a low percent.

Among PCB congeners with dioxin-like toxicity, the toxicity equivalence factor (TEF) for PCB 126 is the greatest. A minute fraction of the total mass of PCBs is made up of PCB 126. The toxicity equivalents (TEQ) per mass of Aroclor-1268, however, are very sensitive to the exact amount of PCB 126 present. The impact of these assumptions primarily affected the uncertainty section in the risk assessments, and may have affected risk interpretation, but did not affect the calculations in the ecological risk assessment. The uncertainty section in the BERA relied on Burkhard and Lukasewycz (2008), who assumed 1.8 μg/g (0.18%) PCB 126 in Aroclor-1268, after Rushneck et al. (2004). The HHRA uncertainty section assumed 0.7 μg/g (0.07%) PCB 126 in Aroclor-1268, after Anderson (1991). Anderson (1991) reported 1.49 μg/g (0.149%) PCB 126/129 in Aroclor 1268, which means that the PCB126 and PCB129 were not separated from each other by Anderson's analysis. The HHRA (Table 25) assumed half of this value was PCB 126. A somewhat higher percentage of PCB 126 of 3.6 μg/g (0.36%) was reported by Kannan et al. (1997), who characterized Aroclor-1268 from the OU1 Domain 1 marsh excavation area. The congener analysis conducted in 1996, where the site-specific composition of PCBs was measured, detected PCB 126 concentrations in the range of 1 to 2 percent. The 1996 PTI investigation of PCB congeners in OU1 measured 18 μg/g (1.8%) of PCB 126. The average was among samples of Purvis Creek and Domain 3 sediments. The particular type of Aroclor-1268 that ended up in OU1 sediments is only about one-third as toxic as Aroclor-1254 instead of ten or more times less toxic (as described on Page 20 of the FS).

PCB 126 has been shown to affect the bone density and structural development in juvenile diamondback terrapins (Malaclemys terrapin) [Holliday and Holliday (2012)]. Chambers et al. (2012) reported that sturgeon species, such as shortnose sturgeon (Acipenser brevirostum) and Atlantic sturgeon (*Acipenser oxyrinchus*), are particularly sensitive to early-life stage toxicity from exposure to PCB 126. The authors reported a minimum dioxin TEQ of 50 pg/g in tissue as inducing significant toxicities in shortnose sturgeon (22 mg/kg Aroclor-1268 in tissue for a TEQ composition of 2.4E-06 kg/kg).

Response: Information related to this comment relative to wildlife is provided in the Response to the Supporting information for Comment #21 (Category 1).

Supporting Information for Comment #12 (Category 1): The natural rate of sedimentation in the marsh is governed by the gradual rate of sea-level rise. A consistent supply of sediment is necessary to nourish the marsh. As tides flood the estuary, sediments washed from marsh creeks settle on top of the marsh flats where they are deposited or trapped by vegetation. The historical sedimentation rate in the vicinity of the Site is approximately 3 millimeters per year (see web link). See the following link for information on historical sea level rise in the vicinity of the site: http://www.tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8670870

Response: No reply is needed for this comment, as these issues are addressed in detail in other responses.

Supporting information for Comment #21 (Category 1): The RI and FS acknowledge the limitations associated with the NOAELs and LOAELs in risk assessment. Therefore, EPA has considered dose-response curves for Aroclor-1268 and mercury. The dose-response curve for Aroclor-1268 was based on dietary exposure studies of mink fed fish from the Hudson River. The OU1 BERA used a NOAEL toxicity reference value of 0.03 mg/kg-bw/d and a LOAEL toxicity reference value of 0.3 mg/kg-bw/d for the omnivorous mammal (raccoon) and piscivorous mammal (river otter). The LOAEL toxicity reference value of 0.033 mg/kg-bw/d for total PCBs from Bursian *et al.* (2103) represents 20 percent mink kit mortality through stillbirth and within 6 weeks of birth. The LC20 LOAEL from Bursian *et al.* (2013) compares favorably with the NOAEL used in the BERA. The toxicity values used for mammals in the BERA were based on studies of Aroclor-1254.

Dioxin-like PCB Congener Abbrev or Dioxin/Furan	Congener No.	g/g in 1996 LCP Data[a]	WHO 2005 mammal TEF	Source
2,3,3',4,4',5,5'-HpCB2	189	1.50E-04	0.00003	1996 PTI Data
2,3,3',4,4',5'-HxCB2	157	3.61E-04	0.00003	1996 PTI Data
2,3,3',4,4',5-HxCB2	156	8.11E-05	0.00003	1996 PTI Data
2,3,3'4,4'-PeCB1,2	105	2.83E-04	0.00003	1996 PTI Data
2,3,4,4',5-PeCB1,2	114	1.47E-05	0.00003	1996 PTI Data
2,3',4,4',5-PeCB1,2	118	7.50E-04	0.00003	1996 PTI Data
2',3,4,4',5-PeCB2	123	9.75-E05	0.00003	1996 PTI Data
3,3',4,4',5,5'-HxCB1,2	169	1.77E-05	0.03	1996 PTI Data
3,3',4,4',5-PeCB1,2	126	3.00E-05	0.1	1996 PTI Data
3,3',4,4'-TeCB1,2	77	6.97E-05	0.0001	1996 PTI Data
3,4,4',5-TeCB2	81	1.32E-05	0.0003	1996 PTI Data
1,2,3,4,6,7,8-HpCDD	NA	1.90E-09	0.01	Falandysz *et al.* 2005
OCDD	NA	7.40E-09	0.0003	Falandysz *et al.* 2005
2,3,7,8-TCDF	NA	5.10E-09	0.1000	Falandysz *et al.* 2005
1,2,3,7,8-PeCDF	NA	1.10E-07	0.0300	Falandysz *et al.* 2005
1,2,3,4,7,8-HxCDF	NA	1.30E-06	0.1000	Falandysz *et al.* 2005
1,2,3,6,7,8-HxCDF	NA	2.60E-07	0.1000	Falandysz *et al.* 2005
1,2,3,7,8,9-HxCDF	NA	8.70E-09	0.1000	Falandysz *et al.* 2005

2,3,4,6,7,8-HxCDF	NA	3.50E-07	0.1000	Falandysz *et al.* 2005
1,2,3,4,6,7,8-HpCDF	NA	4.60E-06	0.0100	Falandysz *et al.* 2005
1,2,3,4,7,8,9-HpCDF	NA	1.80E-07	0.0100	Falandysz *et al.* 2005
OCDF	NA	3.20E-06	0.0003	Falandysz *et al.* 2005

a – Average of samples SCC03-2, SCM03-2, SCCD09-2, SCCD06-2, and SCCD08-2.

The average TEQ per gram of Aroclor-1268, including dioxin-like PCBs and dioxins and furans as contaminants of Aroclor-1268, is estimated to be 2.4E-06 kg/kg. (Compare with Section 6.2.1 in the BERA.) The EC20 toxicity reference value of 0.033 mg/kg-bw/d for mink corresponded to 281 pg TEQ/kg-bw/d (Bursian *et al.*, 2013). For the site-specific composition of dioxin-like PCBs and dioxin/furans in Aroclor-1268, the 281 pg TEQ corresponds to a LC20 of 0.12 mg/kg-bw/d. The LC50 value from Bursian *et al.* (2013) of 0.78 µg total PCBs/g feed is equivalent to 0.78 * 2.6 / 0.34 * 97 g-food/day/kg-bw ÷ 1E+09 ÷ 2.4E-06 = 0.24 mg/kg-bw/d. The LC20 and LC50 toxicity reference values are similar in concept and magnitude to the values used in the BERA. However, the LC50 toxicity reference value for Aroclor-1268 for sensitive mammals is lower than the LOAEL used in the BERA.

The dose-response curve can add perspective to the discussion of the characterization of the risks to omnivorous mammals. Mink represent a sensitive species in OU1. Although mink were not chosen as a representative receptor in the BERA, the assessments of the risks to the raccoon and river otter are similar. Based on the exposure factors assumed in the BERA for the river otter, the estuary-wide grand mean Aroclor-1268 concentration in sediment (Table 4-3a in BERA) and the estuary-wide grand mean concentrations in biota from the BERA, the estimated daily dose for the river otter was 0.18 mg/kg-day for OU1 or about halfway between the LC20 dose and the LC50 dose from Bursian *et al.* (2013). The starting total estuary Aroclor-1268 conditions in Purvis Creek and the area-weighted grand means for the estuary correspond to roughly 36 percent mortality to sensitive mammals. A LOAEL HQ of 1 could represent greater than 50 percent mortality to sensitive mammals. It does not represent risk reduction to a no observable adverse effect level (NOAEL). The acceptable degree of reproductive impairment to mammals is a risk management decision.

The same can be said of the risk reduction for the piscivorous bird. The OU1 BERA used a NOAEL of 0.02 mg/kg-bw/d for the piscivorous bird and a LOAEL of 0.06 mg/kg-bw/d. The NOAEL dose to birds of 0.02 mg/kg-bw/d corresponds to roughly zero percent reduction in reproductive success. The LOAEL of 0.06 mg/kg-bw/d corresponds to about 20 percent reduction in reproductive success in birds and 0.037 mg/kg-bw/d corresponds to 10 percent reduction in reproductive success. See Jackson et al. (2011) for mercury dose-response curve and Custer et al. (2012) for diet-to-egg extrapolation. An OU1 mercury SWAC of 1.8 mg/kg represents a 38 percent decline in avian reproductive success. The SMA 1 alternative reduces the total estuary SWAC from 1.8 to 1.2 mg/kg mercury in OU1 sediment, which corresponds to 22 percent decline in reproductive success or a gain of about 16 percent reproductive success. The SMA 2 and SMA 3 alternatives both result in an estuary average mercury SWAC of 1.4 mg/kg, which corresponds to a decline in reproductive success of 27 percent. The 192 acres of Domain 4 East has mercury SWAC of 2.0 under SMA 2 and SMA 3 alternatives, which corresponds to a 43 percent decline in reproductive success, affecting approximately 65 breeding pairs in Domain 4 East for a bird with a home range of 3 acres (Cumbee et al., 2008). The estimates of risk reduction used here for the green heron are based on the bioaccumulation models from sediment to biota in the BERA. The alternatives presented in the FS need careful consideration. The FS should make a clear distinction between the levels of effectiveness achieved by each alternative.

Summary: Comment 20 (Category1) does not suggest that different risk model or a different receptor species should be used than was used in the OU1 BERA or that the toxicity reference values from Bursian *et al.* (2013) or Jackson *et al.* (2011) should be used for the FS. A hazard quotient of 1 for mercury represents an approximately 20 percent decline in reproductive success. A LOAEL hazard quotient of 2.3 for mercury represents a 50 percent decline in reproductive success of birds. A LOAEL hazard quotient of 0.8 for Aroclor-1268 represents an approximately 50 percent decline in offspring survival in sensitive mammals. A LOAEL hazard quotient of 0.4 for Aroclor-1268 represents approximately a 20 percent decline in offspring survival for sensitive mammals. The general shape of the dose-response curves should be about the same regardless of the species or assumptions. In summary, a LOAEL hazard quotient of 1 should not be equated with acceptable risk due to the uncertainties presented in the comment. This should be brought out in the Uncertainty Section of the FS.

Response: These comments address two main topics, discussed below:

- Relative toxicity for mammals exposed to Aroclor 1268
- Relative toxicity for birds exposed to mercury

The points raised in this comment are not used in the FS because this degree of conservatism of interpretation is not warranted when considering the results of the Michigan State University study of Aroclor 1268 toxicity for mammals. Similarly, the potential mercury impacts to birds are overstated in the comment, upon close examination of the basis of mercury studies.

Response Related to the Relative Toxicity for Mammals Exposed to Aroclor 1268

The supporting information for Comment #21 (Category 1) discusses the Aroclor-1268 TRVs for mammals and the mercury TRVs for birds, closing with the assertion that a "*LOAEL hazard quotient of 0.8 for Aroclor 1268 represents an approximately 50 percent decline in offspring survival in sensitive mammals [and] LOAEL hazard quotient of 0.4 for Aroclor-1268 represents approximately a 20 percent decline in offspring survival for sensitive mammals...a LOAEL hazard quotient of 1 should not be equated with acceptable risk due to the uncertainties presented in the comment. This should be brought out in the Uncertainty Section of the FS.*"

It is not disputed that the TRVs that underpin the HQs contribute significant uncertainty to the overall assessment, particularly with respect to the relative toxicity of Aroclor-1254 (which is the basis for the TRV used in the BERA and FS) and of Aroclor-1268. In light of that source of uncertainty, Honeywell funded a chronic reproductive toxicity study on mink, executed at Michigan State University (MSU) by the same researchers who published the study on mammalian toxicity of Hudson River PCBs and employing an identical study design. That work has been presented in poster format at the North American and European meetings of the Society of Environmental Toxicology and Chemistry, and a manuscript is in preparation. In brief, mink were tested with the following dose groups for Aroclor 1268:

Treatment	Sum PCBs		TEQs
	ug/g lipid wt	mg/kg ww	ng/kg ww
Negative control	0.01	0.001	0
Aroclor 1268 Treatment 1	20	1.7	1.25
Aroclor 1268 Treatment 2	40	4.0	2.5
Aroclor 1268 Treatment 3	101	10	5
Aroclor 1268 Treatment 4	175	17	7.5
Aroclor 1268 Treatment 5	281	29	10
Positive control (PCB 126)	0.18	0.018	28

The no observable adverse effect concentration (NOAEC) and lowest observed adverse effect concentration (LOAEC) values for the various endpoints are:

	NOAECs			LOAECs		
	Sum PCBs (ug/g lipid wt)		TEQs (ng/kg lipid wt)	Sum PCBs (ug/g lipid wt)		TEQs (ng/kg lipid wt)
	Dietary	Adipose	Dietary	Dietary	Adipose	Dietary
6-week kit survival and body mass	175	925	75	281	No data	100
3-week kit body mass	101	227	50	175	925	75
Adult body mass (at breeding)	101	1328	50	175	2346	75
Juvenile thyroid mass	175	526	75	281	735	100
Juvenile platelet count	101	266	50	175	526	75
Adult TT4	40	492	25	101	1328	50
Adult, juvenile, and kit liver mass	40	492, 99, 81	25	101	1328, 266, 227	50

The key findings of the study were:

- No adverse effects in 2 lowest treatment groups (20, 40 ug/g lipid wt)
- No mortality caused by PCB toxicity
- Whelping success and birth weights were similar across all Aroclor 1268 treatments
- Diminished 3- and 6-week kit weights at 175 ug/g lipid wt
- Decreased 6-week kit weights and survival at 281 ug/g lipid wt
- Infanticide and low feed consumption contributing factors

The MSU authors attributed the observed effects to changes in nutritional status related to the reduced palatability of the food administered to the higher treatment groups. Kit mortality in the 29 mg/kg group was due primarily to infanticide, suggesting that females consumed kits rather than eating unpalatable Aroclor 1268-spiked diet. The authors also reported a reduction in serum thyroxine in the 10, 17, and 29 mg/kg groups, but suggested that this response could also be related to nutritional status. Regardless of whether the effects observed in the highest Aroclor 1268 dose groups were related to toxicity or food avoidance, the corresponding dose levels were much higher than Aroclor 1254 doses associated with near-complete reproductive failure.

The body weight normalized NOAEL and LOAEL TRVs for Aroclor-1268 are calculated below, based on the treatment-specific food ingestion rates and body weights, for the most ecologically relevant endpoint (6-week kit survival and body mass).

	Dietary Conc. (sum PCBs, ug/g lipid wt)	Dietary Conc (sum PCBs, ug/g wet wt)	Body Weight (g)	Food Ingestion Rate (g/day)	Dose (mg/kg-day)
6-week kit survival and body mass: NOAEL	175	17	994	110.6	1.9
6-week kit survival and body mass: LOAEL	281	29	998	117.1	3.3

The estimated daily dose for the river otter was 0.18 mg/kg-day in the OU1 BERA, which is considerably lower than the lowest NOAEL TRV for mink kit survival, generated by this mink study for Aroclor 1268. In summary, the uncertainty in TRVs based on Aroclor 1254 is so great that it predicts risks that are not supported by the bioassay conducted on Aroclor 1268. Rather, when an appropriate Aroclor-specific study provides the basis for the TRV, neither mortality nor any other adverse effect is predicted in any sensitive individual animals. Because the MSU study was done using Aroclor 1268, this study is considered applicable and relevant to OU1.

Response Related to the Relative Toxicity for Birds Exposed to Mercury

The comment about mercury toxicity for birds uses a recently published dose-response model for mercury effects on birds (Jackson et al., 2011) to estimate reproductive effects on green herons for different SMAs. While a dose-response approach can be useful in principle, the dose-response model developed by Jackson et al. (2011) is severely flawed and overestimates risks. Additionally, the Jackson et al. (2011) dose-response model applies to mercury concentrations in bird eggs, which have not been analyzed at the LCP site. Therefore, a diet-to-egg extrapolation was adopted using data from Custer et al. (2012), a study of tree swallows exposed to low levels of mercury. The Custer et al. (2012) exposure scenario is not the most appropriate for estimating mercury concentrations in green heron eggs and also overestimates risks. If more appropriate data sources are considered, as discussed below, it is apparent that birds are not at risk due to mercury under any of the SMAs.

Jackson et al. (2011) Dose-Response Model

Jackson et al. (2011) evaluated Carolina wren reproduction in the floodplains of two mercury-contaminated river systems in Virginia. Wrens were studied upstream and downstream of the historical mercury sources, with observations including both nest boxes and natural nests. Mercury exposure was evaluated primarily based on analyses of adult wren blood, although some egg analyses were also conducted. Based on nests from which at least one offspring fledged (successful nests), Jackson et al. (2011) identified no significant difference in productivity between the study areas and the upstream reference areas.

However, a significant difference was observed in nest success, due at least in part to parental abandonment of a larger number of nests in the study areas. Jackson et al. (2011) used MCESTIMATE software to derive a dose-response relationship, estimating nest success as a function of blood mercury concentrations. The resulting dose-response equation is also extrapolated to mercury concentrations in eggs, based on a blood-egg regression equation (Jackson et al., 2011).

Jackson et al.'s (2011) dose-response evaluation is significantly flawed. Essentially, Jackson et al. (2011) do not provide sufficient detail to allow an independent review of the dose-response modeling exercise, and the limited data presented in the paper do not agree with the model as presented. Specific data that would be needed to evaluate the appropriateness of the dose-response model include the paired blood mercury and nest success results, as well as the paired blood and egg mercury concentrations. The authors have declined to make these data sets available for review, and therefore it is not possible to fully compare actual data with model predictions. However, the data that are available reveal the following issues and inconsistencies:

- The formula given for the dose-response model (Figure 5A of Jackson et al., 2011) does not yield the dose-response predictions portrayed by the authors (Figure 5 and Table 5 of Jackson et al., 2011). The formula appears to be in error, as it predicts no reduction in nest success at relevant mercury exposures. Our discussion is based on the tabulated dose-response predictions rather than the formula.

- The dose-response model predicts that nest success in the references areas should have been between 75 and 80% based on a blood mercury level of 0.2 to 0.5 mg/kg ww. However, the actual reference area success is reported as only 60%. The nest success in the study area appears to be predicted more accurately, at least based on average blood mercury concentrations, such that the dose-response curve appears to be too steep. Jackson et al. (2011) did not characterize the goodness of fit of their dose-response model. Model fit was judged solely based on Akaike's information criterion (AIC), which is designed to assess trade-offs between model complexity and goodness of fit, rather than providing a direct measure of goodness of fit. However, the fact that the model does not accurately predict the results observed in the reference area suggests a basic flaw in the model.

- Jackson et al. (2011) use a blood mercury concentration of zero, rather than reference conditions, as the baseline for estimating percent reduction in nest success associated with various mercury exposures. Because mercury is a naturally occurring element, an assumption of zero mercury is unrealistic. Further, predictions based on zero mercury extrapolate beyond the available data, as mean blood mercury concentrations in the reference areas were on the order of 0.2 to 0.5 µg/g. The authors also extrapolate beyond the available data in the discussion of reproductive impairment at high mercury concentrations.

- The EC10 of 0.7 µg/g mercury in wren blood is closer to the concentrations in the reference areas (see above) than in the study areas, where mean blood mercury concentrations ranged from 1.74 to 2.69 µg/g. It is unclear whether any mercury concentrations as low as 0.7 µg/g were observed in the blood of study area wrens, as the range of concentrations is not reported. The study was not designed to determine whether reference area mercury concentrations were impairing Carolina wren reproduction.

- The MCESTIMATE program used in the dose-response model development is presented as mature and tested software. In fact, MCESTIMATE appears to be a proprietary, internally-developed tool that to our knowledge has not been peer reviewed, and the source code has not been provided for evaluation. The lack of validation is particularly troubling given the poor fit described above.

In addition to these critical flaws in the quantitative dose-response analysis for Carolina wrens, there are important uncertainties regarding the ecological significance of the observed Carolina wren nest success rates, as described below.

- The relationship between nest success and overall productivity is uncertain, because the authors indicate that some pairs that abandoned a nest subsequently re-nested. Jackson et al. (2011) did not report the overall production of fledglings per mated pair.

- Jackson et al. (2011) did not discuss whether habitat conditions (e.g., extent of woody vegetative cover, proximity to roadways) were comparable between contaminated and reference areas. The extent to which this or other potentially important confounding factors (e.g., age of nesting adults) might have affected the study results is thus uncharacterized.

In summary, although there was a difference in Carolina wren nest success rates between reference and study areas, the quantitative dose-response relationship presented by Jackson et al. (2011) cannot be fully reviewed and does not appear to accurately represent the relationship between mercury exposures and effects at their study sites. There is also uncertainty related to the ecological significance of the observed effects. Taken together, these issues are sufficiently problematic that the Jackson et al. (2011) dose-response analysis should not be used as a basis for predicting post-remedy reproductive success in green herons at the LCP Brunswick site.

Effect of Dose-Response Assumptions on Risk Estimates

To illustrate the effect on risk estimates of the issues described above, we estimate the mercury concentration in green heron eggs corresponding to an average sediment concentration of 2 mg/kg (i.e., the Domain 4 East SWAC for SMAs 2 and 3) and compare the result to different estimates of mercury toxicity. The mercury concentration in green heron eggs is estimated based on the BAF from Custer et al. (2012) as follows:

- Using green heron prey preferences and sediment-to-biota BAFs from the LCP Brunswick BERA, an average total mercury concentration of 2 mg/kg total mercury dw in sediment corresponds to an average total mercury concentration in green heron diet of 0.4 mg/kg dw.
- The comment do not list the specific bioaccumulation factor (BAF) they derived from Custer et al. (2012); therefore, we derived a BAF as follows. For tree swallows feeding over low pH lakes, total mercury averaged 0.08 mg/kg dw in diet and 0.28 mg/kg dw in eggs, yielding a BAF of 3.5. For tree swallows feeding over neutral pH lakes, total mercury averaged 0.05 mg/kg dw in diet and 0.21 mg/kg dw in eggs, yielding a BAF of 4.2. The average BAF is thus 3.9.
- Combining the diet-to-egg BAF of 3.9 and the dietary concentration of 0.4 mg/kg dw yields an estimated egg concentration of 1.6 mg/kg dw.
- The above egg concentration is equivalent to 0.4 mg/kg ww, assuming 75% water content in eggs. This conversion is necessary because the relevant toxicity data are based on wet weight egg concentrations.

According to Jackson et al. (2011), a concentration of 0.4 mg/kg ww in Carolina wren eggs would cause a 40% to 50% decrease in nest success; however, this prediction is based on a flawed dose-response relationship as described above. Shore et al. (2011) assembled egg-based NOAELs and LOAELs for mercury effects on reproduction in 19 bird species. Both controlled experiments and field studies were included. The lowest egg mercury concentration associated with an adverse effect was 0.8 mg/kg ww (Shore et al., 2011). Similarly, Henning et al. (2013) compiled egg-based NOAELs and LOAELs for mercury effects on reproduction in 20 bird species. The lowest egg mercury concentration associated with an adverse effect was 0.75 mg/kg ww (Henning et al., 2013). These studies are particularly useful because of the large number of bird species considered. The lowest LOAELs from Shore et al. (2011) and Henning et al. (2013) are well above the green heron egg concentration of 0.4 mg/kg ww estimated above, and neither is consistent with the dose-response relationship posited for Carolina wrens by Jackson et al. (2011). Thus, although application of the Jackson et al. (2011) dose-response relationship to the egg mercury concentration identified above predicts significant effects, more appropriate reviews of mercury effects on multiple bird species indicate that actual adverse effects are unlikely.

Diet-to-Egg Bioaccumulation

The comment identifies Custer et al. (2012) as the basis for estimating mercury concentrations in green heron eggs at the LCP Brunswick site. This study presents mercury concentrations in the diet and eggs of tree swallows. The tree swallow-based BAF is likely to overestimate egg mercury concentrations in green herons at the LCP Brunswick site for two reasons: (1) more efficient methylmercury detoxification is triggered in birds with higher mercury exposures, whereas the tree swallows studied by Custer et al. (2012) experienced low mercury exposures; and (2) piscivorous birds such as green herons may detoxify and eliminate methylmercury more efficiently than insectivorous species such as tree swallows. These issues are further described below.

As reviewed by Robinson et al. (2011) and Eagles-Smith et al. (2009), bird species are known to detoxify and eliminate methylmercury through several mechanisms. Methylmercury can be detoxified through demethylation in the liver, with the resulting inorganic mercury either eliminated or stored as a non-toxic mercury-selenium complex. Both methylmercury and inorganic mercury can be secreted in bile for elimination in feces. Birds can also depurate methylmercury by depositing it in their feathers, although this mechanism is only effective during molting. All of these mechanisms serve to reduce maternal transfer of mercury to eggs.

Hepatic demethylation is known to be a dose-dependent process, with increased demethylation efficiency observed above an exposure threshold (Eagles-Smith et al., 2009). Thus, diet-to-egg BAFs are expected to be inversely related to overall mercury exposure levels. The dietary mercury concentrations (0.05 to 0.08 mg/kg dw) reported by Custer et al. (2012) are low relative to mercury concentrations in prey at the LCP Brunswick site. The Custer et al. (2012) results support a diet-to-egg BAF in tree swallows of 3.9. Longcore et al. (2007) observed lower BAFs (average = 2.6) in tree swallows exposed to higher total mercury concentrations in prey (0.13 to 0.29 mg/kg ww, approximately equivalent to 0.5 to 1.2 mg/kg dw).

Additionally, substantial differences between species have been noted in methylmercury detoxification rates and may be linked to feeding guild. Hepatic demethylation is thought to be an active process requiring energy input (hence the existence of a threshold exposure triggering this detoxification mechanism). As such, it should be subject to natural selection, with greater demethylation potentially favored in species that feed higher on the food chain and thus naturally experience higher exposure to background mercury concentrations in prey (Robinson et al., 2011). Because this detoxification process has been studied primarily in piscivores, the connection between diet-to-egg BAFs and feeding guild has not been fully confirmed. Examples of diet-to-egg BAFs for piscivorous birds include a BAF of 0.6 in osprey (Henny et al., 2009) and a BAF of 2.4 in common loons (Barr 1986). Both of these examples are lower than the tree swallow BAF identified from Custer et al. (2012).

In summary, although the diet-to-egg BAF for mercury in green herons at the LCP Brunswick site is not known, the information discussed above suggests that it is very likely lower than the BAF assumed in the Agency comment. Even with such a conservative BAF assumption, egg mercury concentrations in green herons associated with a mercury SWAC of 2 mg/kg are below appropriate risk thresholds. Thus, all three SMAs, including SMA 2 and SMA 3, are protective of green herons in Domain 4 East.

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LCP Brunswick FS
Agency Comments Table 1: Summary of Themes

Comment # (a)	Draft FS Section (March 2013)	Revised FS Section with Changes	Themes Theme #1 SMAs	Theme #2 Source Areas	Theme #3 HH Risk	Theme #4 Threshold Crit, RGOs & RAOs	Theme #5 Data issues	Theme #6 Water Quality Standards (WQS)	Theme #7 CSM and SWAC	Theme #8 Hydro-dyanmics	Theme #9 Remedy Alts	Other (b)
1.1	2	2										
1.2									X			
1.3									X			
1.4												
1.5					X							
1.6	2.2.3	2							X			
1.7	2.2.4	2								X	X	
1.8	2.2.4	2								X		
1.9	2.4.1	2										
1.10	2.5.2	2		X								
1.11	3.4	5	X									
1.12	4.2.3	4									X	
1.13											X	
1.14	4.2.4	4, App I, App J										
1.15	5	5	X									
1.16	6.2.2							X				

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LCP Brunswick FS
Agency Comments Table 1: Summary of Themes

Comment # (a)	Draft FS Section (March 2013)	Revised FS Section with Changes	Themes Theme #1 SMAs	Theme #2 Source Areas	Theme #3 HH Risk	Theme #4 Threshold Crit, RGOs & RAOs	Theme #5 Data issues	Theme #6 Water Quality Standards (WQS)	Theme #7 CSM and SWAC	Theme #8 Hydro-dyanmics	Theme #9 Remedy Alts	Other (b)
1.17	6.2.6	6, App J										
1.18	7					X			X			
1.19	7.1	7										
1.20	7.1	7.00										
1.21	7.2	7										
1.22	App. C	App E					X					
2.1			X			X						
2.2	3.3							X	X			
2.3	3.4	3, 5, 6	X			X		X				
2.4	4.2	4									X	
2.5	6	6				X						
2.6	6.2.1	3, App L	X			X						
2.7	App. E2	App L				X			X			
2.8	App. E2	6, App L				X			X			
3.1						X						
3.2	3.2	3										
3.3	3.2	3										
3.4	3.2	3										
3.5	3.2	3										
3.6	5.1.1	5				X						
3.7	5.1.2	5				X						
3.8	6.1.1	6				X						
4.1												
4.2	Fig 2-5	2										X
4.3	2.2.1	2										X
4.4	2.2.1	2										X
4.5	2.2.2	2										X
4.6	2.2.4	2										X
4.7	2.3.1	2										X
4.8	2.3.2	2										X
4.9	2.4.1	2										X
4.10	2.3.4	2										X
4.11	2.4.1	2										X
4.12	2.4.1	2										X
4.13	2.4.1	2										X
4.14	2.4.2	2										X
4.15	2.4.2	2										X
4.16	2.4.4	2										X

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4.17	2.5	2										X
4.18	2.5.3	2										X
4.19	Table 3-1	6										
4.20	3.2	3										
4.21	5.4.2	5										X
4.22	6.2.1	6										X
4.23	6.2.1	App L										
4.24	6.2.1	6, App L										
4.25	6.2.1	6				X						
4.26	6.2.1	6										X
4.27	7.2.1	7										X
4.28	7.2.1	7										X
4.29	7.2.4	7										X
4.30	App. A	App A										
4.31	App. A	App A										
4.32	2.4.1/App.A	2										
4.33	App. A, App. B	App. A, App. B										
4.34	App. B.	App. A, App. B										
4.35	App. B.	App B										
4.36	App. B.	2										
4.37	App. B.	App B										
4.38	App. E1 & E2	4, 5, 6, App I, App J										
4.39	App. E2	App L										
4.4	App. E2	App L										X
4.41	App. E2	App L										X
4.42	App. H	App J										
4.43	App. H	App J										
4.44	App. H	App J										
4.45	App. H	App J										
4.46	App. H	App A, App J										
4.47	App. H	App J										
4.48	App. H	App J										
5.1												X
5.2	2.4.3	2										X
5.3	1	1										X
5.4	1.1	1										X
5.5	2	2										

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Comment # (a)	Draft FS Section (March 2013)	Revised FS Section with Changes	Themes Theme #1 SMAs	Theme #2 Source Areas	Theme #3 HH Risk	Theme #4 Threshold Crit, RGOs & RAOs	Theme #5 Data issues	Theme #6 Water Quality Standards (WQS)	Theme #7 CSM and SWAC	Theme #8 Hydro-dyanmics	Theme #9 Remedy Alts	Other (b)
5.6	2.4	2										X
5.7	2.4.1	2										X
5.8	2.4.1	2										X
5.9	2.4.2	2										X
5.10	2.4.2	2										X
5.11	2.4.2	2										
5.12	2.4.4											
5.13	3.2	3										X
5.14	Table 3-3	3										X
5.15	Table 3-4	3										X
5.16	4.3, Fig 4-7	4									X	
5.17	Fig. 4-7	4										X
5.18	6.2.1	6										X
5.19	Figs 6-1A,6-1B	6, App L										
5.20	6.2.3	6										X
5.21	6.2.6	6										X
5.22	6.2.7	6										
5.23	6.2.7, App. G	6										X
5.24	Fig 7-1, B/7-1C	7										X
5.25	Figs 6-1A to 6-3C	6										
5.26	Table E2-2	App L										X

(a) Nomenclature aligns with comment sections and numbers within those sections (e.g. Comment 1.1 is in Comment 1 from Section 1).

(b) Addressed in revised FS document but not in RTC document