GRANITE CONSTRUCTION COMPANY

OFF CHANNEL MINING AND RECLAMATION

CACHE CREEK HYDRAULICS STUDY

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GRANITE CONSTRUCTION COMPANY – CAPAY & ESPARTO REACHES OFF-CHANNEL MINING AND RECLAMATION

CACHE CREEK HYDRAULICS STUDY

INTRODUCTION

This report is an update to Cunningham Engineering Corporation's (CEC) Hydraulics Report prepared for Granite Construction Company (GCCo) dated December 3, 2001. The study area includes the existing Capay Plant and the proposed Esparto reach located immediately adjacent to the east. This update report has been prepared in support of GCCo's proposal to perform streambank stabilization along the north creek bank in accordance with the *Cache Creek Resources Management Plan* (CCRMP) and Section 4.2, "Minor Bank Protection Works," of the *Cache Creek Improvement Program* (CCIP).

SITE DESCRIPTION

The subject mining reach is located between County Roads 85 and 87 in Yolo County along the north creek bank. More specifically, the Capay reach begins at County Road 85 (Capay Bridge) and extends toward the east (downstream) approximately 8,600 feet, which is about 2,000 feet upstream of County Road 87 (Esparto Bridge). The Esparto reach is located in the 2,000 feet between the Capay reach and the Esparto Bridge.

SCOPE OF HYDRAULICS STUDY

The primary purpose of this study was to update design water surface elevations for the 100-year frequency flows in Cache Creek for compliance with the requirements of the Yolo County *Off-Channel Mining Plan* (OCMP) and the CCIP using updated modeling techniques and technology, current and more extensive topographic data, and more complete historical streamflow information, prior to performing streambank stabilization along the north bank.

This analysis only addresses existing conditions and proposed or future streambank improvements in the creek. It does not include analysis of mining or other work within the Cache Creek channel, or any analysis of flow effects on the bridges, or analysis of pit capture.

BACKGROUND

Computer Model

This study was completed using the Hydrologic Engineering Center River Analysis System (HEC-RAS) computer program, as was used in the 2001 study. The program models one-dimensional, steady state, gradually-varied flow, and calculates water surface profiles.

Peak Flow

Numerous hydrologic studies of Cache Creek have been performed over the years. In 1994, the US Army Corps of Engineers (Corps) completed a reconnaissance level report titled *Westside Tributaries to Yolo Bypass, CA* that established peak flow rates for the Capay Gauge located approximately 4 miles upstream of County Road 85, which was used in the 1995 Cache Creek Hydraulics Study. The 100-year peak discharge used in the 1995 analysis was 63,500 cubic feet per second (cfs).

For the 2001 study, CEC conducted a sensitivity analysis to determine the magnitude of change in the 100-year water surface elevations using the range of flow rates presented by the Corps in their report titled *Lower Cache Creek, Yolo County, CA – City of Woodland and Vicinity Flood Reduction Study, F3 Milestone Conference Report, Administrative Draft, March 12, 2001*. A comparison of the two values presented for the Capay Gauge site (63,500 cfs for 1994 study versus 61,500 cfs for 2001 study) yielded an average 100-year water surface elevation difference of 0.15 feet along the reach between County Roads 85 and 87. Hence it was determined that the modeled water surface elevation is not highly sensitive to differences in peak discharge rates on the order of 2,000 cfs, relative to construction tolerances at a typical mining site. Based on the relatively insignificant difference in the 100-year water surface elevations for discharge rates varying on the order of 2,000 cfs, the 2001 study used the same flow values as used in the 1995 Hydraulic Analysis.

These flows are generally consistent with the most recent 2002 Flood Insurance Study for the City of Woodland which shows 100-year flows of approximately 61,500 cfs in the subject study reach. This study uses the updated flow rates as presented below.

Cache Creek Peak Flows used for Updated Hydraulics Model	
Exceedence Frequency	Flow Rates Used for 2007 Updated Analysis (cfs)
10-year	34,000
100-year	61,500
500-year	75,000

It is noted that these are recommended values for analysis or design purposes. Actual flow rates are subject to various factors, including the timing of releases from the Clear Lake and Indian Valley reservoirs.

Additional studies of Cache Creek that have been conducted in the subject area that included analysis of the water surface elevations include:

1. A study for Yolo County by Northwest Hydraulics in conjunction with EIP Associates for the "Technical Studies and Recommendations for the Lower Cache Creek Resource Management Plan" (October 1995).

2. A study for Yolo County and Martin Kane Associates by Northwest Hydraulics titled "Design Hydraulic Study / Location Hydraulic Study, Capay Bridge Located on County Road 85" (September 1995).

3. A letter report prepared for Solano Concrete by Cunningham Engineering, submitted to Yolo County in support of both the short term and long term off-channel mining and reclamation permit applications titled "Hydraulic Study – Madison Sand and Gravel Mining Site" (August 1, 1994).

4. A report prepared for Syar Industries by Cunningham Engineering, submitted to Yolo County in support of a long term off-channel mining and reclamation permit application titled "Syar Industries Off-Channel Mining and Reclamation – Cache Creek Hydraulics Study" (December 11, 1995).

5. A report prepared for Granite Construction Company by Cunningham Engineering in support of long term off-channel mining and reclamation title "Granite Construction Company Off Channel Mining and Reclamation – Cache Creek Updated Hydraulics Study" (December 3, 2001).

Channel Topography

This 2007 analysis is based on aerial topography flown May 2007 provided by Stewart Geotechnologies via Yolo County and additional topographic information provided by Granite Construction Company on August 16, 2007 and November 12, 2007. Horizontal and vertical control for the aerial topography was based on a control network tied by Andregg, incorporated to a network of published benchmarks. The vertical datum is NGVD29.

The detail and lateral extent of the coverage across Cache Creek is more extensive for the 2007 mapping relative to the 2001 mapping. CEC conducted a comparison of cross sections along the GCCo mining reach from the Capay Bridge (Road 85) to the Esparto Bridge (Road 87) to determine areas of aggradation and degradation of the creek bottom. Graphic representations of comparable cross sections are attached as Appendix A. The constriction caused by the bridge abutments are graphically represented on the cross section plots as "ineffective flow areas" and the tops of banks are graphically represented on the cross section plots as "bank stations". The streamwise locations of the cross-sections are shown on Sheet 1, attached.

ANALYSIS APPROACH

To update the 100-year water surface approximation for the design of bank protection projects and for off-channel mining and reclamation operations, a new numerical model of the creek topography and flow characteristics was created using HEC-RAS. The same creek centerline was used as the 2001 study with the exception of the area upstream of the Capay Bridge which was adjusted to coincide with the creek geometry as shown on the 2007 aerial survey. The centerlines were also extended approximately 500 feet upstream and 1400 feet downstream to meet the County requirement that the analysis extend beyond the study reach by at least 1,000

feet. The majority of the same cross section locations used in the 2001 study were used for this study. Ten additional cross sections were added to model the Capay and Esparto Bridges, plus 1,000 feet of the creek upstream of the Capay Bridge and 1,000 feet downstream of the Esparto Bridge.

Centerline stationing was set at 1383+00 at the Capay Bridge to maintain continuity with the 2001 data. Channel roughness (Manning's "n") values used in this analysis were the same values used in the 2001 study: 0.038 for channel flow and 0.070 for overbank flow. These remain reasonable values based on our field examination of the creek (June 7, 2007).

GCCo plans to conduct a streambank stabilization project on the north bank of the Esparto Reach, approximately from station 1277+30 to station 1300+23. The stabilization project will consist of placing a compacted buttress fill up to the 100-year flood elevation. The updated hydraulic study models the north bank of the Esparto reach at this proposed channel boundary (see Sheet 1 and Appendix C). The north bank of the Capay reach (station 1300+23 to station 1382+82) and the south bank of the Capay and Esparto reaches (station 1277+30 to station 1382+82) were modeled at the existing channel boundary as shown on the 2007 aerial topography (see Sheet 1 and Appendix C).

STUDY RESULTS

The numerical results presented in Appendix B and Sheet 1 are not meant to be exact predictions of future water surface elevations. In general, the 100-year water surface elevations are consistent with the results from our 2001 model with small variations that can be attributed to the more detailed topographic information, increased number of cross-sections, and the inclusion of the CR85 and CR87 bridges in the 2007 model.

The results of the model indicate that, within the study reach, all flows from the 100-year frequency design flow will be contained within the high banks of the channel. However, between station 1296+00 and 1328+70 of both the existing and proposed channel boundary conditions, the 100-year water surface elevation extends into the existing access road adjacent and to the south of the existing Capay plant site mitigation berm.

The CCIP calls for 3 feet of freeboard for "Major Stabilization" and "Priority" projects. The areas described in this report fall into the category of "Minor Bank Protection Works." As stated in the CCMRP, the CCIP "shall contain provisions to ensure that 100-year flood protection is maintained within the planning area and that existing flooding problems downstream are not exacerbated by channel reshaping." To accomplish this goal, we have assumed that Minor Bank Protection Works will be constructed to provide flood protection at the 100-year water surface elevation.

CONCLUSIONS AND RECOMMENDATIONS

1. The HEC-RAS model predicts that the estimated 100-year flow will stay within the creek along the GCCo reach with one exception adjacent to the Capay plant site.

This limited area requires the placement of up to 1'+/- of fill to raise the grade to the 100-year water surface elevation.

2. To maintain historic 100-year flood capacity, significant sand and gravel bars should be removed in areas where aggradation is occurring within the channel boundaries. This can be determined by comparison of current topographic surveys with historic surveys performed within the last 10 years.

3. The proposed streambank stabilization at the north bank adjacent to the Esparto Reach will allow for a more efficient north bank transition as the creek approaches the Esparto Bridge. Implementation of this project will still achieve the necessary capacity to convey the 100-year flows within the creek and will reduce the potential for erosion of the north abutment of the bridge.

4. We recommend, as stated in the County Off-Channel Mining Ordinance, that this analysis be updated in 5 years as part of the monitoring of the flow capacity of the creek and to make adjustments to the creek bottom as described in recommendation No. 2 above where necessary to maintain the modeled 100-year water surface elevation.

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