

To:	Henri Mulder, PE USACE Sacramento District		
From:	Christopher Krivanec, PE, GE	Project:	TRLIA - Phase 4
CC:	Ray Costa, PE, GE		
Date:	22 February 2007	Job No:	201064-36522

RE: Evaluation of As-Built Conditions, Yuba River Cutoff Wall (Phase 4)

BACKGROUND

In your review dated 7 February 2007 of construction records for the Three Rivers Levee Improvement Authority (TRLIA) Phase 4 Levee Repair Project, follow up was required by the design team on the cutoff wall constructed at the Yuba River left bank levee between UP Railroad and Simpson Lane. In your review, you stated that the slurry wall trench subsurface profiles should be reviewed to ensure that the design intent (cutoff of the pervious gravel layer) was achieved.

Per your request, we have evaluated the construction of the cutoff wall and, while the Contractor's trench logs indicate up to 6 locations may not have fully penetrated 5 feet into the underlying clay layer, we conclude that the as-constructed cutoff wall should meet the intent of the design. We plan to install instrumentation along the cutoff wall at several of these locations to measure the potential effectiveness of the seepage barrier. This memorandum summarizes our evaluation.

PHASE 4 CUTOFF WALL ANALYSIS AND DESIGN

Eighteen exploratory borings have been completed along the Yuba River levee between the UP Railroad and Simpson Lane, as described in the Problem Identification and Geotechnical Alternatives Analysis reports prepared by Kleinfelder for Phase 4. To address through and underseepage conditions at the levee along this reach, an 80-foot deep cutoff wall was recommended to reduce seepage through an underlying sand, gravel, and cobble layer. The cutoff wall was designed to reduce vertical exit gradients at the landside levee toe to meet USACE criteria for both 100- and 200-year flood conditions. The boring logs generally indicated a low permeability layer existed at about Elevation 15 feet, and that an 80-foot deep cutoff wall to about Elevation 0 should provide up to about 15 feet of penetration into that clay layer.

To confirm the constructability of the slurry wall and to verify geologic conditions, three test trenches were completed outside the waterside toe of the levee. The test trenches were 50 to 70 feet in length, and extended into the underlying clay layer at each location. All trenches were logged by an experienced geotechnical engineer/geologist from Kleinfelder. At these locations the test trenches confirmed (1) the excavation trench side walls penetrating the gravel layer could be supported by the bentonite slurry with little or no caving, (2) fluid levels could be maintained in the trench and the slurry would not be lost into the gravel layer, (3) the excavated gravel materials were too coarse and not suitable as reuse for SCB backfill for the cutoff wall, and (4) the impervious clay layer existed at the depths anticipated (about Elevation 15 feet).

It was required in the specifications that a long-stick excavator be used to construct the cutoff wall to depths of 80 feet below the degraded levee elevation using conventional slurry methods. The specifications required the Contractor provide geotechnical/geologist personnel to prepare trench logs that identified the materials encountered during cutoff wall excavation/construction. Of importance was to document the extent of gravels encountered within the trench. The gravelly materials were to be hauled off at additional payment to the Contractor and replaced with imported finer grained materials that would enable the wall backfill to be prepared to the specification requirements.

CONSTRUCTION ISSUES

As part of the required Quality Control program, the Contractor prepared slurry wall trench excavation profiles for each of four headings. The furnished profiles are attached to this Memorandum. As shown, the simplified logs identify the work platform, the top of gravels, the bottom of the area designated "gravel and contaminated by gravel area", and record elevation. The profiles identified 6 locations which the "gravel and contaminated by gravel area" extended to the bottom of the trench. These locations and lengths of this condition are shown in the table below:

LENGTHS OF CUTOFF WALL OVER WHICH "GRAVEL OR CONTAMINATED BY GRAVEL AREA" EXTENDS TO BOTTOM OF TRENCH LOG	
STATION INTERVAL	LENGTH (FEET)
41+95 TO 42+5	10
71+50 TO 71+70	20
91+20 TO 91+70	50
92+20 TO 92+40	20
95+80 TO 96+00	20
96+40 TO 96+90	50
TOTAL LENGTH	170

Note that the entire wall extends between Stations 35+00 and 103+50, over 6,850 feet. The lengths in questions presented in the table above represent about 2.5% of the entire cutoff wall length.

The Quality Assurance inspectors were not informed of this condition during construction and as a result were not able to independently confirm/evaluate these conditions. At locations where gravels were logged, the Contractor was instructed to extend the trench to the maximum reach of the excavator. As indicated above, all gravelly materials were hauled off at additional payment to the Contractor and replaced with imported materials that met backfill requirements.

ASSESSMENT OF AS-BUILT CONDITIONS

As requested, HDR and Kleinfelder have reviewed the slurry wall trench excavation logs prepared by the Contractor. The purpose of this review was to consider the possible impacts to the cutoff wall performance should gravels extend to the full depth of the wall and a full cutoff was not achieved. The geologic profiles created using the boring and test trench data were reviewed and compared with the Contractor's trench logs. Based on our review, subsurface profile conditions described in the Contractor's trench logs do not appear consistent with the boring and test trench data in the areas of concern.

It is our opinion that some poorly graded gravels and cobbles may have sloughed into the bentonite slurry and were logged at the bottom of the trench as "contaminated by gravel area", but this could not be verified. In any case, the Contractor was directed to remove these suspect materials. While the Contractor's trench logs suggest a few limited reach locations may not have keyed into the underlying lower permeability layer, we anticipate the as-constructed cutoff wall should serve to effectively reduce seepage gradients along this reach to meet USACE criteria.

RECOMMENDATIONS

As a follow up to construction of the Phase 4 slurry cutoff wall, we recommend piezometer instrumentation be installed along the cutoff wall to monitor its performance. This recommendation is in accordance with the USACE Sacramento District SOP EDG-03 Geotechnical Levee Practice document (2004), which provides guidance that piezometer monitoring should be performed routinely after seepage remediation in order to confirm the design parameters used and make adjustments as new data becomes available. As we discussed on 20 February 2007, this recommended installation of monitoring devices should confirm our opinion concerning the effectiveness of the cutoff wall with respect to the Contractor's trench log profile. During installation of the piezometer instrumentation the boreholes at locations in question can be logged to evaluate

the presence of an underlying low permeability layer at the bottom of the cutoff wall. Since there are several locations where the boring information would be useful for bottom layer confirmation, we recommend monitoring devices be installed at Stations 71+60, 91+60, 96+50 and between Stations 46+80 and 47+10. One additional monitoring device should be installed at Station 50+00 to provide coverage over the entire wall length. Our plan is that all monitoring devices will be installed and monitoring performed by representatives of RD 784 before November 1, 2007.