



Columbia River Estuary Study Taskforce  
Attn: Otter Point Restoration Project  
750 Commercial Street, Room 205  
Astoria, OR 97103

**REVIEW REPORT AND  
RESPONSE COMMENTS  
90% DESIGN LEVEL**

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## **Otter Point Restoration Project Section 408 IEPR**

**Clatsop County, Oregon**



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Prepared by:

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## INTRODUCTION

The Columbia River Estuary Study Taskforce (CREST) is managing the Otter Point Estuarine Habitat Restoration Project for the National Park Service. This restoration project requires a modification to a Federal levee operated and maintained by Clatsop County Diking District No. 11. Section 33 of United States Code (USC) 408 requires that a determination be made that modifications to a Federal project will not impair the usefulness of the Federal project. Because this levee is considered a Federal levee by the U.S. Army Corps of Engineers (USACE), it requires that a Section 408 permit be submitted for the modification and that the permit show that a Type II Independent Expert Peer Review (IEPR) has been conducted in accordance with the requirements of USACE Engineering Circular (EC) 1165-2-209 “Civil Works Review Policy” dated January 31, 2010. CREST will prepare the Draft Section 408 Application Package.

CREST has retained HDR to perform the Independent External Peer Review (IEPR) on the following:

- Hydraulic and Hydrology report
- Geotechnical Report
- Construction Plan Set
- Environmental Documentation
- Other supporting documentation for the application

The intent of this review document is to satisfy the Safety Assurance Review (SAR) requirements for the Clatsop County Diking District No. 11 Otter Point Estuarine Habitat Restoration Project as required by Section 2035 in the Water Resources Development Act (WRDA) of 2007 as described in the USACE EC 1165-2-2009.

The purpose of a SAR is to verify and review that good science, sound engineering, and public health, safety, and welfare are the most important factors that determine a project’s fate and is achieved by independent and impartial review. The SARs are used to inform the USACE Chief of Engineers on the adequacy, appropriateness, and acceptability of the design and construction activities for public health, safety, and welfare.

For this project, the SAR shall include participation by independent experts selected from among individuals who are distinguished geotechnical engineering and hydraulic engineering experts. Independent, in this instance, means that the persons selected to review the design are not involved in the original design, and have no conflict of interest. The IEPR Panel (Panel) shall evaluate whether the interpretations of analysis and conclusions are valid.

The Panel will consider how project features adequately address redundancy, robustness, and resiliency and how the findings during construction reflect the assumptions made during design. The Panel will provide comments and recommendations to Clatsop County Diking District #11, the National Park Service, and CREST, but does not advise, or make recommendations to the Federal Government regarding the project. The Panel does not meet the criteria of a Federal Advisory Committee and is therefore compliant with Federal Advisory Council Act (FACA).

The Panel for the Otter Point Estuarine Habitat Restoration Project includes:

Mr. Ron Mason, P.E. Hydraulics and Hydrology; and  
Mr. Rich Hannan, P.E. Geotechnical.

Mr. Mason and Mr. Hannan are recognized experts in flood control projects, geotechnical engineering (Hannan), and hydrologic and hydraulic engineering (Mason). Mr. Mason has over 30 years of experience planning, designing, operating, and managing environmental and water resource projects. Mr. Hannan has 39 years experience as a geotechnical engineer. Both Panel members have specific experience working on USACE and Columbia River levee certification projects. The panel members' qualifications are clearly indicated in the Conflict of Interest disclosure forms and in their resumes that have been provided to CREST. The members of the Panel have no conflicts of interest with respect to the Otter Point Estuarine Habitat Restoration Project. They do not own land in the vicinity of the levee footprint nor do they own land in the Astoria, Oregon. Their fields of expertise and practice are in geotechnical adequacy of embankment designs and construction, and hydrologic and hydraulic engineering.

## **BACKGROUND**

Clatsop County Diking District No. 11 proposes to work with the National Park Service, CREST, along with the Bonneville Power Administration and the USACE to restore 33.5 acres of salmon habitat, intertidal wetlands, and the historic landscape at a location known as Otter Point within the Lewis and Clark National Historic Park.

As part of the proposed project a modification to a federally authorized levee system will occur with the construction of an approximately 1,400-linear-foot new cross levee at the north boundary of the Otter Point project site. The purpose of the levee is to maintain flood protection for Clatsop County Diking District No. 11 from implementation of the project within the Lewis and Clark National Historic Park.

This levee modification work is the second phase of a project to restore tidal wetlands and salmon habitat for juvenile migrating salmon in the Columbia River estuary. Phase I of the project involved clearing the site, removing non-native invasive plant species, and excavating historic and new channels all within the existing levee system.

Phase II work includes construction of a new 1,400-foot-long cross levee just inside the northern boundary of the project site and breaching the existing levee. The top of the new levee elevation is planned at 15 feet to address concerns about future certification of the levees in Clatsop County Diking District No. 11. This levee will be constructed from approved excavation materials from the channel restoration work in Phase I under the supervision and approval of a geotechnical engineer.

Once the new levee is in place, the existing levee will be breached to connect the internal channels to the Lewis and Clark River. There will be three additional breaches to allow floodplain connectivity to the central area of the site. The CREST is managing this project.

## SUPPLEMENTAL INFORMATION - CREST RESPONSES TO IEPR REVIEW COMMENTS

Based on the Review Report dated June 2, 2011, CREST and its design team have made changes to the original 90% design level reports. These changes were based on the IEPR team (Mason and Hannan) review comments. During the week of June 20, 2011, the following revised documents were submitted to the IEPR members for review by CREST:

- Construction Plan Set for the proposed project at Otter Point, dated June 15, 2011,
- Report of Geotechnical Engineering Services, Otter Point Restoration Project, Astoria, Oregon, dated June 17, 2011,
- Specification Appendix, dated June 15, 2011,
- Hydraulic Analysis Report, Otter Point Restoration, dated June 2011,
- Design Summary Memorandum, prepared by CREST, dated June 17, 2011,
- Memo prepared by CREST with Summary of Responses to IEPR comments,
- Construction QA Plan Appendix, dated June 17, 2011.

The following sections of the Review Report have been amended by incorporating a short narrative after each IEPR comment that addresses the revisions to the design report for the Otter Point Restoration Project.

Additionally, for clarification, the title of the "Review Report 90% Design Level" has been changed to ***Review Report and Response Comments*** dated June 22, 2011.

In summary, CREST has provided an adequate response to all IEPR review comments.

It should be noted, that given the soil material properties and potential moisture issues at the project site, thorough quality control construction measures will be needed during the construction of the proposed levee.

## REVIEW COMMENTS AND RESPONSES ON THE GEOTECHNICAL REPORTS

### Geotechnical Review

The following products were reviewed:

- Draft Report of Geotechnical Engineering Services, Otter Point Restoration Project, Astoria Oregon, March 14, 2011.
- Otter Point Estuarine Habitat Restoration Project, Construction Documents Plan Set, Clatsop County, Oregon, March 11, 2011.

Design guidance for levees is contained in USACE Engineer Manual (EM)-1110-2-1913, *Design and Construction of Levees* dated April 30, 2000. Guidance is provided in seven general areas. The geotechnical review generally focuses on the requirements of these items.

- Field Explorations
- Laboratory Testing

- Borrow Areas
- Seepage Control
- Slope Design and Settlement
- Levee Construction
- Special Features

**Comment #1:**

EM 1110-2-1913 (2000) states “The term levee as used herein is defined as an embankment whose primary purpose is to furnish flood protection from seasonal high water and which is therefore subject to water loading for periods of only a few days or weeks a year. Embankments that are subject to water loading for prolonged periods (longer than normal flood protection requirements) or permanently should be designed in accordance with earth dam criteria rather than the levee criteria given herein.” Based on the levee section on sheet C-12 it would appear that the levee is subjected to a hydraulic loading of up to about 6 feet daily potentially requiring the use of earth dam criteria for the design. Use of levee design criteria may require a waiver from the USACE. Realignment of the levee to the south to provide a natural ground bench on the north, or landward, side of the levee and realignment of the North Backwater Channel to the south to provide a bench of natural ground on the south, or waterward, side of the levee would generally cause the base of the levee to be located above the daily water level fluctuation and allow the use of levee design criteria.

**IEPR Response:** CREST has stated that the Portland District USACE is recommending the use of EM 1110-2-1913 for design guidance of its tidally influenced levees. Discussions with the USACE have confirmed this policy.

**Comment #2.**

**Field Explorations:** The purpose of subsurface explorations is to better define the geology of the area, the soil types present and to develop general ideas of soil strengths and permeability, and to perform in-situ testing and to collect samples for laboratory testing purposes. Standard Penetration Testing (SPT) and field vane shear tests are recommended. Both were incorporated into the explorations program and the data is contained in the report.

Section 2-9(a): ***Exploration – Borings – Location and Spacing:***

**Requirement:** Initial spacing of borings usually varies from 60 to 300 meters (m) (nominally 200 to 1,000 feet [ft]) along the alignment, being closer spaced in expected problem areas and wider spaced in non-problem areas. At least one boring should be located at every major structure.

**2a. Finding:** Geotechnical Report: A total of 6 borings made along 2 sections. Borings are located 300 ft from each end and 600 ft apart with what appears to have been a boring near each toe of the proposed levee and one near the center. General Location and Spacing appears to be in compliance with the EM. No borings were located at the site of the proposed culvert and tide gate. Because of the nature of this structure, a boring could be seen as not being required.

**IEPR Response:** No response required.

Section 2-9(b): *Exploration – Borings – Depth:*

Requirement: Depth of borings along the alignment should be at least equal to the height of the proposed levee at its highest point but not less than 3 m (nominally 10 ft). Boring depths should always be deep enough to provide data for stability analyses of the levee and foundation.

2b. Finding: All borings extend to a depth of at least 22 ft with one boring along each section going to below 50 ft. Boring depths appear to be in general compliance with the EM.

IEPR Response: No response required.

Comment #3.

**Laboratory Testing:** Reference is made to EM 1110-1-1906 *Laboratory Soil Testing* for testing procedures and EM 1110-2-1902 *Slope Stability* for applicability of the various shear strength tests for stability analysis.

Section 3-1(b): *Testing of Fine-Grained Cohesive Soils:*

Recommend Testing:

- Water Content
- Permeability – to assumed based on soil type
- Atterberg Limits
- Consolidation
- Compaction
- Shear Strength

Findings: Data was provided for the following tests:

- Gradation - minus #200 sieve (6 tests)
  - Water Content (47 test)
  - Atterberg Limits (2 tests)
  - Consolidation (1 tests)
  - Compaction (2 tests from borrow area)
  - Shear Strength:
- 3a. Direct Shear (2 on foundation materials, 1 on borrow material) with information presented in Figure A-10. The plot appears to show a very high Internal Friction Angle, with a cohesion of about 64 pounds per square foot (psf). Table 2 presents the undrained strength parameters that were used in the analysis, but the values do not appear to reflect the information in Appendix A. The determination of drained strength parameters need to be documented.

IEPR Response: Comments related to strength testing have been addressed satisfactorily in the revised geotechnical report.

- 3b. Unconsolidated Undrained (1 test on foundation material, 1 test on borrow material).

IEPR Response: No response required.

- 3c. Testing was performed both laboratory and insitu samples but strength parameters are not shown for the different tests. Values for both Cohesion and the Angle of Internal Friction are listed in Table 2 of the write-up, but it could not be determined how the values were determined.

IEPR Response: Comments related to strength testing have been addressed satisfactorily in the revised geotechnical report.

- 3d. Soil Strength Parameters selected for use in the analysis are presented in Table 2. Data is also provided on the boring logs and figures in Appendix A. The soft foundation value of  $c=400$  psf needs further explanation and documentation. It appears to reflect vane shear test results. It could not be determined if the vane shear tests were corrected, but it appeared that they were not. See Paragraph 2-12 “test results in high plasticity clays must be corrected using empirical correction factors as given by Bjerrum (1972) (but these are not always conservative).”

IEPR Response: Comments related to strength testing have been addressed satisfactorily in the revised geotechnical report.

- 3e. Note that about half of the specimens for the Direct Shear and Consolidation tests were obtained from thick-walled drive samples (Dames and Moore U and Standard Penetration Test samplers). Such samplers are generally considered to be unable to provide “undisturbed” samples for use in strength and consolidation testing. Therefore, the use of the results from such samplers should be questioned.

IEPR Response: Procedures related to sampling have been addressed satisfactorily in the revised geotechnical report.

#### Comment #4.

**Borrow Areas:** EM 1110-2-1913 generally addresses availability, material type, and natural water content, and in Section 4-2a states “almost any soil is suitable for constructing levees, except very wet, fine-grained soils or highly organic soils. The EM recognizes that in some cases these weak materials can be used, but cautions that the cost associated with drying and flattening slopes often exceeds the cost of off site borrow.” The Geotechnical Report generally covers borrow and addresses the concern of water contents in excess of optimum further indicating that off-site borrow may be required, but does not address the questionable nature of the material. Based on the relatively limited testing, the excavated material will have high liquid limits (95 and 101) and plasticity indexes (55 and 58). Such materials are often not allowed in construction of new levees unless mitigation measures or soil improvement techniques are used. Materials from the proposed borrow area were tested for natural moisture content, compaction, and shear strength, but the shear strength values appear questionable. The EM seems to suggest that use of this type of material on the very soft foundation may be acceptable if used in conjunction with berms or flatter slopes such as 1V:4H. However, such measures do not appear to have been incorporated into the current design. No source of off-site material was identified, and no material properties assumed for any potential off-site material. If off-site material is used for levee construction, it

will be necessary to perform sufficient testing to determine the properties of the material so that seepage and stability computations can be computed.

IEPR Response: Comment has been addressed by modifications to the specifications.

Comment #5.

**Seepage Control:** Engineer Technical Letter (ETL) 1110-2-569 *Design Guidance for Levee Underseepage* provides guidance for design of levees for seepage.

Requirement: ETL 1110-2-569 provided interim guidance for the design of levees to minimize the adverse effects of levee underseepage. Section 6.d. established the exit gradient at the toe of the levee of  $i=0.5$ . EM 1110-2-1913 paragraph 3-6 does not require laboratory permeability testing on fine-grained materials, and recommends that the average values for the coefficient of permeability be based on the dominant soil type. EM 1110-2-1913, Appendix B provides additional guidance for seepage analysis. This guidance should be incorporated into the seepage analysis.

Finding: The report indicates that a seepage analysis was performed, but there was no discussion of any results of a seepage analysis in the Geotechnical Report. The seepage model does not identify a difference between the foundation material and the compacted levee material. Boundary conditions for the model need to be clarified, and the model appears to show water to about elevation 8 feet on the landside of the levee. The levee should be modeled with the landside ditch dry per USACE guidance in EM 1110-2-1913. It also appears an elevation of 14.2 was used for the 100-year flood. The H&H report shows the 100-year flood to be at approximately elevation 12.5.

IEPR Response: Comment has been addressed. Seepage analysis has been satisfactorily addressed in the revised geotechnical report.

Comment #6.

**Slope Design – Embankment Geometry:**

Requirement: Minimum requirements for low levees on proven foundations are provided in EM 1110-2-1913 paragraph 6-1. The guidance recommends a slope no steeper than 1 Vertical (V) on 3 Horizontal (H) for ease of maintenance and inspection with slopes being no steeper than 1V on 2H depending on the results of the stability analysis. A crown width of 10 to 12 ft is recommended. In addition to slope considerations, EM 1110-2-301 Guidelines for Plantings and Vegetation Management for levees and dams requires that a 15-foot vegetation free (except for grass) zone be maintained. This zone is required to be mowed and maintained free of shrubs and trees.

Findings:

- 6a. The Geotechnical Report did not address how the levee slopes or crown width were selected. The sections shown in the plan set indicate a 1V on 3H landside slope and a 1V on 2H riverside slope with a 12-foot-wide crown. This appears to meet the minimum geometry requirements for the landside and crest. The riverside slopes do not meet the

minimum for maintenance. There are also significant issues with regard to embankment stability and the use of inappropriate embankment materials that are likely to require a redesign of the embankment slopes. At a minimum, a re-evaluation of the slopes for stability will be needed (see Comment #7, below). If material is available, the use of very flat slopes 1V on 6 H can be used as a means of controlling nutria burrowing. USACE investigations at Fern Ridge Reservoir found that nutria would not burrow into slopes that had been flattened to 1V on 6H. This is not a USACE requirement and only practical if large quantities of material are available.

IEPR Response: Levee geometry and material strength parameters have been addressed in the revised geotechnical report and show the stability of the slopes meets the requirements found in EM 1110-2-1913.

- 6b. The Geotechnical Report on pages 1 and 5 seems to indicate that the crown elevation has been established based on a 100-year flood elevation of 14.2 feet. If true, the designers failed to incorporate the 3 feet of freeboard generally required by FEMA and other agencies when they established Elevation 16.2 feet as the crown elevation. Based on the 2010 USACE Periodic Inspection Levee Report, the authorized levee elevation is 14.2 feet or 14.3 feet NAVD88. The 2010 H&H report prepared by Anchor Environmental states that the 100-year flood for this area is at approximately elevation 12.5 feet. If the 100-year water surface is truly 12.5 feet and is the Design Water Surface Elevation (DWSE), the levee crown elevation would be designed to be 17.5 feet using 3 feet of freeboard and the assumptions that the designers outlined (12.5 DWSE + 3 feet of freeboard + 1 foot for future settlement + 1 foot for gravel road = 17.5 feet). This would be 1.3 feet higher than the 16.2-foot crown elevation shown in both the report and the drawings. The report should be modified to eliminate the inconsistencies in design water surface elevation and properly design and document the levee geometry.

IEPR Response: The design elevation issue has been adequately addressed by CREST in their response to our comments.

- 6c. The levee design sections shown on sheets C-12 and C-16 do not provide for the required 15-foot width at the toe of the levee required for levee access, inspection, vegetation management, and flood-fighting.

IEPR Response: The riverside slope is shown at a 1V on 2H which meets stability requirements, but it is not clear how vegetation maintenance is to be accomplished in the zone between the mean high water (elev. 9 feet) and the top of the completed levee (elev. 17 feet). Vegetation maintenance will also be an issue at the landside toe of the levee due to the lack of a bench between the toe of the levee and the drainage swale. Vegetation maintenance will need to be addressed in the O&M manual for the new section of levee.

#### Comment #7.

**Slope Design – Embankment Stability:** Analytical methods, conditions requiring analysis, and minimum factors of safety are discussed in Chapter 6 of EM 1110-2-1913.

Requirement: Shear Strength and pore water pressure considerations are discussed in EM 1110-2-1913, Table 6-1a. Minimally acceptable factors of safety are shown in EM 1110-2-1913, Table 6-1b.

Findings:

- 7a. Shear strength assumptions are shown in Table 1 of the Geotechnical Report but it could not be determined how the values were determined. More documentation is needed before it is possible to determine if the assumed values are appropriate and how they were derived (see Comment #3). The undrained shear strength shown in Table 2 for the foundation material does not match the value shown for the undrained foundation material in Appendix C (i.e., the use of 500 psf for shear strength versus the value of 400 psf identified in Table 2).

IEPR Response: Slope stability and shear strength issues have been adequately addressed in the revised geotechnical report.

- 7b. Slope stability analyses need to consider that the more rigid embankment material that will be placed on the soft foundation will crack, and that the cracks possibly will be partly filled with water for both the steady-state and rapid drawdown analyses. In addition, the unsaturated portions of the embankment fill should not be assigned the high cohesion value of 500 psf determined for undrained testing.

IEPR Response: Slope stability issues related to cracking have been adequately addressed in the revised geotechnical report.

- 7c. The Steady State Conditions analysis appears to show a water level on the landside of the levee at approximately elevation 8 feet. It should have been analyzed as being dry per USACE guidance (see EM 1110-2-1913, 2000).

IEPR Response: Slope stability issues related to water levels have been adequately addressed in the revised geotechnical report.

- 7d. There was no discussion on how pore pressures were handled for the design load cases analyzed. EM 1110-2-1913 Table 6-1a provides guidance on the use of effective stress vs. total stress, and the appropriate use of undrained strength and drained strength to be used when analyzing the three different loading conditions that are required to be analyzed. Based on information provided, it does not appear that the guidance was followed.

IEPR Response: Slope stability issues have been adequately addressed in the revised geotechnical report.

- 7e. The stability section slopes presented in Appendix C of the Geotechnical Report appear to be steeper than the slopes shown in the plan set. The analyzed slopes were not defined in the report. Since both the upstream and downstream slopes analyzed appear to be steeper than designed slopes in the plans package, the factor of safety could be greater than what was calculated.

IEPR Response: Slope stability issues have been adequately addressed in the revised geotechnical report.

- 7f. The Rapid Drawdown section of the Geotechnical Report appears to have been done incorrectly. Rapid Drawdown is a riverside analysis.

IEPR Response: The Rapid Drawdown analysis was recomputed and is adequately addressed in the revised geotechnical report.

**Comment #8.**

**Embankment Design – Settlement:**

Requirement: EM 1110-2-1913 states that settlement estimates can be made using theoretical analysis in EM 1110-1-1904, *Settlement Analysis*.

**Findings:**

- 8a. The Geotechnical Report states that a settlement analysis was performed. Assumptions and parameters used in the analysis were not provided. Assumptions, parameters, and a sample calculation should be included in the Appendix of the report. Based on the settlement reported and observed for similar newly constructed levees in the vicinity of this project, the estimate of 1 foot of settlement is probably too small, but the placement of the borrow stockpile on the levee footprint may have helped mitigate the amount of anticipated settlement.

IEPR Response: All settlement analysis issues have been adequately addressed in the revised geotechnical report.

- 8b. Explorations, sampling and testing were performed after stockpiling of borrow material on the levee footprint. The impact of this loading should be included in the report.

IEPR Response: The impact of stockpiled materials on the levee alignment has been satisfactorily addressed in the revised geotechnical report.

**Comment #9.**

**Levee Construction:** Levee construction requirements are addressed in Chapter 7 of EM 1110-2-1913.

Requirements: Minimum foundation preparation includes clearing, grubbing, and stripping of the levee footprint. EM 1110-2-1913, Table 7-1 recommends a water content range be specified with respect to standard effort, optimum water content, uncompacted lift thickness of 6 to 9 inches and be compacted with a sheep's foot or rubber tired roller, and allows for specifying a minimum required density.

**Findings:**

- 9a. The Geotechnical Report recommended clearing, grubbing, and stripping of the foundation. Borrow material has been placed on the foundation footprint. It was not

stated in the report if clearing and grubbing had in fact been completed prior to this fill placement. Drawings suggest considerable variability in the elevation of the ground from north to south across the levee section. Since the time that the design was developed, excavation and fill placement activities have significantly altered the apparent elevation of the area. The specifications need to clearly state that all stockpiled material and any other loose or unsuitable material will be removed from the levee foundation prior to levee construction. The drawings should also be modified to explicitly require the removal of the existing fill.

IEPR Response: Levee construction issues have been adequately addressed in the revised geotechnical report and in the specifications. We concur that the embankment material moisture content and compaction are a concern that must be closely monitored during construction.

- 9b. Neither the Geotechnical Report nor the construction drawings indicate that an inspection trench will be excavated and backfilled. EM 1110-2-1913 (2000) generally requires completion of a 6-foot deep inspection trench (see page 7-3). The design and construction drawings should be modified to incorporate an inspection trench unless there is a clear and documented compelling reason to not do so.

IEPR Response: The need for an inspection trench has been adequately addressed in the revised geotechnical report.

- 9c. Based on information provided, it appears that the foundation should be considered weak and compressible. Due to the soft compressible nature of the foundation, staged construction or pre-loading techniques may be needed to satisfactorily construct the new levee. Stockpiled material appears to have already been placed on the levee footprint to a height of several feet. If it is felt that this stockpiled material is functioning as a pre-loading fill it should be discussed in the report. In any event, the potential for an undrained end of construction slope/bearing failure and the need for staged construction and/or pre-loading should be fully addressed and documented.

IEPR Response: Foundation stability and the impact of stockpiling have been adequately addressed in the revised geotechnical report.

- 9d. The Geotechnical Report indicates that the borrow materials should be expected to be very wet and drying will be required. The report does not address the desired moisture content to be achieved prior to compaction, nor does the plan set. Proper moisture content will control the ability to achieve the specified densities in the embankment. Moisture control is a critical element to successful construction.

IEPR Response: The geotechnical report and specifications have been revised to address moisture control. Embankment material moisture content and compaction are a concern that must be closely monitored during construction.

- 9e. The Geotechnical Report recommends thin lifts but does not specify a lift thickness. Lift thickness is not addressed in the plan set other than that it is to be done under the guidance of “the geotechnical engineer.”

IEPR Response: Lift thickness has been adequately addressed in the revised geotechnical report and specifications.

- 9f. The Geotechnical Report specifies compaction to greater than 70 pound per cubic foot (PCF) (this is approximately 90% of optimum). This value could not be found in the plan set, but defers to the guidance of “the geotechnical engineer.”

IEPR Response: Compaction has been adequately addressed in the revised geotechnical report and specifications.

- 9g. No detailed embankment construction sequence has been identified for the construction of the levee. The contractor may wish to use a construction sequence that allows for drying of the stockpiled borrow material in-place with foundation preparation and fill placement starting at the west end and progressing towards the remaining borrow material stockpile that is presently on the alignment of the proposed levee.

IEPR Response: Construction sequence has been adequately addressed in the revised geotechnical report.

#### Comment #10.

**Slope Protection:** Protection of the levee's riverside slope from daily fluctuations of water level was not addressed. Sheet C-9 of 22 of the plan set appears to show the north channel encroaching onto the toe area of the levee with no provisions for slope protection between elevation 5 foot and the normal daily high water. Erosion of levee slopes along sloughs connecting directly to the Lewis and Clark River were reported during the 2010 Periodic Levee Inspections. Slope protection in the zone of daily fluctuations of water level need to be addressed.

IEPR Response: Toe erosion issues have been adequately addressed in the revised geotechnical report and on the plan set.

#### Comment #11.

**Pipes:** General requirements for pipes under levees are addressed in Chapter 8 of EM 1110-2-1913 with specific guidance contained in EM 1110-2-2902, *Conduits, Culverts, and Pipes*. EM 1110-2-2902 establishes the minimum diameter of a pipe under a levee at 36 inches. The Geotechnical Report does not address pipe installation and the plan set only provides minimal information related to location and depth. The specified pipe appears to be a 30-inch reinforced concrete pipe. This does not meet the minimum diameter of 36 inches. In addition, both of the above EM's generally require the addition of a drainage filter along the landside third of the pipe length within the levee. Either such a filter should be incorporated, or the reason why one is not needed be fully documented. Installation requirements related to compaction and bedding needs to be fully documented and included (see Table 8-1 EM 1110-2-1913).

IEPR Response: This component of the project has been removed.

# REVIEW COMMENTS ON THE HYDRAULIC AND HYDROLOGIC REPORTS

## Hydraulic and Hydrologic Review

The following reports and memorandum were reviewed:

- Hydraulic Analysis Report, Otter Point Restoration Project, dated July 2008. Prepared by Anchor Environmental, LLC.
- Hydraulic Analysis Report, Otter Point Restoration Project, revised June 2010. Prepared by Anchor Environmental, LLC.
- Memorandum, dated 3-11-2011, Otter Point Restoration Project, H & H Response to 408 Permit Questions, prepared by Anchor QEA.

### Comment #12.

**Design Water Surface Profiles.** The project reports do not contain a discussion of the design water surface profiles that were used to establish the height of the levee. Section 6-1(b) of EM 1110-2-1913, *Final Levee Grade* presents information on this topic. The existing levee system was authorized and constructed by USACE based on the December 1933 flood profiles.

IEPR Response: Comment has been addressed. Design Water Surface Profiles have been satisfactorily addressed in the revised Hydraulic report for the project.

### Comment #13.

**Interior Drainage Hydrologic Analysis.** The project reports do not contain a discussion of the interior drainage. Plan sheet C-16 shows installation of two reinforced concrete culverts (18 inches and 30 inches) What is the rationale for the sizing of these two pipes? EM 1110-2-1413, *Hydrologic Analysis of Interior Areas* presents information on this topic. Continuous record analysis or coincidental frequency analysis to determine peak hydrologic conditions for design are normally examined/studied.

IEPR Response: The Interior Drainage Component of the project is not required for this phase. The construction of a new drainage pipes will not occur during this phase of the project.

### Comment #14.

**Culvert Design/Pipe Diameter Size.** EM 1110-2-2902, 4-1 covers the pipe diameter size that should be used for reinforced concert pipes that are used for drainage structures; the minimum required size is 36 inches. What is the size of the existing culvert that is going to be replaced?

IEPR Response: No longer a valid comment for this phase of the project. Pipes will not be constructed during this phase of the project.

### Comment #15.

**Pipe Backfill Requirements.** EM 1110-2-1913, section 8-1, the project reports should document if materials at the pipeline crossing are susceptible to piping.

IEPR Response: No longer a valid comment for this phase of the project.

Comment #16.

**Closure Devices.** Requirements for positive closure devices are discussed in EM 1110-2-1913, section 8-6. The project reports provided for review do not contain a discussion of the positive closure device/tide gate. The need for this structure and rationale for design elevations should be documented in the project report. An Operations and Maintenance manual should be prepared for the tide gate that is to be proposed. Detailed operations procedures should be discussed.

IEPR Response: No longer a valid comment for this phase of the project.

Comment #17.

**Residual Risk of the Project.** Normally, USACE will include a discussion of the residual flooding risks associated with the proposed project. For this levee project, the residual risk would be from flood events that exceed the design flood levels. Impacts should be described.

IEPR Response: Comment has been addressed. Residual Risk has been satisfactorily addressed in the revised Hydraulic report for the project.

Comment #18.

**Hydrology.** Project Report Section 3.2.1. The equations used to produce the hydrology for the project report should be presented in the report. Was the hydrologic analysis prepared using mean daily discharges or instantaneous peak discharges? The titles used in Table 2 are somewhat confusing. Please explain the term “average flow” and “minimum flow.” How was the minimum flow used in the report?

IEPR Response: Comment has been addressed. Hydrologic discussion has been satisfactorily addressed in the revised Hydraulic report for the project.

Comment #19.

**Tides.** Project Report Section 3.2.2. Please identify the station identification numbers for the tide stations that were used in the report.

IEPR Response: Comment has been satisfactorily addressed in the revised Hydraulic report for the project.

Comment #20.

**Erosion Protection.** (1) The Project Report should include a discussion of erosion protection measures downstream of the 30-inch culvert outlet that is being proposed. This topic is discussed in EM 1110-2-1913, section 8-15 (d). (2) Along the riverside of the new proposed levee, erosion protection measures below the mean high water (MHW) should be considered. Daily tidal fluctuations will not allow the proposed vegetation to grow that would otherwise provide erosion protection.

IEPR Response: Comment no longer valid, this component of the project has been removed from this phase.

Comment #21.

**Water Surface Profiles for 100-Year Flood Event.** Water surface profiles for the 100-year flood event for the Lewis and Clark River should be displayed for existing authorized project levee conditions and new proposed re-aligned levee project. This allows for a quick comparison of hydraulic impacts.

IEPR Response: Comment has been addressed. Figures 27 and 28 have been added to the revised Hydraulic report for the project.

Comment #22.

**15 Foot Setback Zone.** Fences, power poles and other obstructions (encroachments) are not allowed in the 15-foot setback zone from the toe of the proposed levee. The plan displays some items that might be in this setback zone. In actuality, there is no setback zone from the toe as the drainage ditch fully occupies the land between the landside levee toe and the property line. This is not adequate for access or inspection. Consideration should be given to moving the alignment of the new levee 15 feet further upstream to provide 15 feet of land beyond drainage ditch for access for maintenance, inspection, and flood-fighting, or to purchase an additional 15 feet of land beyond the drainage ditch.

IEPR Response: Documents provided address concerns raised in Comment #22. Power pole and new fence have been moved to the property line. For maintenance and flood fighting activities consideration should be given to moving the fence to the north side of the easement. The O&M manual should address flood fighting activities for this portion of the levee.

Comment #23.

**Hydrodynamic Modeling.** The scope of the numerical modeling and level of effort supports the environmental components of the proposed project restorations at Otter Point. Results and conclusions presented in the report are very reasonable.

IEPR Response: No response needed.