MEMORANDUM

To: Marc Mammola, Cemex

From: Martin Lewis, Cunningham Engineering Corporation (CEC)

Date: March 10, 2016

Subject: Cache Creek: Hydraulic Analysis of the Cemex Reach

The purpose of this memorandum is to document compliance with Cemex's Condition of Approval #36 by providing information on Cache Creek's 100-year water surface profile abutting the Cemex Mining Site in Yolo County. The Cemex Reach begins at I-505 and extends approximately 2½ miles downstream, as indicated in Attachment 1.

In order to plot the Creek's 100-year water surface profile, Yolo County recently provided Cemex with a copy of an existing steady-flow HEC-RAS model of Cache Creek. It is our understanding that the County derived the model from California DWR's 2014 CVFED hydraulic model for the Lower Sacramento River and tributaries. The work of adapting DWR's model for the County's use was done by Dr. Eric Larsen - in his then-capacity as the Cache Creek TAC geomorphologist.

The County model shares the same stream geometry as the DWR model (referenced to vertical datum NAVD 88), and extends from River Station (RS) 31.258 (near Capay Dam) downstream to RS 3.721 (Cache Creek Settling Basin). Within that, the ±2½-mile Cemex Reach extends from RS 22.579 (I-505 Bridge) downstream to RS 19.905.

Documentation was not received with the County model, but it appears that the major difference between it and the DWR model is the conversion from unsteady flow to steady flow, with the inclusion of steady-state simulations for 100-year, 200-year and 500-year discharges. The County model is uncalibrated. It utilizes a 100-year discharge of 64,000 cfs, and it applies a roughness value of n = 0.043-0.045 for the Creek channel along the Cemex Reach. The values of these input parameters are generally consistent with previous studies. For example, Cunningham Engineering's 2009 hydraulic analysis of the Cemex Reach utilized a discharge of 61,500 cfs (from City of Woodland 2002 Flood Insurance Study) and a main channel roughness value of n = 0.038.

A steady-flow model of this nature is appropriate for the purposes of estimating the creek's 100-year water surface profile along the Cemex Reach. Accordingly, we ran the County's 100-year

model (without modification), and visually compared the model's computed 100-year water surface elevations with the model's top-of-bank elevations along Cemex's mining site. For the ±2½-mile reach beginning at I-505, the County model indicates that the 100-year water surface is effectively contained within the Creek. This is illustrated in the attached HEC-RAS 100-year Profile Plot and Cross-Section Plots, as described below.

The Profile Plot indicates the computed 100-year water surface profile (labeled 'WS 100 yr'), together with the creek invert (labeled 'Ground'), and the right (south)/left (north) top-of-bank profiles (labeled 'ROB' and 'LOB' respectively). Beginning at RS 22.579, and continuing ±2½ miles downstream to RS 19.905, the plot shows that the model's 100-flow is contained within the creek's main channel, except at RS 20.135. At that location there is a localized low spot (EL 120.20) in the creek's south bank profile. At that station, the model's computed 100-year water surface elevation is EL 120.67. As such, the profile plot indicates that during the 100-year event, some flow will spill out of the main Creek channel at that location. However, review of Cache Creek topographic mapping (Yolo County, 2011) indicates that a creek spill there would be confined to an existing, isolated creekside depression. The depression lies outside of existing and planned Cemex mining areas, and the County topo mapping shows that the depression is bounded by higher ground on its land side, thus isolating it topographically from the mining areas. Those higher ground elevations are several feet higher than the local top-of channel bank elevation. Therefore, in the modeled 100-year event, a localized creek spill into the isolated depression near RS 20.135 would not result in creek flows entering the Cemex mining areas.

The Cross-Section Plots, which are oriented looking downstream, serve as further confirmation that that water is effectively contained within the Creek. For the plotted cross-section at RS 20.135, the local depression abutting the Creek's right bank is clearly visible, together with the higher ground on the land side of said depression, isolating it from the mining areas.

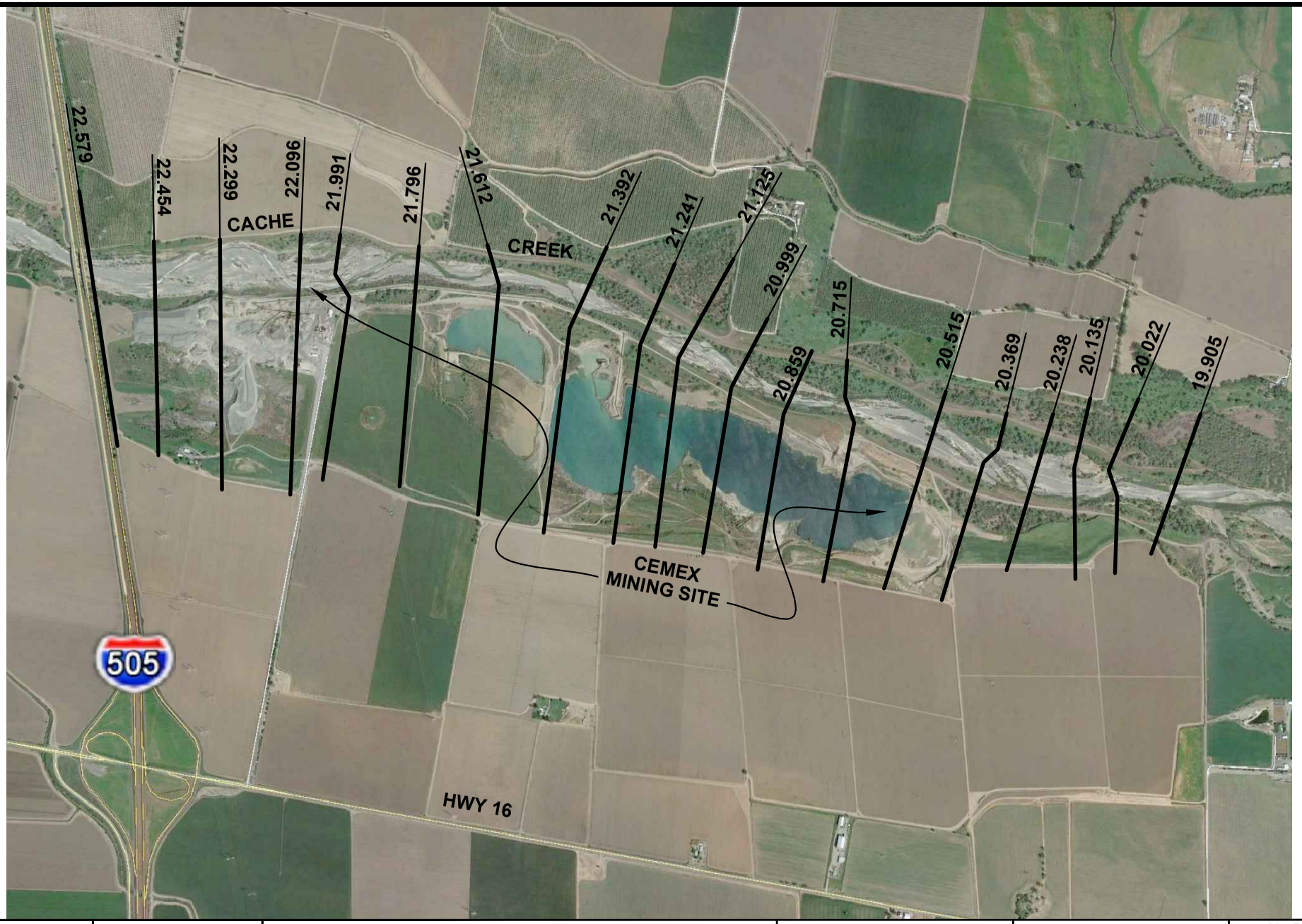
[It is also noted that the model's cross-sections have in general been extended well beyond the creek and into the Cemex mining areas. However, the cross-section plots do show that those mining areas are physically separated from the creek by the creek's right bank, and as such are not hydraulically connected to the creek in the 100-year event. While the model's cross-section plots do indicate a water surface line within those out-of-creek areas, that is only because the model - for plotting purposes - will automatically 'fill' low-lying non-contiguous areas within the overall cross-section. For computational purposes however, the model has been configured to consider those hydraulically isolated off-channel areas (indicated in the plots with diagonal hatching) to be 'ineffective flow areas'. As such, those off-channel areas do not contribute to creek conveyance capacity in the model's computation of peak water surface].

As a check, we also manually compared the model's computed water surface elevation numbers with a plan-view plot of topographic mapping of the creek banks and Cemex site (Yolo County, 2011). For the Cemex reach, the computed 100-year WSE's were lower than the adjacent ground elevations along the north edge of the Cemex mining site.

In conclusion, the County HEC-RAS model demonstrates that the 100-year water surface is effectively contained within Cache Creek along the Cemex Reach. Compliance with Condition of Approval #36 is confirmed.

Attachments

1. Vicinity Map/Cemex Reach of Cache Creek
2. HEC-RAS 100-year Water Surface Profile Plot for Cemex Reach (RS 22.579 - RS 19.905)
3. HEC-RAS Cross-Section Plots within Cemex Reach



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CHECKED: ML
DATE: 03/21/16
JOB No: 253.90

0 800 1600
SCALE: 1"=1600'

ATTACHMENT 1

CEMEX REACH OF CACHE CREEK

YOLO COUNTY CALIFORNIA

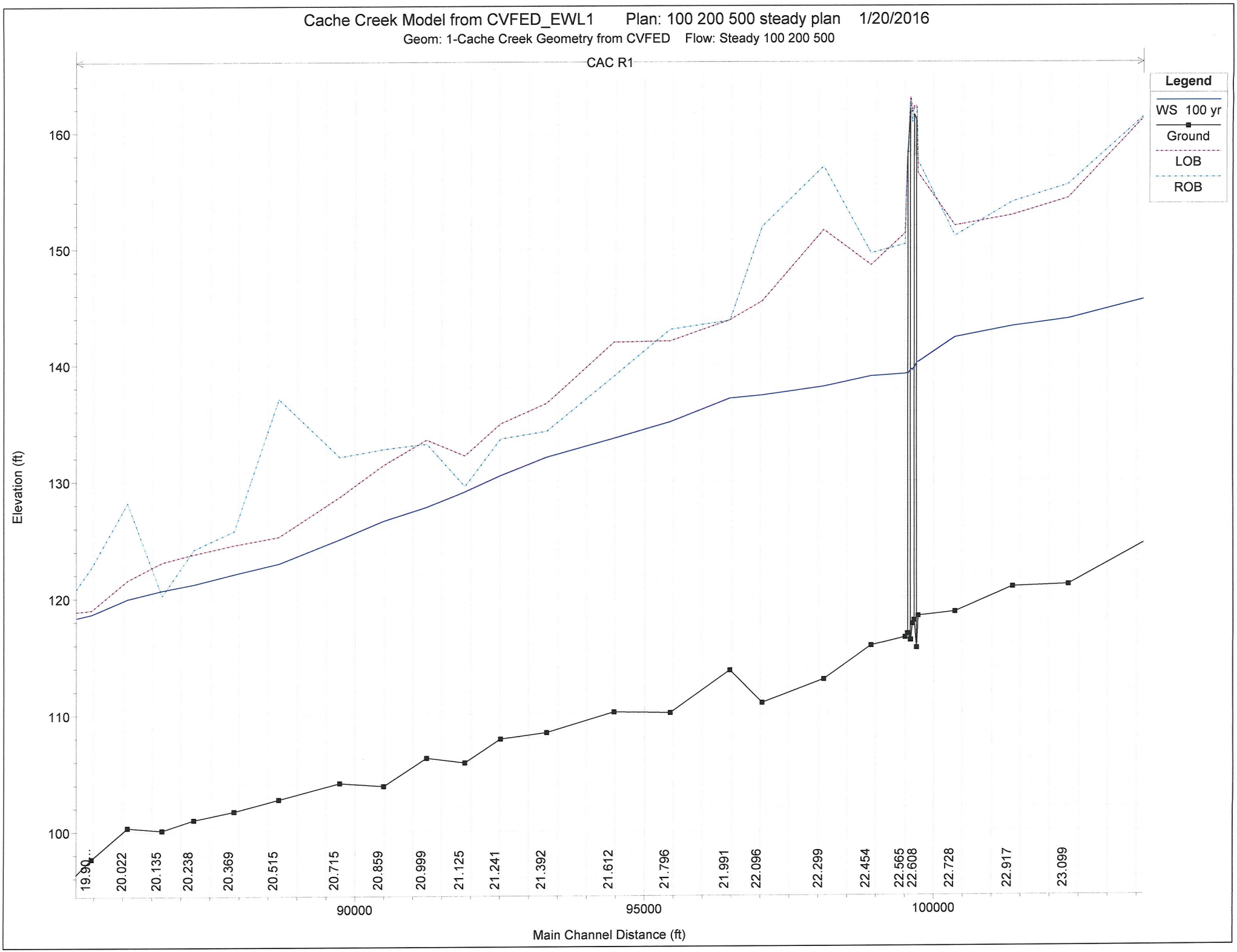
CACHE CREEK RIVER STATION (PER HUDRAULIC ANALYSIS)

CECWEST.COM
Sacramento Office
2120 20th Street, Suite Three
Sacramento, CA 95818
(916) 455-2026
Davis Office
2940 Spafford Street, Suite 200
Davis, CA 95618
(530) 758-2026
Project Planning ■ Civil Engineering ■ Landscape Architecture

SCALE 1"= 1600'±

SHEET 1 OF 1

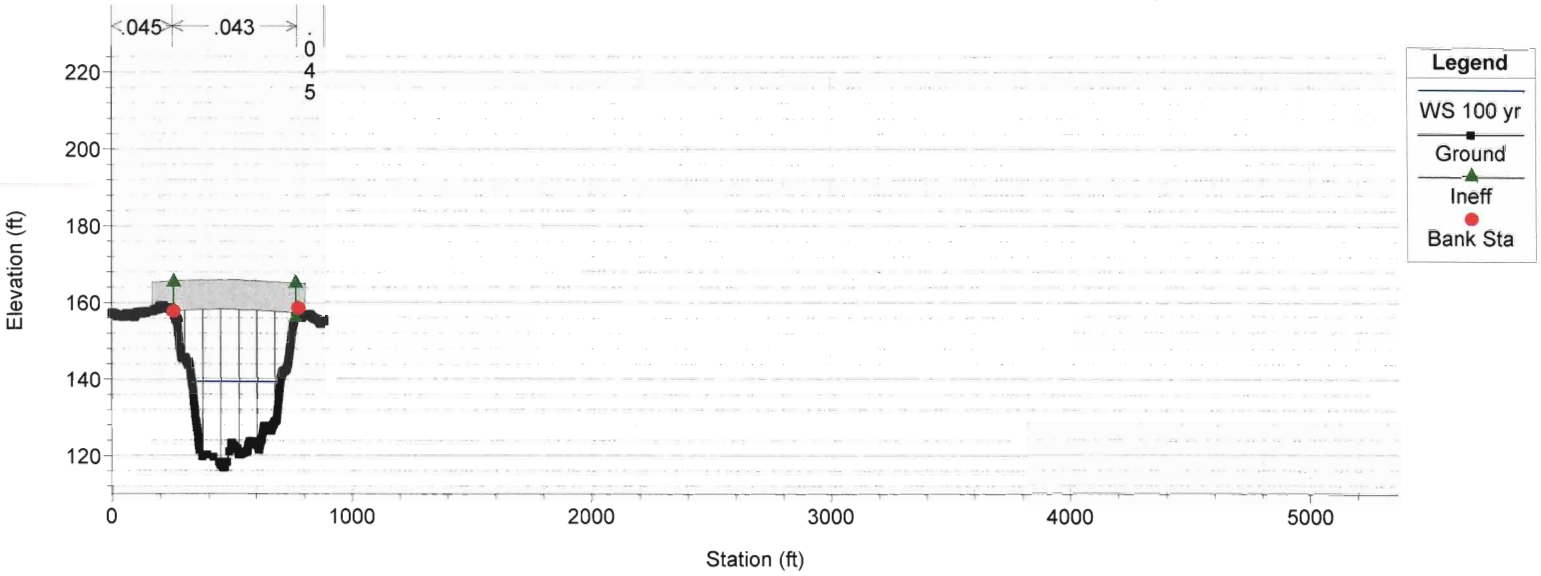
S:\AutoCAD\200\253 Solano Concrete Projects CAD\253-90 ADDITIONAL SERVICES\HYDRAULIC ANALYSIS EXHIBIT\253-90-MEMO EXHIBIT.dwg – MEMO 3/22/2016 – 12:29PM Plotted by: Liz


Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/20/2016
Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500
CAC R1
Legend
WS 100 yr
Ground
LOB
ROB
Elevation (ft)
160
150
140
130
120
110
100
19.90
20.022
20.135
20.238
20.369
20.515
20.715
20.859
20.999
21.125
21.241
21.392
21.612
21.796
21.991
22.096
22.299
22.454
22.565
22.608
22.728
22.917
23.099
90000
95000
100000
Main Channel Distance (ft)

Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

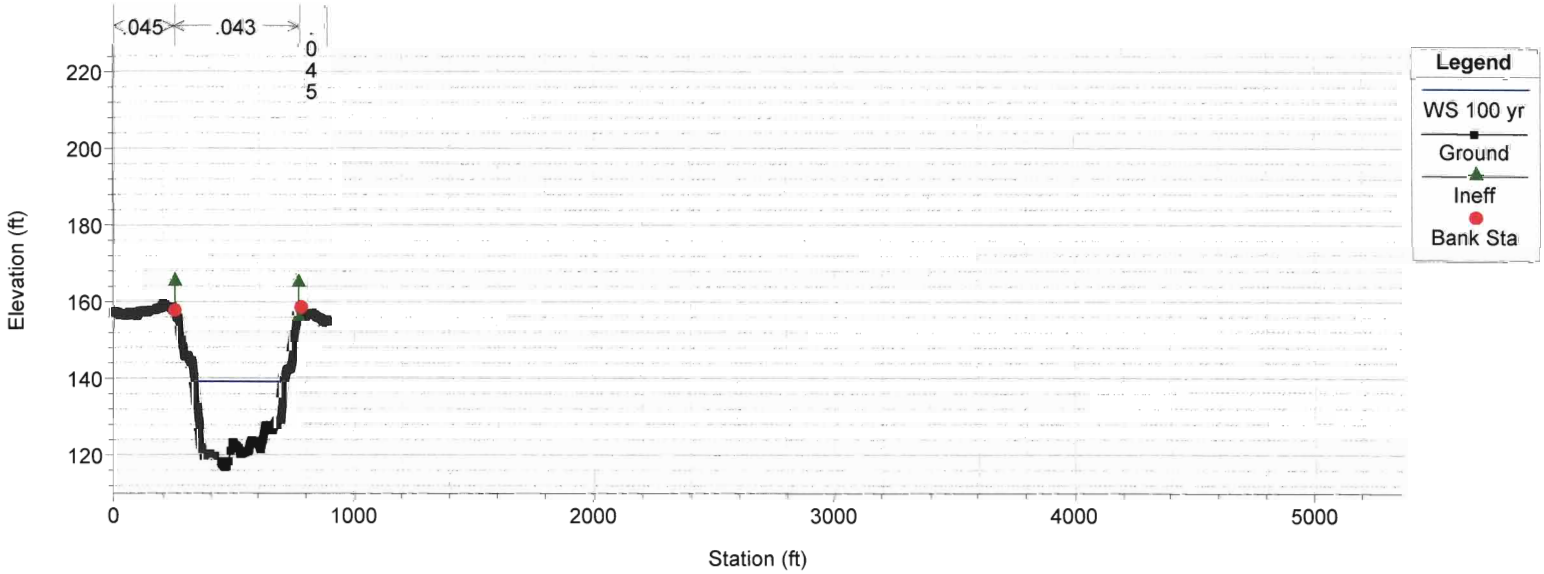
River = CAC Reach = R1 RS = 22.579 BR I-505 Northbound [CAC-2035, CAC-090] Rail Height (2.7') added to



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

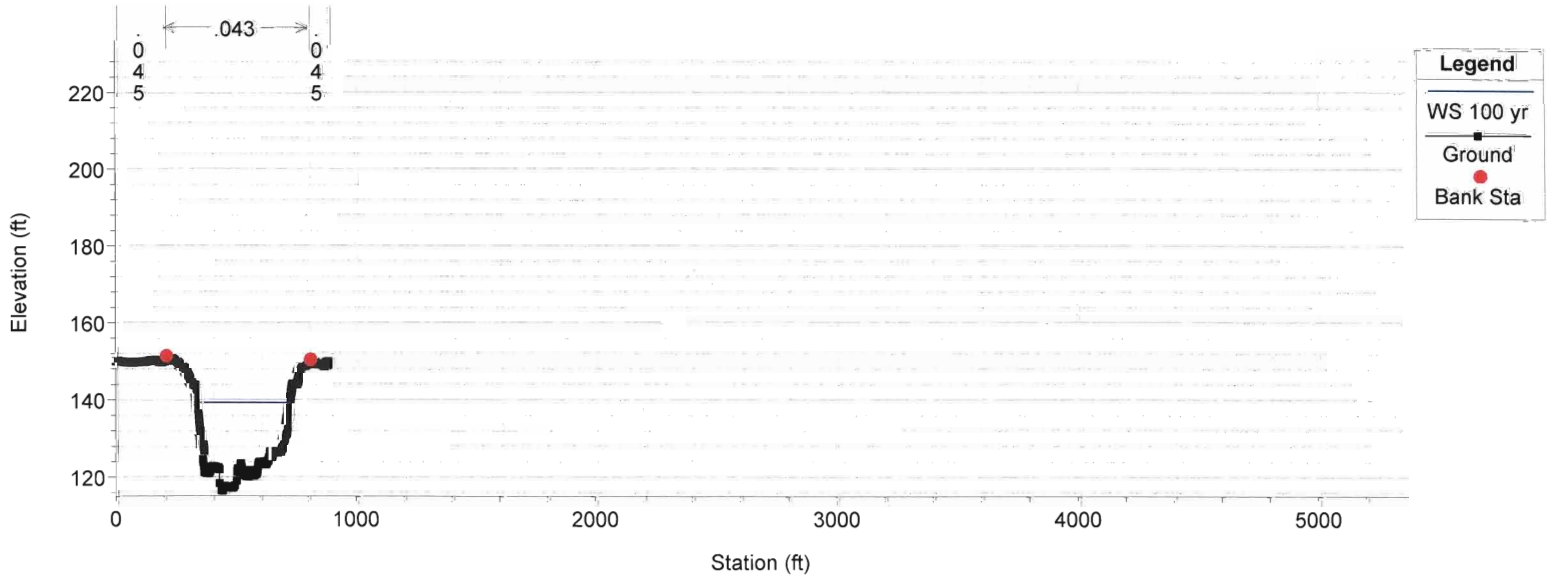
River = CAC Reach = R1 RS = 22.573 CAC-2030



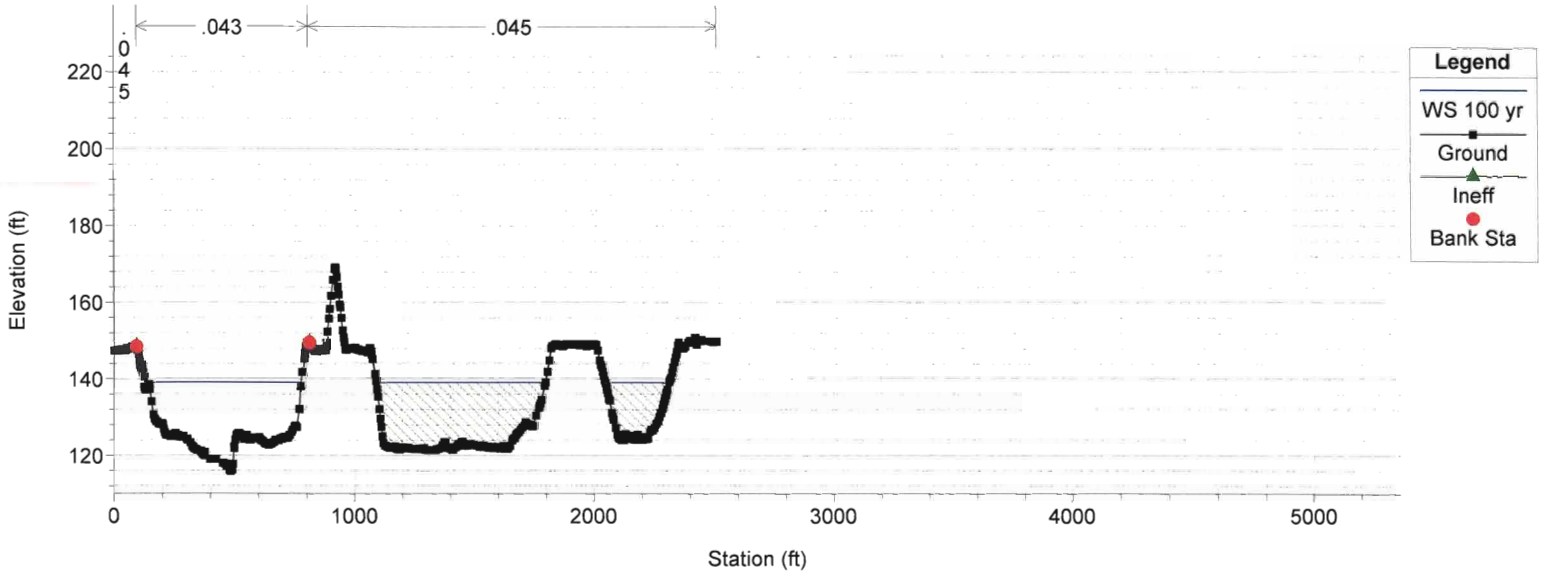
Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

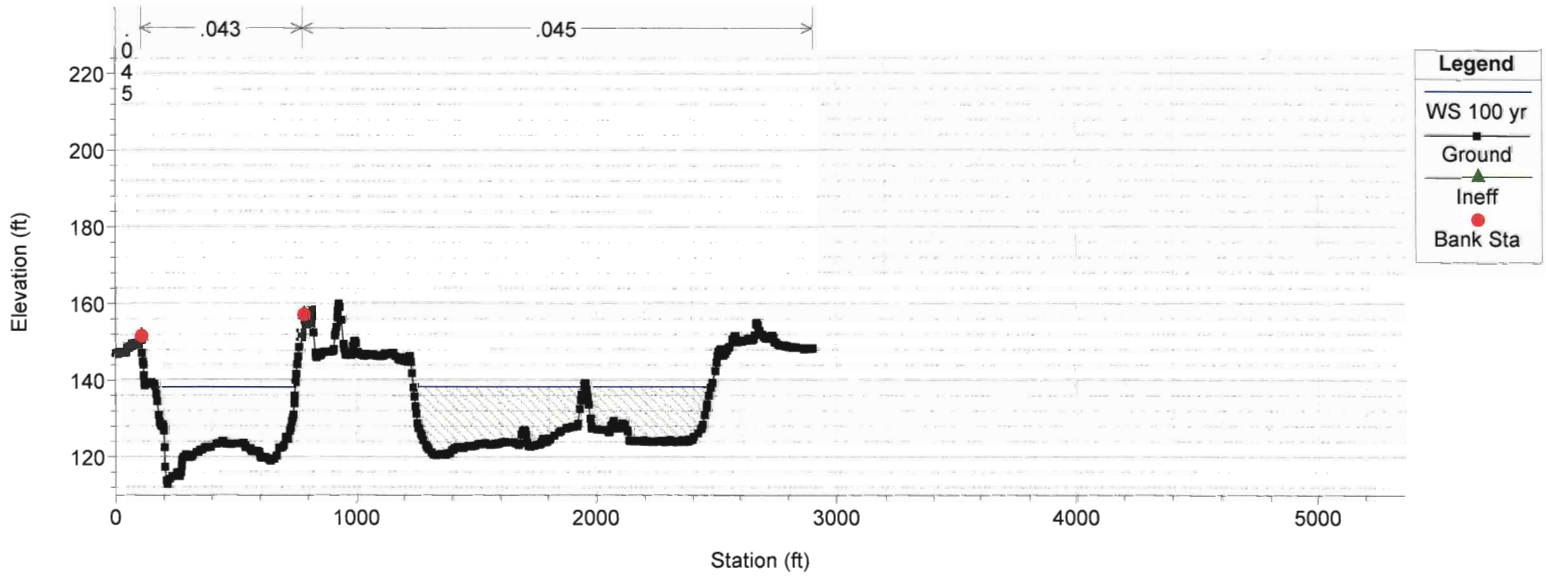
River = CAC Reach = R1 RS = 22.565 CAC-2020



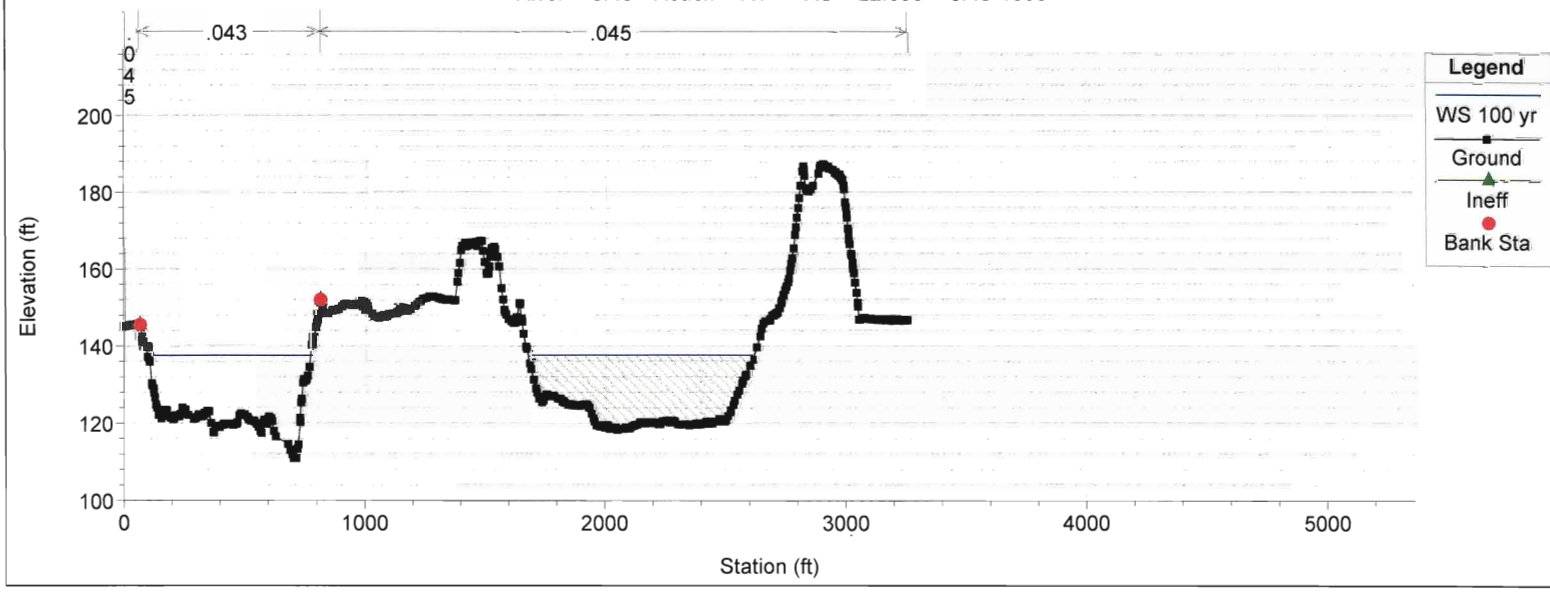
Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014
Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500
River = CAC Reach = R1 RS = 22.454 CAC-2010



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014
Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500
River = CAC Reach = R1 RS = 22.299 CAC-2000



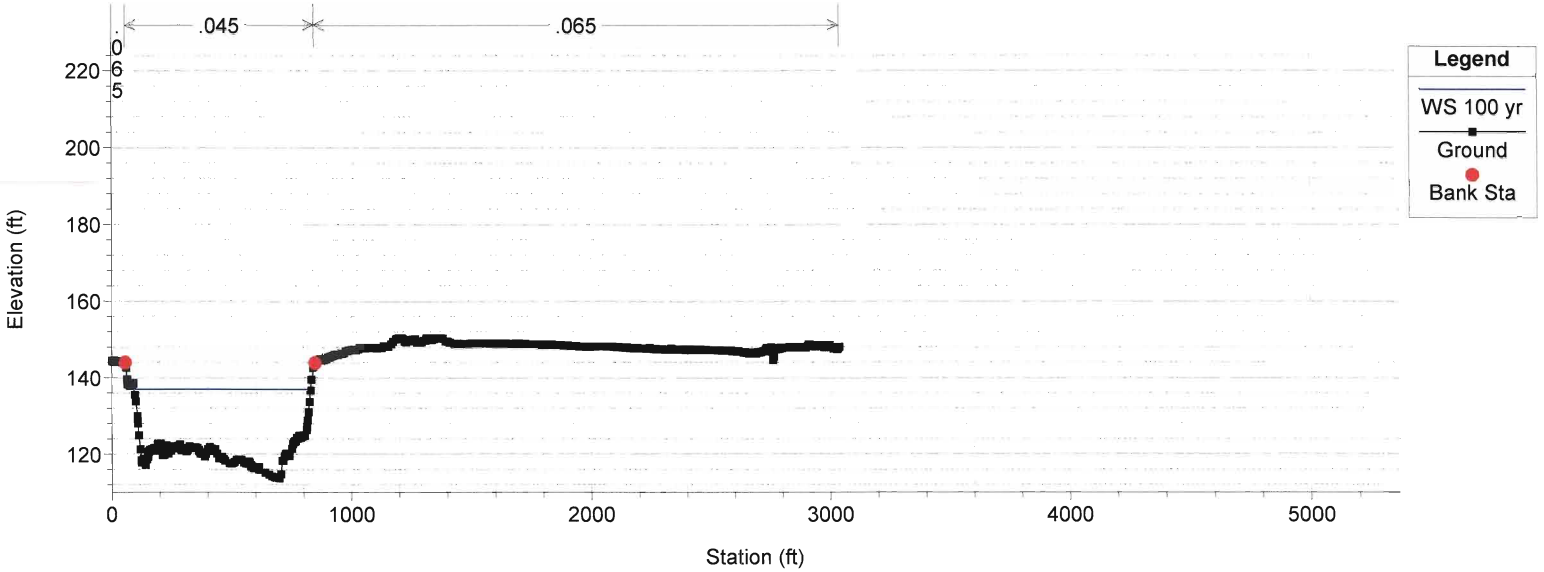
Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014
Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500
River = CAC Reach = R1 RS = 22.096 CAC-1990



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

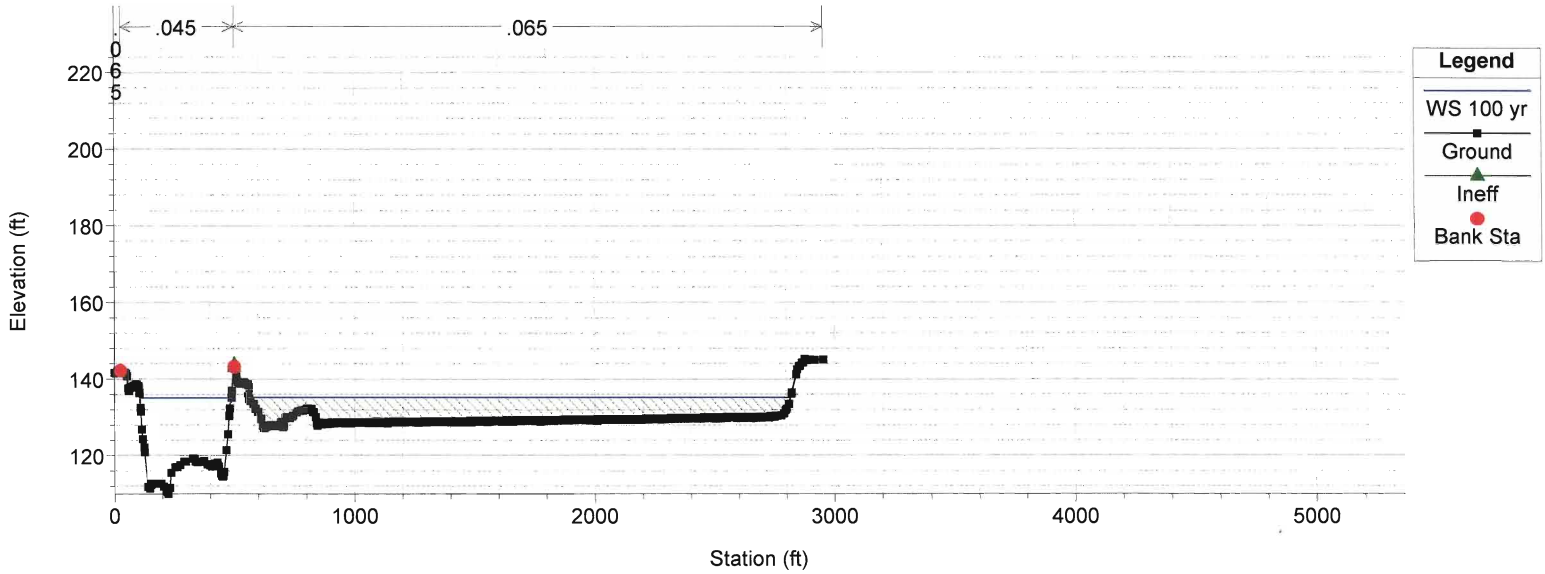
River = CAC Reach = R1 RS = 21.991 CAC-1980



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

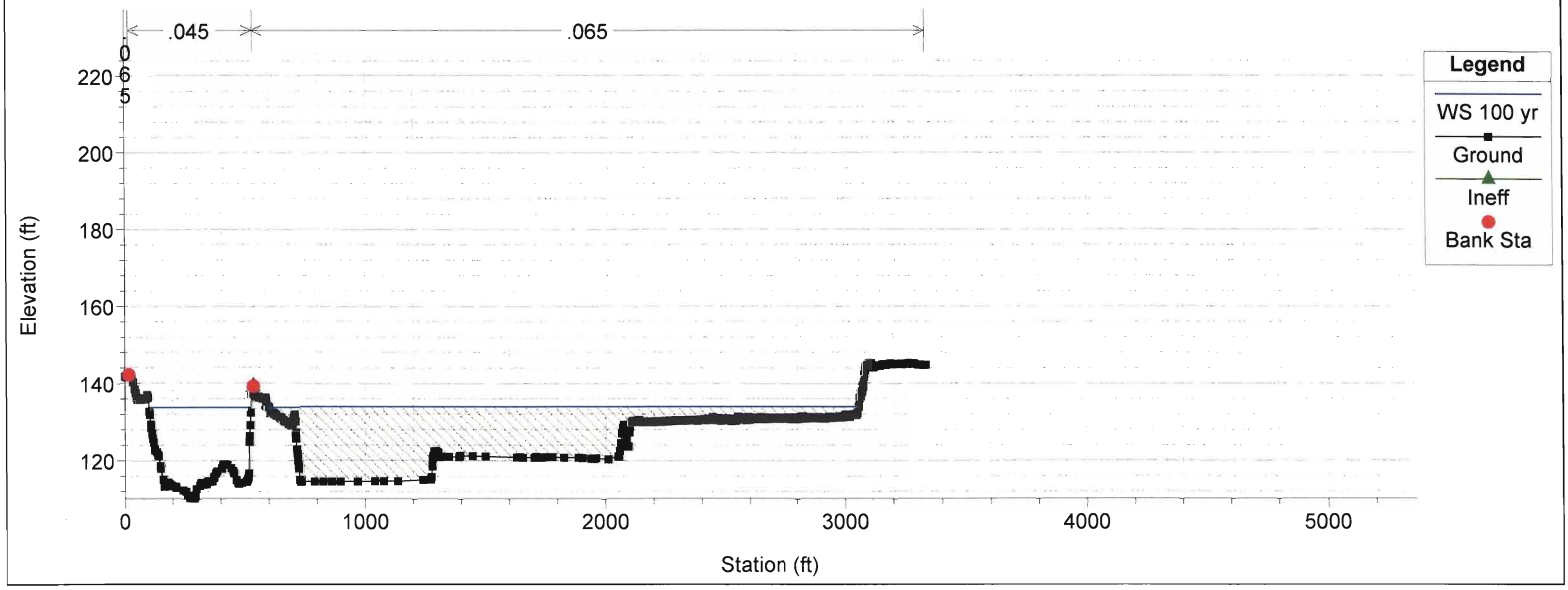
River = CAC Reach = R1 RS = 21.796 CAC-1970



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

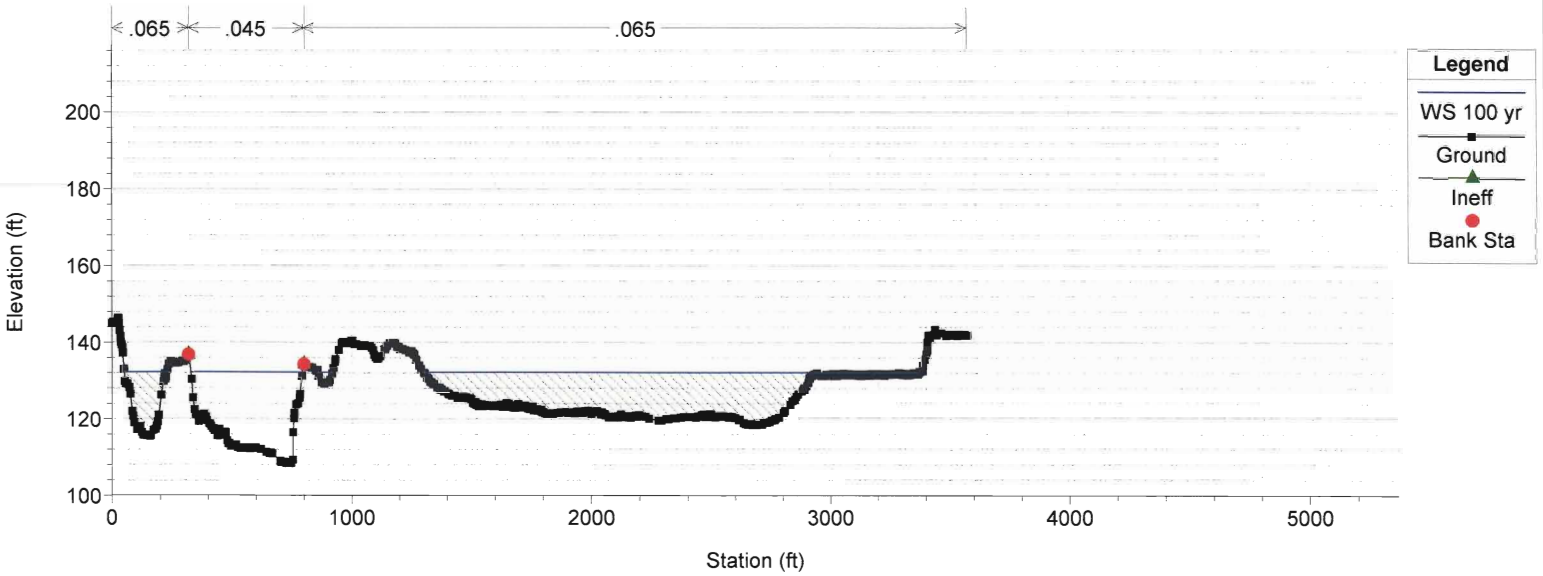
River = CAC Reach = R1 RS = 21.612 CAC-1960



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

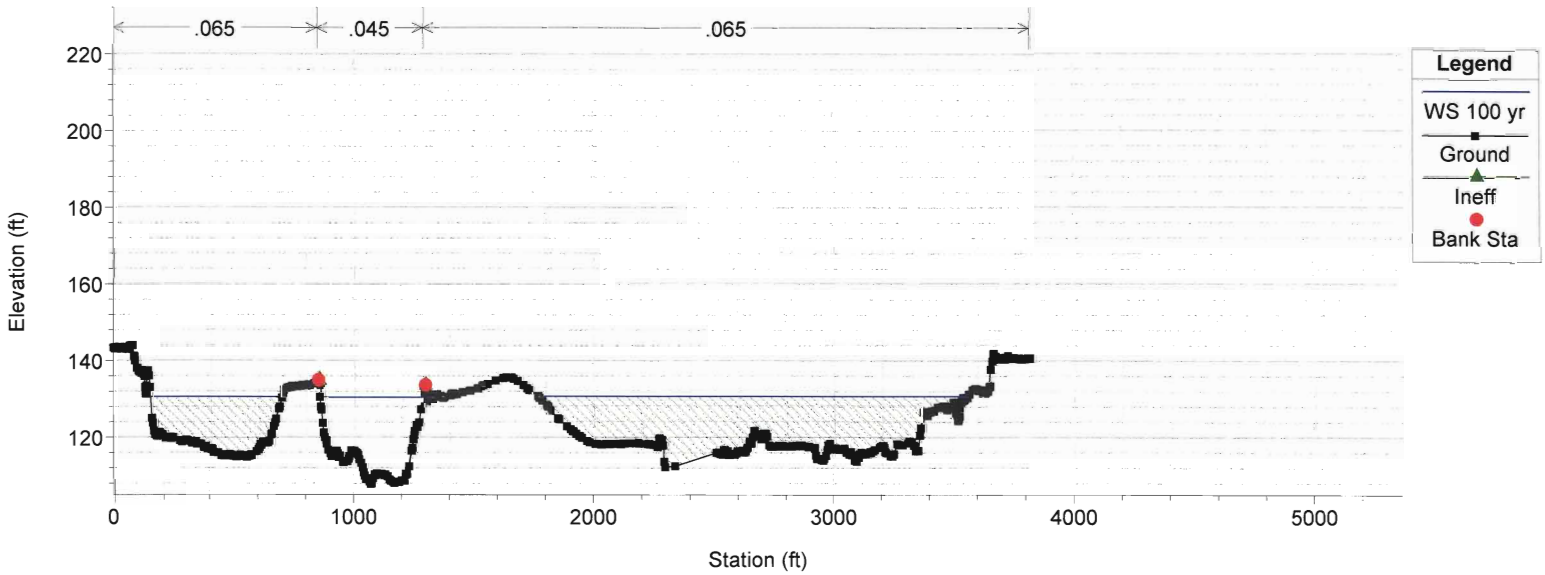
River = CAC Reach = R1 RS = 21.392 CAC-1950



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

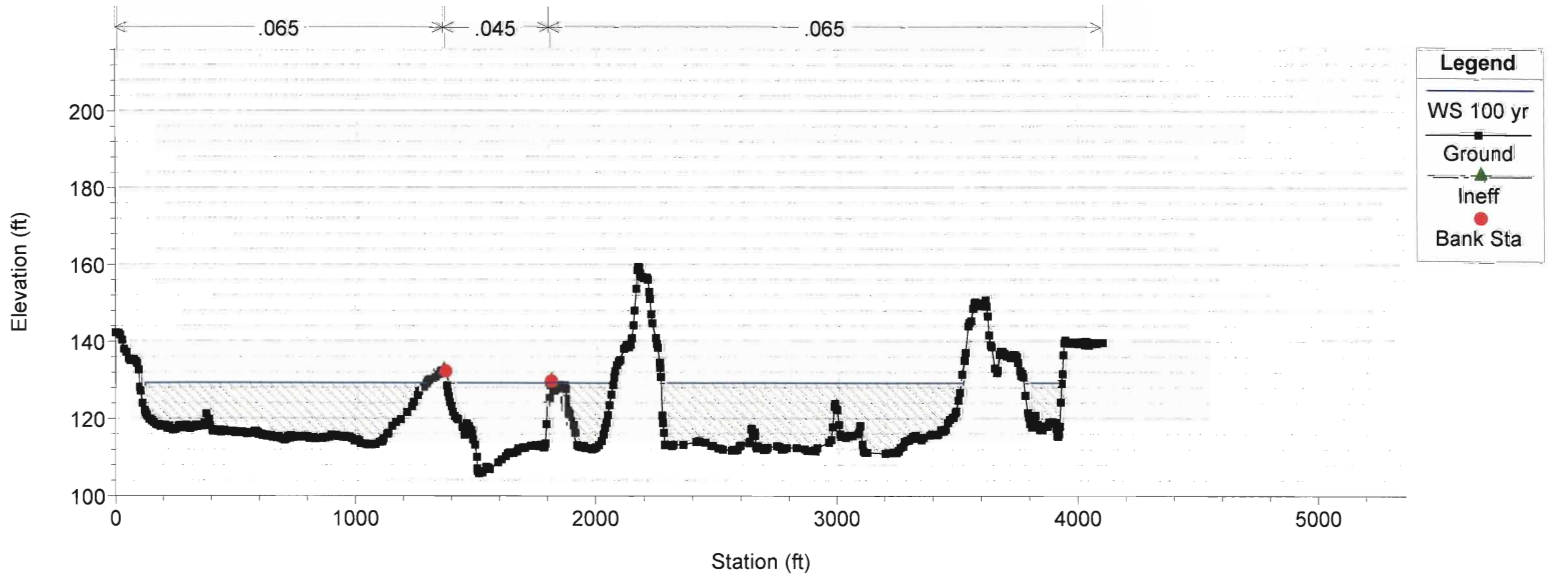
River = CAC Reach = R1 RS = 21.241 CAC-1940



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

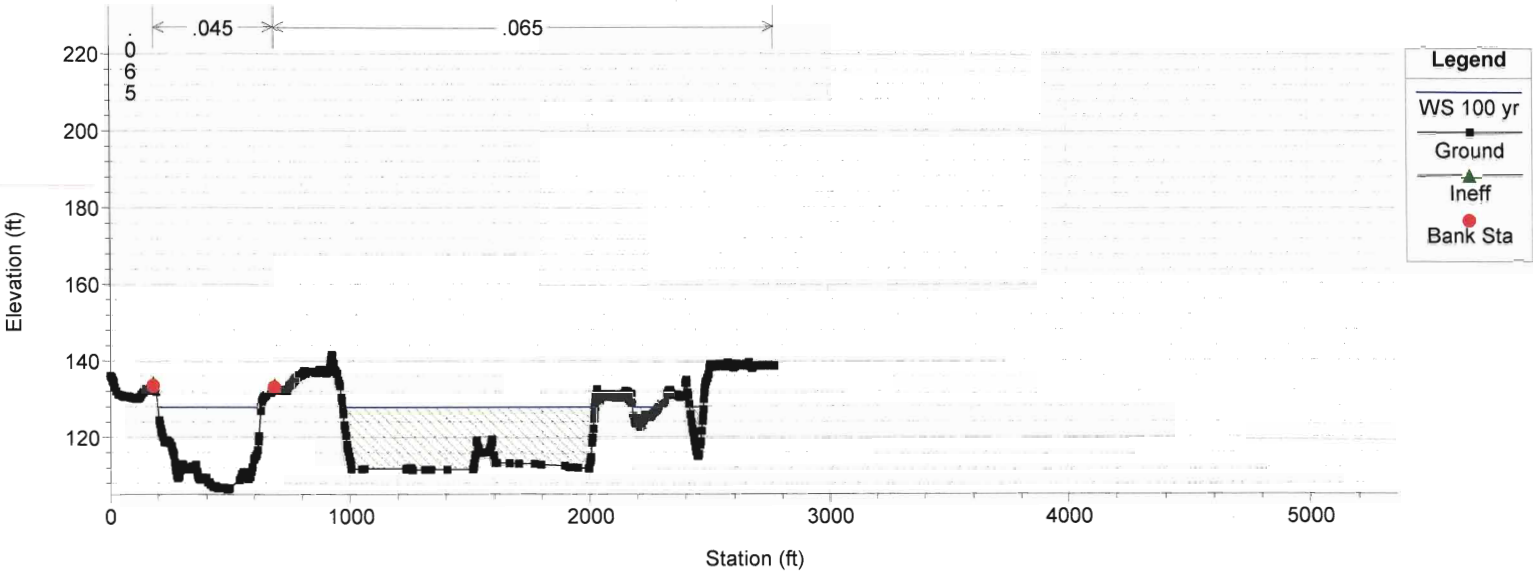
River = CAC Reach = R1 RS = 21.125 CAC-1930



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

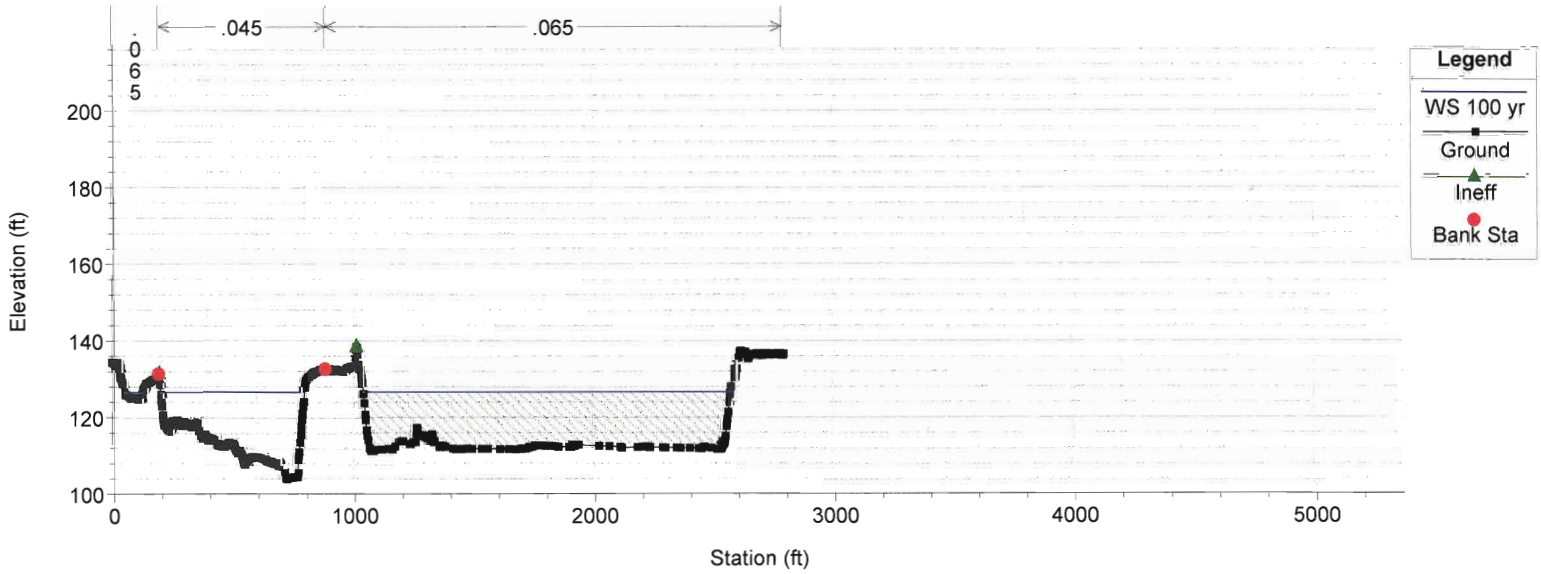
River = CAC Reach = R1 RS = 20.999 CAC-1920



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

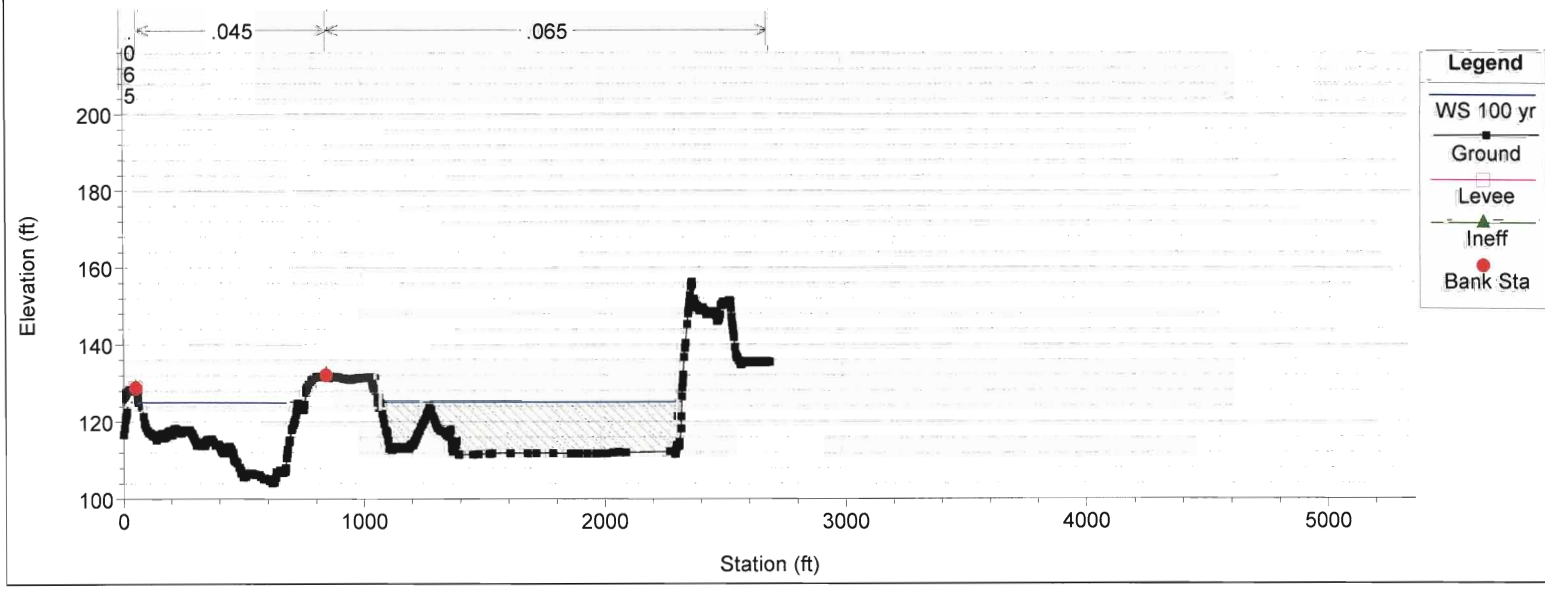
River = CAC Reach = R1 RS = 20.859 CAC-1910



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

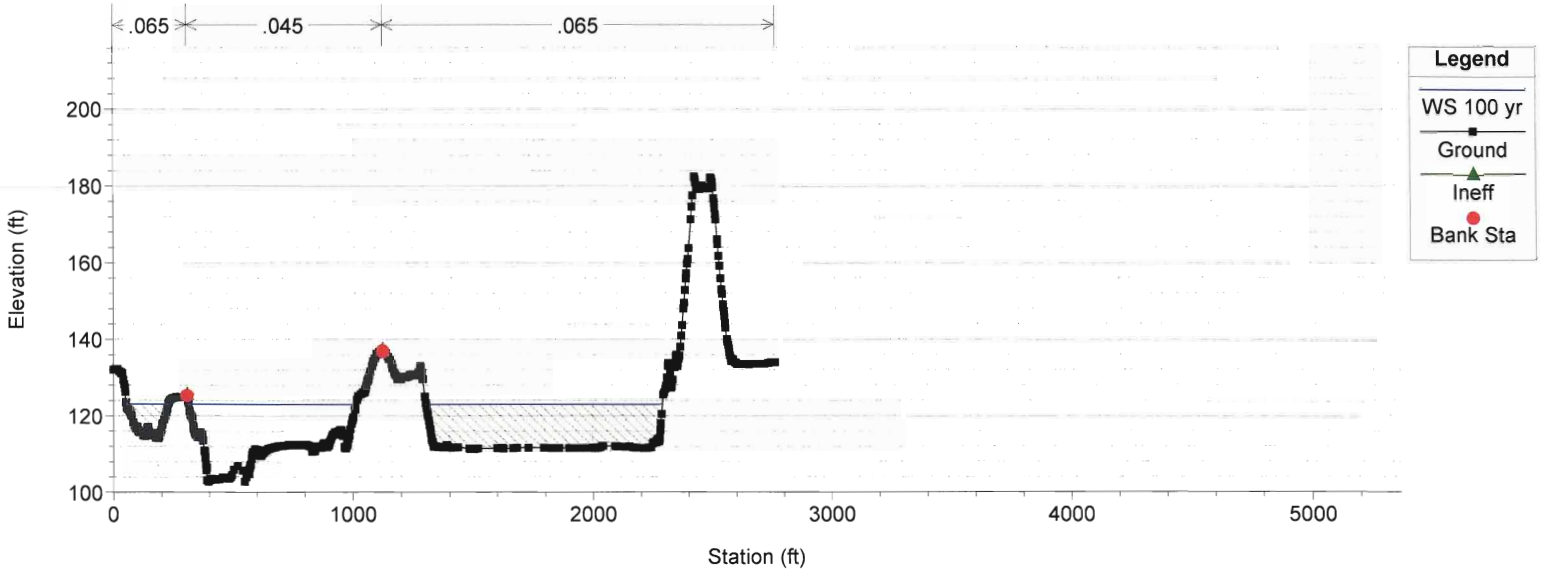
River = CAC Reach = R1 RS = 20.715 CAC-1900



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

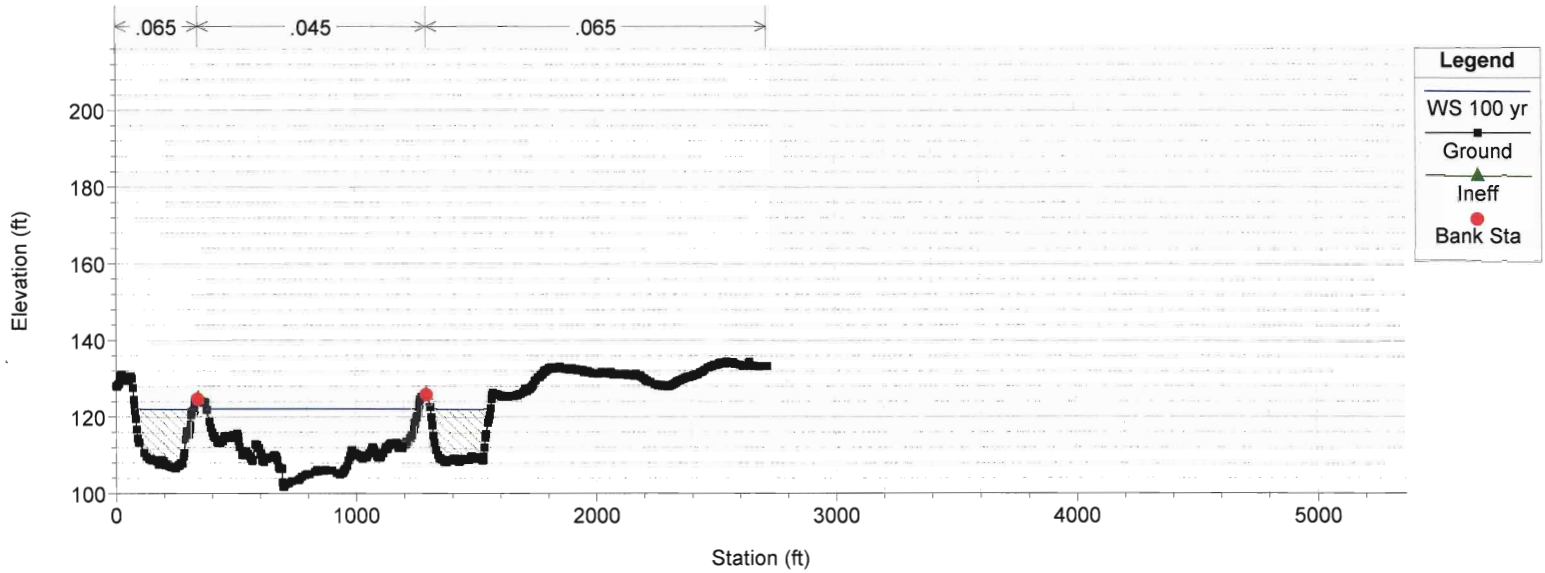
River = CAC Reach = R1 RS = 20.515 CAC-1890



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

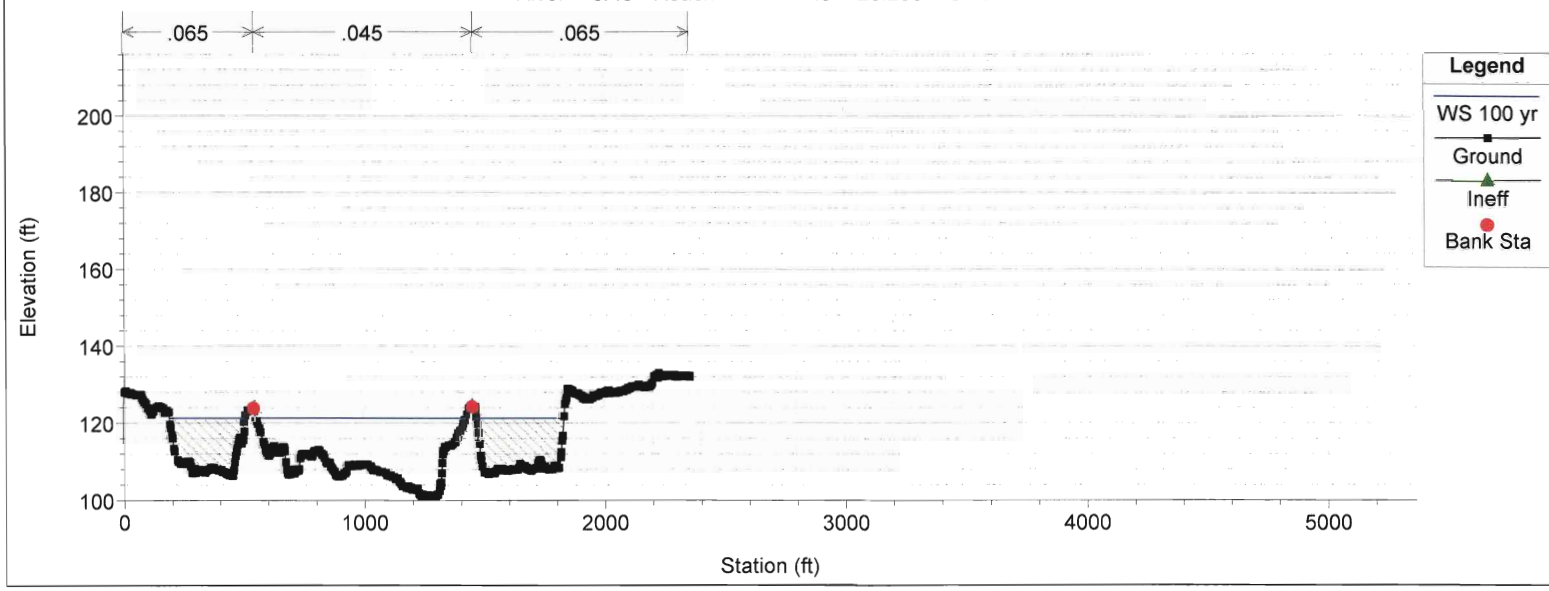
River = CAC Reach = R1 RS = 20.369 CAC-1880



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

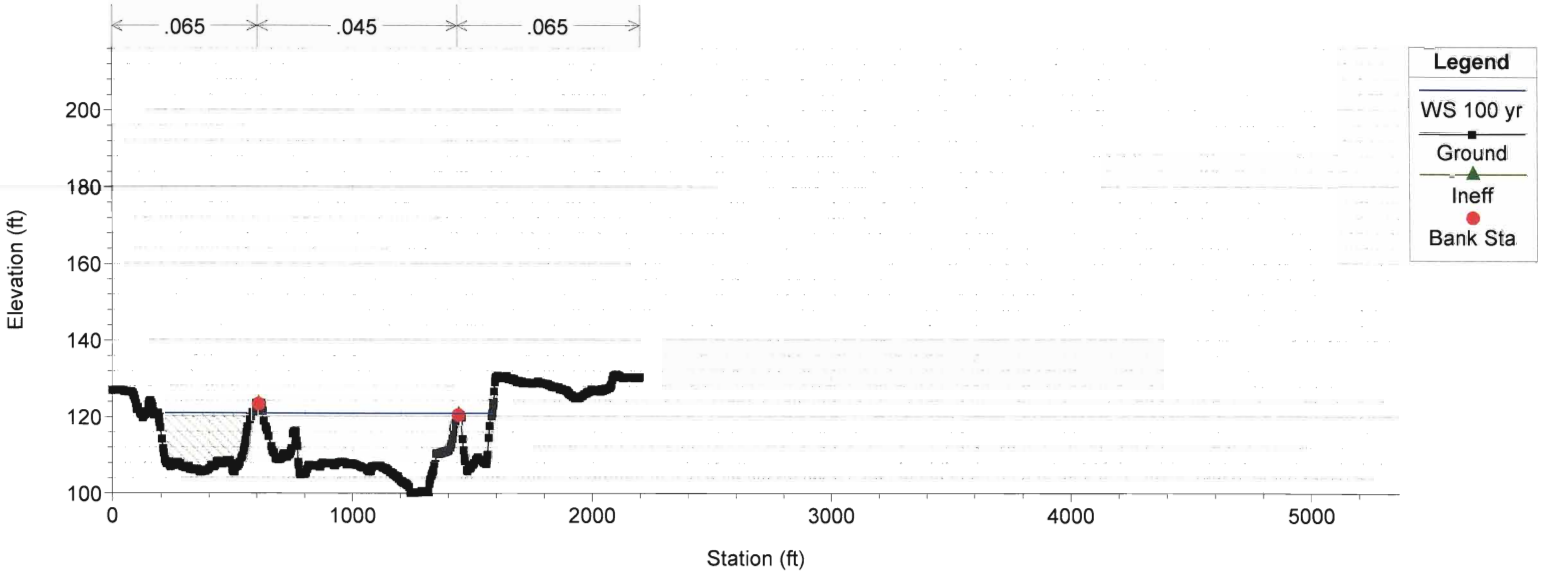
River = CAC Reach = R1 RS = 20.238 CAC-1870



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

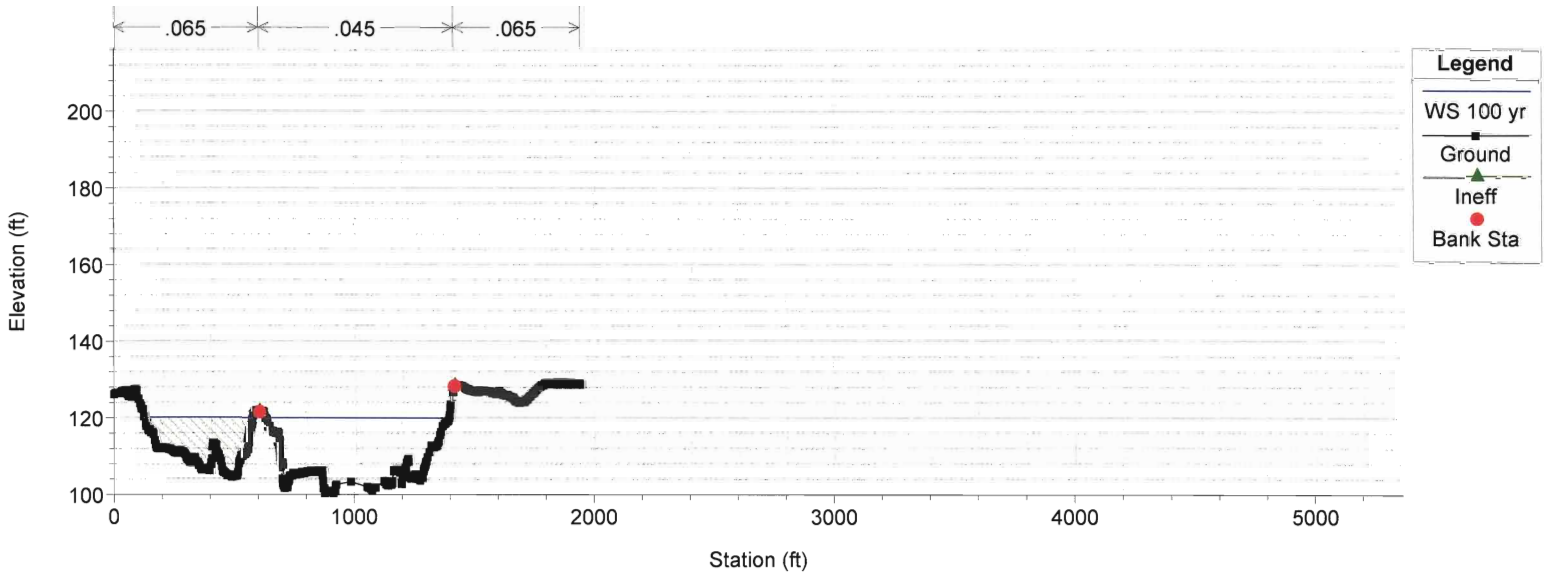
River = CAC Reach = R1 RS = 20.135 CAC-1860



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

River = CAC Reach = R1 RS = 20.022 CAC-1850



Cache Creek Model from CVFED_EWL1 Plan: 100 200 500 steady plan 1/26/2014

Geom: 1-Cache Creek Geometry from CVFED Flow: Steady 100 200 500

River = CAC Reach = R1 RS = 19.905 CAC-1840