UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST REGION
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

April 12, 2012

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

RE: Additional Information for the Commission's Use in its Jurisdictional Review,
La Grange Hydroelectric Project, UL11-1-000.

Dear Secretary:

The National Marine Fisheries Service (NMFS) files herein information for the Commission's use in its jurisdiction review for the La Grange Hydroelectric Project (UL11-1-000).

In a letter to the Commission (January 5, 2012), Mr. John A Whitaker IV, Attorney for the Turlock Irrigation District (TID), discusses the results of a water elevation survey (from the La Grange Dam to the New Don Pedro Dam) and a backwater analysis, both performed by TID for the purpose of informing the Commission on the upstream extent of the La Grange Reservoir. Mr. Whitaker asserts that both analyses demonstrate that the transition from La Grange Reservoir to Tuolumne River occurs downstream of the federal lands managed by the Bureau of Land Management (BLM).

NMFS disagrees with TID's analyses and results, and therefore with Mr. Whitaker's conclusion regarding the upstream extent of La Grange Reservoir. NMFS provides herein comment on TID's analyses and conclusions, along with the results of additional modeling, aerial photographic interpretation, maps, and historical information that support the view that the La Grange Reservoir occupies lands managed by the BLM. The additional modeling performed by NMFS was conducted with the same HEC-RAS model input files used by TID in their earlier analyses; these files (on compact disc) were obtained by mail from the Commission staff who oversees its electronic library.

NMFS believes the information herein is relevant to the Commission's jurisdiction review of the La Grange Hydroelectric Project, as it clearly demonstrates that the continued operation and maintenance of the La Grange Hydroelectric Project affects lands of the United States. In earlier filings, NMFS provided information demonstrating that the La Grange Hydroelectric Project could adversely affect anadromous fish and their habitats in the Tuolumne River.

If you have questions regarding this filing, please contact Mr. John Wooster at (916) 930-3616.

Sincerely,

Richard L. Wantuck
Hydropower Program Supervisor
Habitat Conservation Division

Enclosures

cc: Steve Edmondson, NMFS, Santa Rosa, CA
Maria Rea, NMFS, Sacramento, CA

Enclosure A

ADDITIONAL INFORMATION
FOR THE COMMISSION'S JURISDICTIONAL REVIEW
OF THE LA GRANGE HYDROELECTRIC PROJECT

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Turlock Irrigation District
Modesto Irrigation District
LaGrange Hydroelectric Project **UL11-1-000**

1.0 Introduction

The U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) provides herein comment on analyses performed by the Turlock Irrigation District (TID) regarding the geographical extent of the La Grange Reservoir, an impoundment formed by the La Grange Dam on the Tuolumne River, California. NMFS recommends the Commission closely review our comments and analyses herein, as this information is relevant to the issue of whether TID and/or the Modesto Irrigation District (MID) require a license for the La Grange Hydroelectric Project because the Project's continued operation and maintenance affects lands of the United States, managed by the Bureau of Land Management (BLM).

2.0 Background

The La Grange Dam is located on the Tuolumne River, California, about 2.3 miles downstream of the New Don Pedro Dam (a licensed facility of FERC Project No. 2299). La Grange Dam was completed and water storage began in September 1895, at which time the estimated storage capacity was 2,332 acre-feet (ft.) with a reservoir area of about 56.1 acres (see Enclosure B, Attachment C). Ten years later (October, 1905), a U.S. Geological Survey (USGS) evaluation estimated the storage capacity had decreased to about 1,068 acre-ft., about a 54% reduction in storage capacity (Enclosure B, Attachment C, historic survey data sheet). Reports of the CA Department of Water Resources (DWR) Division of Safety of Dams indicate the storage capacity was reduced to 500 acre-ft. shortly thereafter. In 1931, the La Grange Dam was raised 2 ft., increasing surface area to 57.6 acres and increasing total available storage, which later reports estimate at 3,000 acre-ft. (not accounting for portions in-filled with sediment). A 1982 La Grange Dam Safety Report by CA DWR Division of Safety of Dams estimated that 83% of La Grange Reservoir storage capacity was filled in with sediment, and all of the 500 acre-ft. of permitted water storage occurs in the top 10 to 15 ft. of the dam (Enclosure B, Attachment C).

3.0 The Backwater Effect of La Grange Dam Forms a La Grange Reservoir That Clearly Intersects with Federal Lands Managed by the BLM

Flows down the New Don Pedro spillway are discharged into Twin Gulch, then flow back into the impounded Tuolumne River (La Grange Reservoir) approximately 1.5 miles downstream of the New Don Pedro Dam (Preliminary Application Document, Volume 1, p. 3-6). The confluence of Twin Gulch and the La Grange Reservoir occurs about 6,250 ft. upstream of La Grange Dam, at a point slightly upstream of where the BLM land boundary intersects the La Grange Reservoir (Enclosure B, Attachment A, Figures 1a and 1b). In January of 1997, a peak flood of 60,000 cfs occurred in the lower Tuolumne River, described (McBain and Trush 2000) as the flood of record since New Don Pedro Dam construction. McBain and Trush (2000) describe (p. 90) how this flood accessed the New Don Pedro Dam spillway for the first time in its history, with approximately 45,000 cubic feet per second (cfs) flowing down Twin Gulch.

This spill flow caused 25 to 50 ft. of vertical incision into the underlying bedrock of Twin Gulch, generating a tremendous volume of sediment that was transported to reaches downstream; an estimated 500,000 cubic yards of topsoil mixed with crushed and scoured bedrock was deposited into La Grange Reservoir (McBain and Trush 2000; McBain and Trush 2004). The majority of the coarse sediment remained in La Grange Reservoir, while the finer material flushed downstream and deposited in the lower Tuolumne River channel and floodplain. The coarse sediment deposit remaining in La Grange Reservoir was of such large volume that McBain and Trush (2000) identified it as a potential sediment source for restoration projects to fill mining pits downstream of La Grange Dam.

The impacts of the 1997 sediment delivery to La Grange Reservoir are readily visible in recent aerial photographs, as a large island (or “slug”) of sediment directly adjacent to the Twin Gulch confluence with La Grange Reservoir (Enclosure B, Attachment A, Figures 1a and 1b). The 2011 high-resolution digital terrain model and bathymetric survey provided by TID (filed with FERC in December, 2011) clearly shows how the shallowest areas (those of greatest deposition) of La Grange Reservoir begin at the Twin Gulch confluence and extend downstream approximately 2,500 ft. (Enclosure B, Attachment A, Figures 2a and 2b). One can clearly see that flow paths within La Grange Reservoir have eroded two channels along the reservoir margin, leaving a mid-channel island of sediment at the Twin Gulch confluence. The sediment deposit is also evident in cross-section profiles in the HEC-RAS model of the La Grange Reservoir filed by TID with FERC in December, 2011 (Enclosure B, Attachment A, Figures A1 to A6). The sediment deposit influences how flows pass through La Grange Reservoir because the deposit decreases the depth and flow capacity in the reservoir. At higher discharges, decreased depth and flow capacities force water velocity and water surface gradients to increase in order for the larger flow volumes to pass through this section of the Reservoir. At lower discharges within La Grange Reservoir, flows pass through the Twin Gulch sediment deposit area without creating any changes or perturbations to the water surface profile, and water surface gradients remain constant and flat throughout the La Grange Reservoir for almost a mile upstream of the deposit (and the downstream end of the BLM land boundary). Thus, the impacts of the Twin Gulch sediment deposit on La Grange Reservoir flow paths is the forcing mechanism for the increased water surface gradients cited by TID as evidence that this location marks the end of the La Grange Reservoir and beginning of riverine conditions; in fact, the backwater effect of La Grange Dam forms a La Grange Reservoir that extends much farther upstream and which clearly intersects with Federal lands managed by the BLM. This backwater effect of La Grange Dam is discussed further in the sections below.

4.0 Revised HEC-RAS Modeling Confirms That La Grange Reservoir Extends Approximately One Mile Beyond the BLM Land Boundary.

4.1 Low-Discharge Model Runs

A HEC-RAS model of the Tuolumne River extending from 538 ft. upstream of La Grange Dam to approximately the tailwater of the Don Pedro powerhouse was developed by TID, and filed with FERC in December, 2011. NMFS requested and obtained an electronic copy of this model from FERC, and subsequently performed additional analyses using the same model input files used by TID.

TID previously submitted model runs that simulated conditions with and without La Grange Dam illustrated results at 2,350 and 4,000 cfs. Without changing any model set-up or input parameters, including holding the downstream boundary condition at 296.46 ft. (the crest elevation of La Grange Dam), NMFS conducted model runs using steady state discharges of 10 and 100 cfs (Enclosure B, Attachment D contains the HEC-RAS output tables for 10 and 100 cfs model runs). Water surface gradients for the 10, 100, 2,350, and 4,000 cfs model runs (that hold the downstream boundary condition at 296.46 ft.) are presented in Figure 3 (Enclosure B, Attachment A). Model results in Figure 3 demonstrate that, at lower discharges, the water surface profile extending upstream of La Grange Dam remains completely planar and flat for over 11,000 ft. upstream of La Grange Dam; this indicates a La Grange Reservoir extending approximately 1 mile beyond the BLM land boundary. In other words, the elevated water surface gradients over and downstream of the Twin Gulch sediment slug that are demonstrated at higher discharges are completely absent at lower discharges. Rather, the lower discharges are able to pass through the Twin Gulch sediment slug area (and its decreased flow capacity due to sediment in-filling) without increasing water surface gradient; and these lower discharges result in only a minor change in velocity simply because a smaller volume of water is passing downstream. When much larger discharges pass through this area, flow velocities increase and the water surface gradient increases because the larger volume of water overwhelms the highly aggraded reach near the Twin Gulch sediment deposit.

Additional HEC-RAS model outputs illustrating these effects is provided in Enclosure B, Attachment B. Figure B-1 illustrates a cross-section upstream of the sediment slug, Figures B-2 through B-5 show cross-sections within the influence of the sediment deposit, and Figure B-6 shows a cross-section downstream of the sediment deposit's influence. Figure B-7 illustrates how the hydraulic depth decreases significantly at the Twin Gulch sediment input point, and remains low for about 2,500 ft. downstream of the deposit. Figure B-8 illustrates how velocity increases for a higher discharge run over the same reach where hydraulic depth is low, but only minimally changes at a low discharge.

NMFS predicts that the influence of the Twin Gulch sediment deposit will decrease through time as La Grange Reservoir equilibrates and disperses the sediment downstream, and eventually water surface profiles at higher discharges will be similarly as flat and planar as the profiles for lower discharges at similar upstream distances (however, NMFS notes that the model set-up for higher-discharge runs should also be adjusting the downstream boundary elevation over the dam crest, resulting in flatter, planar profiles with a much smaller increase in water surface gradient over the Twin Gulch sediment deposit – discussed in more detail below). Nonetheless, in the current (2011 topography) state, the HEC-RAS model unequivocally shows a flat, La Grange Reservoir backwater extending over 11,000 ft. upstream at lower discharges, well beyond the BLM land boundary. Furthermore, the elevated water surface gradients over the Twin Gulch sediment deposit at higher discharges are not indicative of a transition to riverine conditions, but rather are a localized hydraulic response to the sediment deposit within La Grange Reservoir; a flat, planar reservoir water surface profile extends for more than 4,000 ft. upstream of the Twin Gulch deposit.

4.2 "Without Dam" Model Runs

In TID's La Grange Backwater Analysis (filed on December 15, 2011) model runs are presented for "without-dam" runs that are cast as without the influence of La Grange Dam; this is done by removing the fixed downstream boundary condition of 296.46 ft. and replacing it with a normal-depth downstream boundary. These "without-dam" model runs are then calculated using the existing bed profile of the La Grange Reservoir, which is a bed profile of a reservoir nearly completely filled in with sediment.

The results of the "without-dam" run for 2,350 cfs are presented in Figure 4 (Enclosure B, Attachment A). Note that this is a reproduction of Figure 3 in the TID La Grange Backwater

Analysis, except that the y-axis scale is adjusted so that one can see the full height of La Grange Dam (including its tailwater elevation), the Twin Gulch sediment influx contribution point is plotted, and the portion of the existing, current channel bed that is likely indicative of pre-dam conditions is also colored differently. A simple linear regression was fit to the data that is likely indicative of the pre-dam topography, and this linear fit independently projects to about the base of the La Grange Dam (i.e., the linear fit was not forced to go through the bottom of La Grange Dam; although that could be a reasonable approach to reconstructing pre-dam bed profiles). Figure 4 illustrates the likely degree or volume of sediment infill behind La Grange Dam, as well as how little bearing TID's approach to modeling "without-dam" has in reality to either the pre-Dam water surface profile or what the water surface profile would be if one was to remove the Dam and leave the existing sediment deposit in place. If the latter occurred, the existing channel bed would instantaneously begin rapidly down cutting and evacuating the sediment fill at a discharge of 2,350 or 4,000 cfs, which would alter the bed profile, alter the water surface profile, and completely violate the steady-state model assumptions used to create the "without-dam" model scenarios in TID's La Grange Backwater Analysis. As such, the "without-dam" scenarios presented by TID provide no utility for determining what a water surface profile would look like either before the La Grange Dam was in place or after a potential Dam removal.

The linear regression of the pre-Dam channel bed presented in Figure 4 gives a reasonable estimate of the reach-averaged channel gradient prior to La Grange Dam construction. The slope of this regression line is 0.0109 ft./ft. (1.1%), or about 57.5 ft./mile. This is similar to what the slope estimate would be by taking the rise over run from La Grange Dam tailwater elevation to the Don Pedro powerhouse tailwater elevation. TID, in their filing of October 14, 2011,states that the historic gradient under La Grange Dam is in excess of 100 ft./mile, calculated by assuming the 120-foot drop at the Dam occurred historically over the first 6,000 ft. upstream of the Dam (because the backwater from the La Grange Reservoir supposedly ends at this point); this is akin to calculating the historic gradient from the high point of the sediment deposit in the reservoir, which in reality has no bearing on the historic channel gradient (Figure 4).

4.3 The Model Downstream Boundary Condition

Model runs previously submitted by TID in the La Grange Backwater Analysis (on December 15, 2011) used a steady-state flow analysis with a "downstream model boundary established as the normal water surface elevation of 296.46 ft., the spillway crest elevation according to Bechtel (1991)" (pg 6) for the "with dam" model runs of 2,350 and 4,000 cfs. This methodology fixes the downstream water surface elevation at 296.46 ft. (the La Grange Dam crest elevation) for the entire simulation, which does not incorporate the known water stage increases that occur at the Dam as spill goes over its crest. TID provided a rating table for stage increases over La Grange Dam with spillway discharge in their October 14, 2011, memo (see TID's Attachment A, Table 1, pg 24). The only plausible explanation for water stage not increasing at La Grange Dam over the crest height at flows of 2,350 and 4,000 cfs is if flows were routed down one or both of the diversion canals at La Grange Dam, and did not pass over the Dam crest. However, the assumptions and model description do not mention that flows were going down either diversion canal; thus, evaluating the backwater extent of La Grange Dam at high flows (e.g., 2,350 and 4,000 cfs) while diverting the water rather than spilling it over the crest of the Dam is not a logical approach to evaluating the effects of the La Grange Dam.

Using TID's filing of October 14, 2011 (Table 1 in their Attachment A); the stage at La Grange Dam would increase to about 298.25 ft. at a discharge of 2,350 ft. and increase to a stage of 299.0 ft. at a discharge of 4,000 cfs. NMFS re-ran TID's "2,350 cfs with dam model run" using the same input parameters used by TID, with one exception: the downstream boundary condition was changed to 298.25 feet. The results of this simulation are presented in Figure 5 (Enclosure B, Attachment A), which compares the two runs of 2,350 cfs – one with a downstream boundary of 296.46 ft. and the other with 298.25 ft. One can clearly see that a revised model simulation, in which the downstream boundary condition is raised to a more realistic water surface elevation at the dam crest, flattens out the majority of the increased water surface gradient over the Twin Gulch sediment deposit. Thus, NMFS' more realistic model run corrects the inaccurate TID model result- and refutes TID's suggestion that the Twin Gulch sediment deposit demarcates the transition between reservoir and riverine conditions. Instead, a more accurate application of the HEC-RAS model - put forward here by NMFS – provides compelling evidence that the La Grange Reservoir backs onto and occupies federal lands within the BLM land boundary.

4.4 Reservoir Area Calculations

Several sources list the current surface area of La Grange Reservoir as 57.6 or 58.0 acres (see Enclosure B, Attachment C, pages C-4 and C-5) including the current CA DWR Division of Safety of Dams website (accessed on 4/9/2012):

http://www.water.ca.gov/damsafety/damlisting/index.cfm

A component of the HEC-RAS model output includes calculating cumulative inundated surface area with upstream distance at each cross-section node. Using TID's HEC-RAS model at 4,000 cfs, NMFS generated the inundated surface of La Grange Reservoir with distance upstream (Figure 6, Enclosure B, Attachment A). The downstream-most node in the La Grange HEC-RAS model is a location 538 ft. upstream of La Grange Dam, and thus the distance from La Grange Dam to 538 ft. is not included in the surface area calculation output by the model. To correct this deficiency, the surface area from La Grange Dam to river station 538 ft. was digitized by NMFS in ArcGIS using GIS shapefiles (e.g. banklines, XS cutlines) provided by TID in their additional information to FERC filed in December, 2011. This area was calculated as 6.3 acres, but was assumed to be about 8 acres to account for any potential unknowns in GIS shapefiles. Thus, 8 acres was added to the HEC-RAS output curve of total surface area to distance upstream in Figure 6 (Enclosure B, Attachment A). Using this curve in Figure 6 shows that a total inundated area of 57.6 acres occurs at a distance of about 11,200 ft. upstream of La Grange Dam, which is about a mile upstream of the approximate BLM land boundary. The distance of 11,200 ft. upstream is also about the same distance that the HEC-RAS model produces a flat, planar surface indicative of a reservoir backwater to (see Figures 3 and 4, Enclosure B, Attachment A). The total inundated surface of La Grange Reservoir at the BLM land boundary is approximately 38 acres (Figure 6, Enclosure B, Attachment A).

5.0 Additional Evidence That Upstream Backwater Extent Encroaches on BLM Lands

In a previous filing submitted on November 17, 2011, NMFS demonstrated the upstream extent of the La Grange Dam backwater by projecting the contour of the La Grange Dam crest upstream and calculating where that contour crosses the river channel. This line would represent the minimum backwater extent of La Grange Dam when at full pool and negligible inflow. Herein, NMFS presents a similar calculation of projecting the 296.46 foot (La Grange Dam crest elevation) contour in the vicinity of La Grange Reservoir; however, the analysis uses the digital terrain model developed by TID in 2011, which includes the recent bathymetric survey of La Grange reservoir collected in summer of 2011. The input data and creation of this digital terrain model is detailed in TID’s December 15, 2011 La Grange Backwater Analysis. The digital terrain model was filed with FERC and the grid file is named “legrange5”. NMFS imported this digital terrain model into ArcGis 10.0, and the 296.46 contour is illustrated in Figure 7 (Enclosure B, Attachment A); the blue area represents all elevations below 296.46 ft. and the red area represents all areas above 296.46 ft. Figure 7 illustrates that there is a clear, defined surface at or below 296.46 ft. in elevation that extends several thousand ft. upstream of the BLM land boundary. While there is an island of "red" (or surface above 296.46 ft.) at the Twin Gulch sediment influx, it does not extend across the entire width of the channel and does not cut-off the backwater from extending further upstream beyond the island. Using the recent, high-resolution topographic data collected by TID, along with a digital contour within ArcGIS, conclusively shows that the upstream backwater from La Grange Dam (when at full pool and negligible inflow) extends beyond the BLM land boundary.

Additional aerial photographic and mapping evidence also exists that illustrates the backwater extent of La Grange Dam extends further upstream than claimed by TID in their October 14, 2011 and December 15, 2011 filings. Both of these filings claim that the transition to riverine conditions occurs within La Grange Reservoir at a location downstream of the Twin Gulch tributary junctions. Inspection of the aerial photograph in Figure 1b (Enclosure B, Attachment A), taken in the summer of 2010, clearly shows a backwater pool extending up into the Twin Gulch tributary entering La Grange Reservoir from the south. If the southern Twin Gulch tributary was not under backwater conditions at its mouth, it would appear in the aerial photograph as a free flowing stream until it crossed the bankline of the Tuolumne River/La Grange Reservoir. A similar backwater in the Twin Gulch tributary entering from north would in all likelihood be evident in the air photo if that tributary wasn't currently significantly aggraded with sediment from the 1997 spillway event. However, the National Wetland Inventory Map of the La Grange Reservoir (filed with the PAD for the Don Pedro Project FERC

No. 2999) and presented as Figure 8 (Enclosure B, Attachment A) herein, illustrates backwatering in both Twin Gulch tributaries and a freshwater emergent wetland in the backwater of the northern Twin Gulch tributary. The Map also depicts the La Grange Reservoir as a lake, extending nearly all the way to Don Pedro Dam.

6.0 Summary

Multiple lines of evidence clearly demonstrate that the extent of the backwater formed behind La Grange Dam extends at least several thousand ft. upstream of the federal (BLM) land boundary intersection with La Grange Reservoir. These conclusions are largely derived from topographic and bathymetric data collected and processed by TID, as well as a HEC-RAS model of La Grange Reservoir developed by TID and based on their recent survey data. Using TID's data and model, NMFS has provided several analyses illustrating the backwater extent of La Grange Reservoir extends upstream far beyond the location (5,400 ft. upstream of La Grange Dam) previously stated by TID as the upstream limit of the Reservoir.

In summary, the multiple lines of evidence provided herein include:

- HEC-RAS model runs at 10 and 100 cfs showing flat, planar water surface profiles (without any indication of riverine conditions) that extend over 11,000 ft. upstream of the La Grange Dam.
- HEC-RAS model runs at higher discharges exhibit a steeper gradient profile in response to the very large-volume sediment deposit in La Grange Reservoir, at the confluence with Twin Gulch. This sediment "slug" was deposited during flood conditions in January 1997, when flows over the New Don Pedro Dam Spillway caused massive erosion of Twin Gulch, and the sediment was deposited in La Grange Reservoir (McBain and Trush

2000). The elevated water surface profile at high-flow model runs does not mark a transition to riverine conditions, but rather occurs due to the presence of a localized hydraulic feature or condition (the large sediment deposit) at the confluence of Twin Gulch and the La Grange Reservoir; the Reservoir backwater clearly extends further upstream.

- Curves of total surface area to distance upstream, generated primarily from HEC-RAS simulations, indicate that the published surface area value for La Grange Reservoir of 57.6 acres is attained only when the distance upstream (Reservoir extent) reaches about 11,200 ft. upstream of La Grange Dam; this point is a mile or so upstream of the federal (BLM) land boundary.
- The 296.46 foot contour line derived from TID's recent, high resolution topographic survey supports the HEC-RAS model results, showing that a continuous La Grange Reservoir area (at or below 296.46 ft.) extends well upstream of the federal (BLM) land boundary.

Therefore, NMFS finds, and the data conclusively show, that the La Grange Reservoir clearly extends onto federal lands managed by the BLM. Moreover, because the La Grange Reservoir, a facility of the La Grange Hydroelectric Project affects lands of the United States, the Commission should immediately act to assume jurisdiction over the Project, pursuant to § 23(b)(1) of the Federal Power Act, 16 U.S.C. § 817(1).

7.0 Literature Cited

McBain & Trush, Inc. 2000. Habitat Restoration Plan for the Lower Tuolumne River Corridor. Arcata, California. Prepared for The Tuolumne River Technical Advisory Committee. March 2000.

McBain & Trush, Inc. 2004. Coarse sediment management plan for the lower Tuolumne River. Revised Final Report. Prepared by McBain & Trust, Arcata, California for Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and California Bay-Delta Authority.

Enclosure B

ADDITIONAL INFORMATION
FOR THE COMMISSION'S JURISDICTIONAL REVIEW
OF THE LA GRANGE HYDROELECTRIC PROJECT

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Turlock Irrigation District
Modesto Irrigation District
LaGrange Hydroelectric Project **UL11-1-000**

Enclosure B contains the following Attachments that include HEC-RAS model plots, model output data, aerial photographs, maps, and reports in support of the NMFS' analyses found in Enclosure A.

- Attachment A: Water surface profiles generated with the TID's HEC-RAS model
- Attachment B: Additional HEC-RAS Plots
- Attachment C: Historical La Grange Reports
  - USGS RESIS-II Database
  - California Department of Water Resources, Division of Safety of Dams Archives
- Attachment D: HEC-RAS Model Output Data for 10 and 100 cfs runs (Source: The 2011 TID La Grange HEC-RAS Model).

Attachment A: Figures

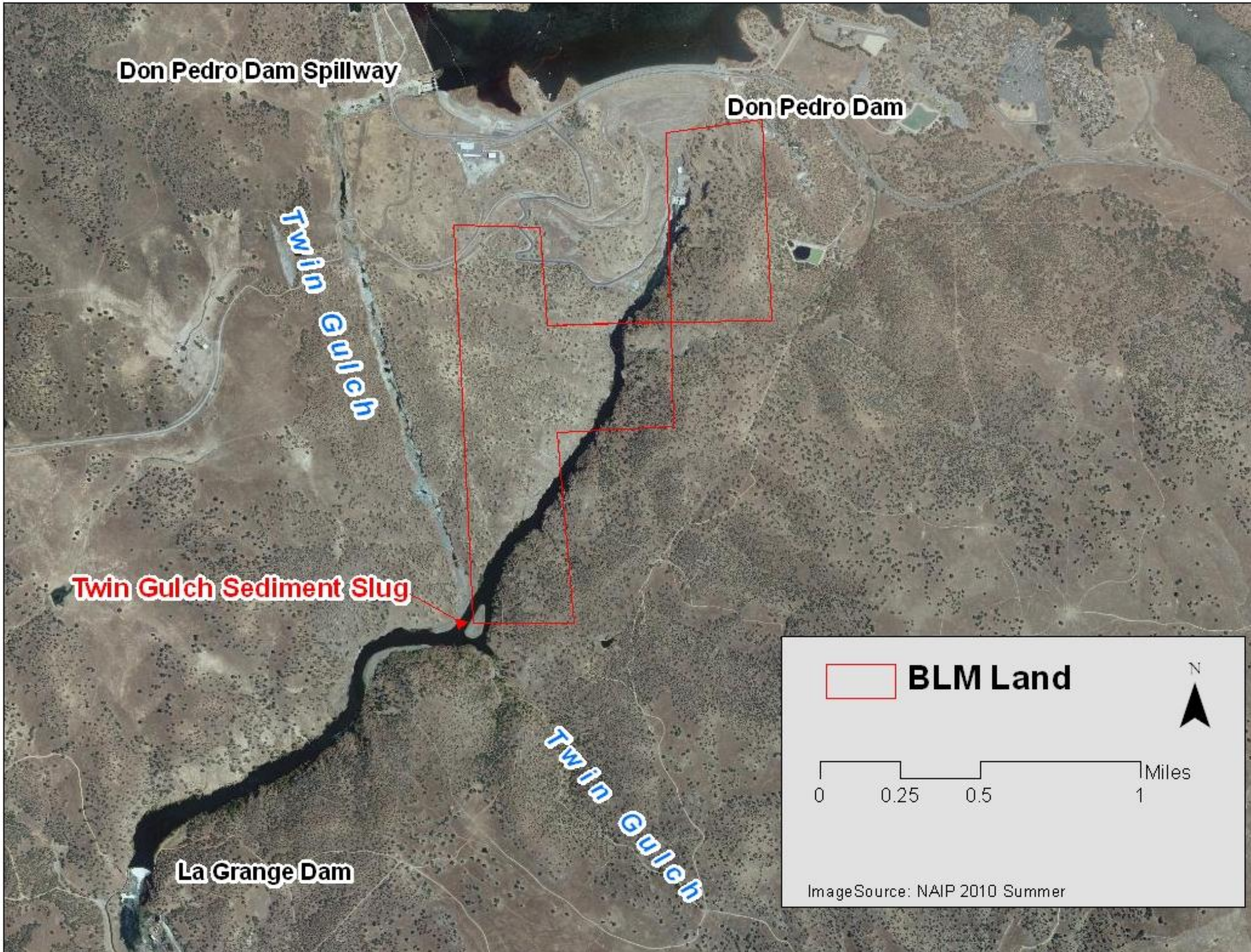


Figure 1a: Aerial photograph of La Grange Reservoir, Don Pedro Dam, Twin Gulch tributaries, BLM land boundaries (image source NAIP 2010).

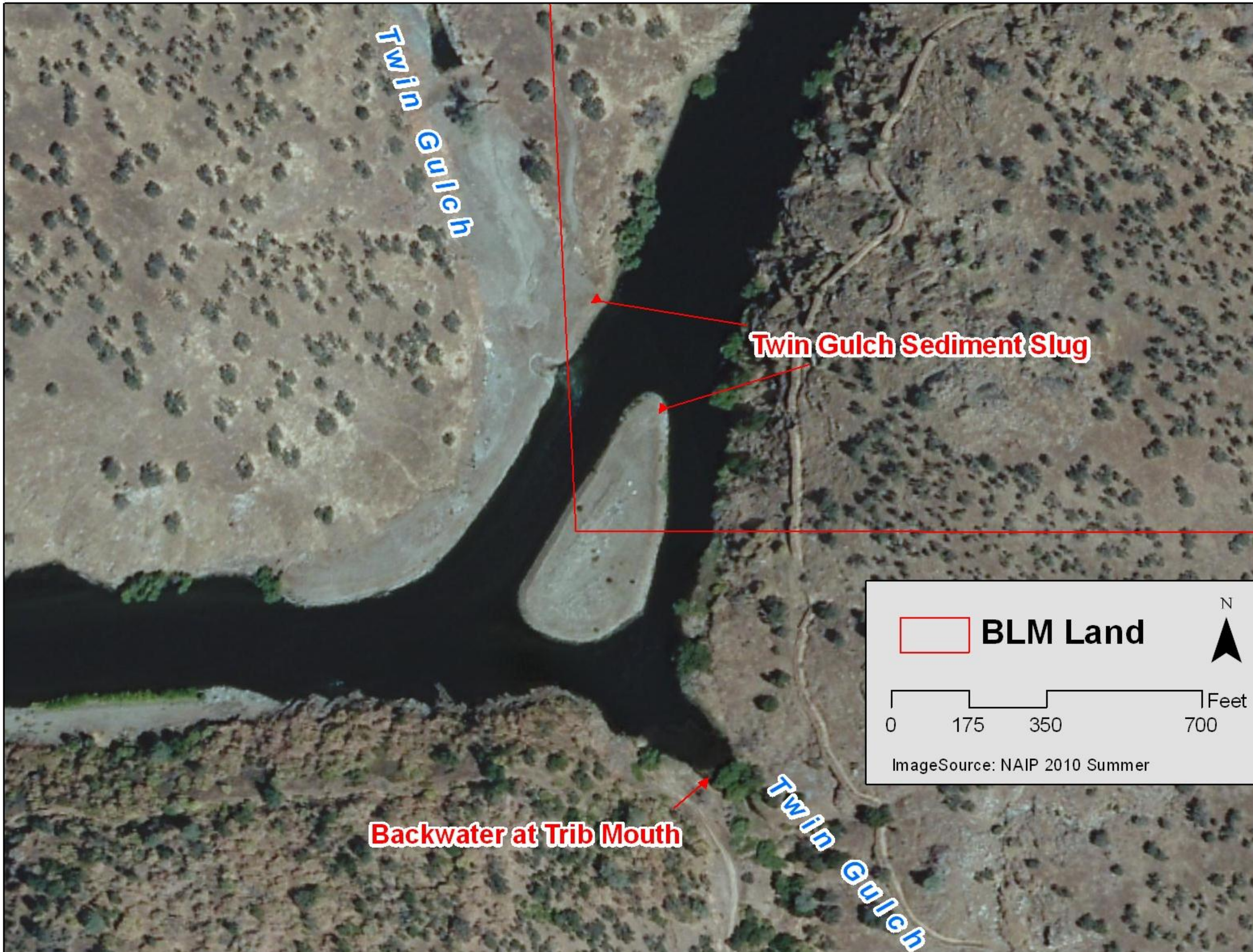


Figure 1b: Aerial photograph of La Grange Reservoir, in vicinity of Twin Gulch tributaries, illustrating portions of Twin Gulch sediment deposit remaining above reservoir water surface. Note backwater conditions in southern Twin Gulch tributary (image source NAIP 2010).

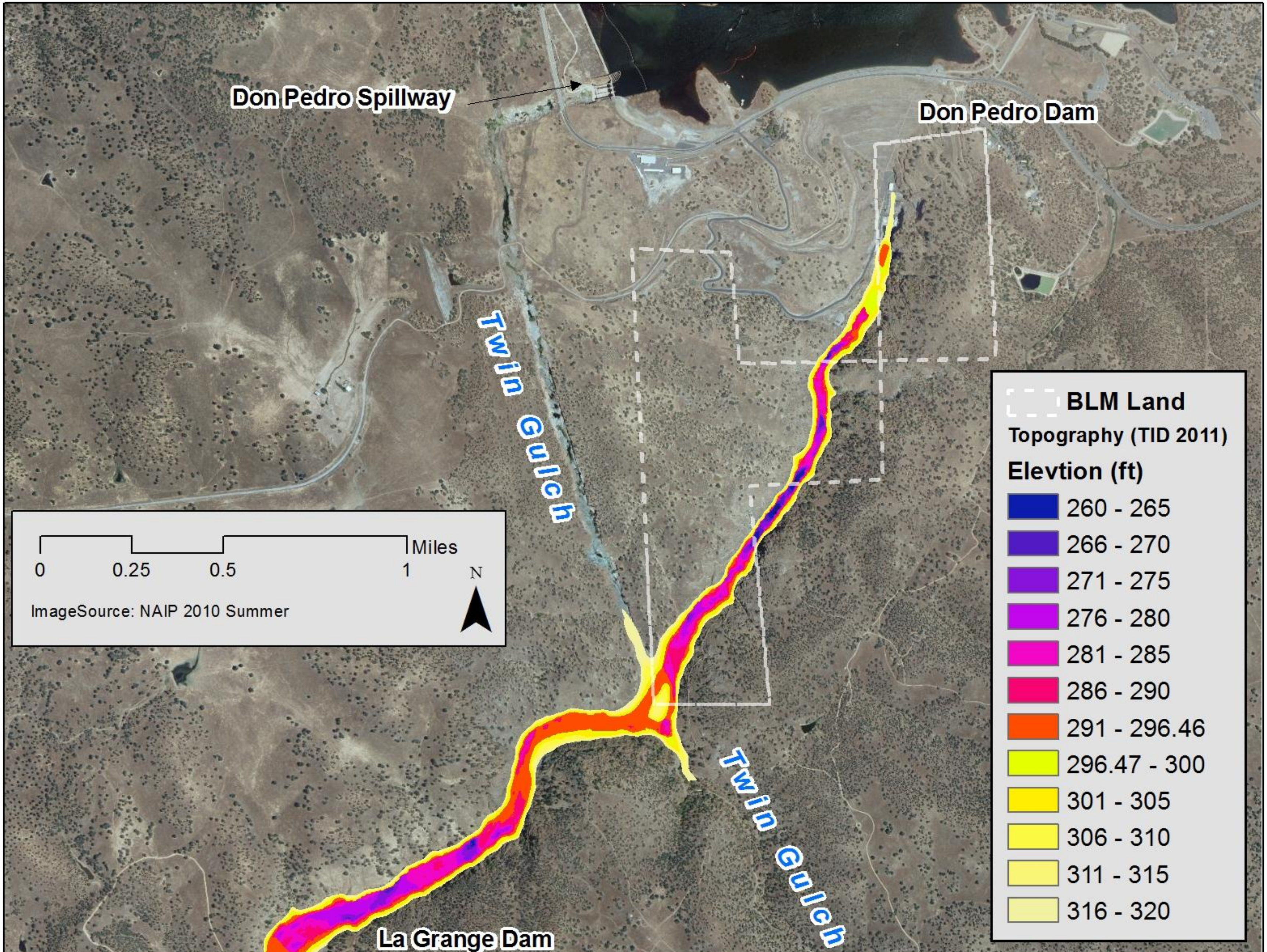


Figure 2a: Digital terrain model of La Grange Reservoir, data source TID 2011 and image source NAIP 2010. Note how channel in the vicinity of Twin Gulch confluence and 3,000 feet downstream is the highest elevation (i.e., shallowest) portion of La Grange Reservoir.

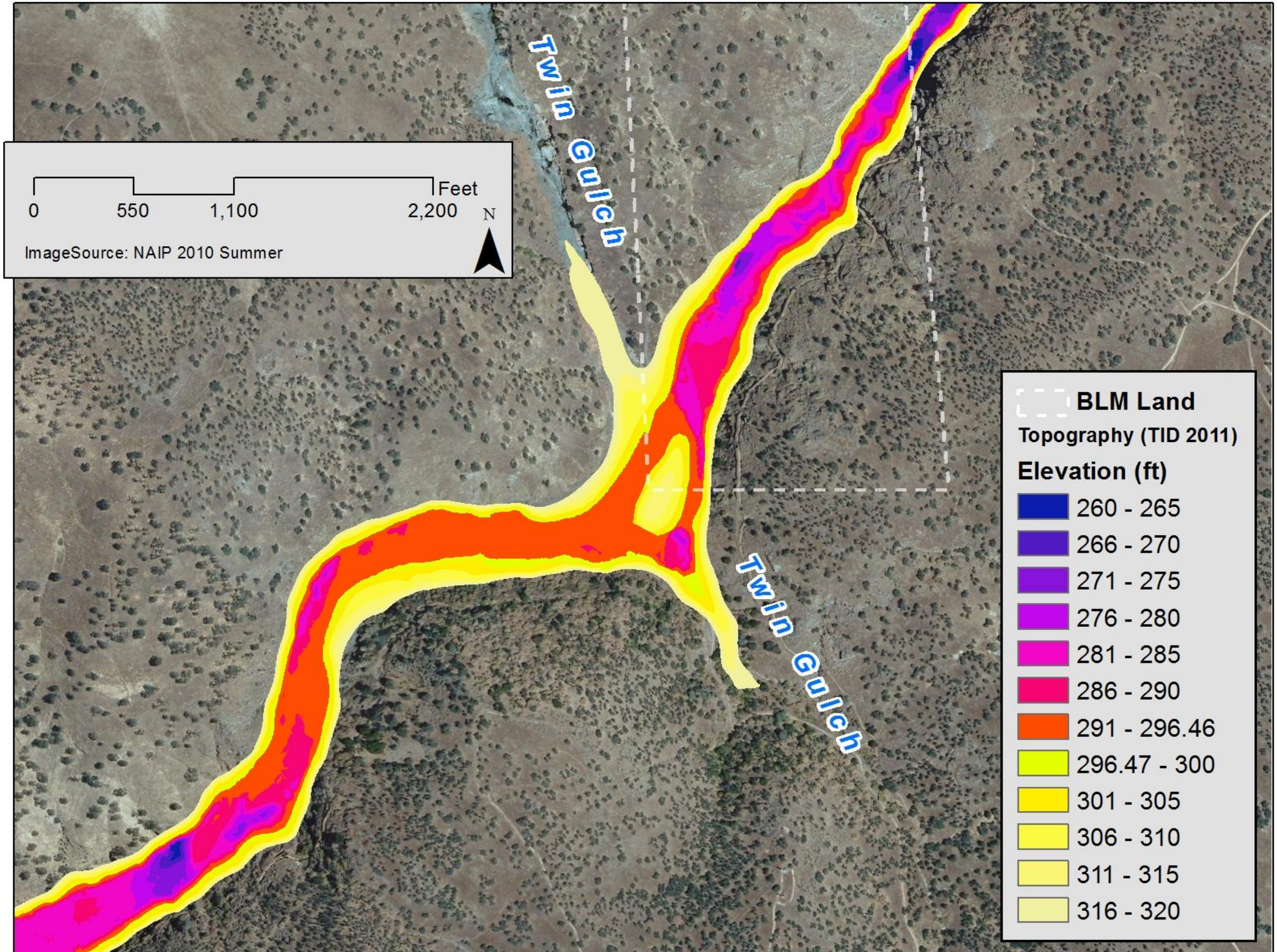


Figure 2b: Digital terrain model of La Grange Reservoir, data source TID 2011 and image source NAIP 2010. Note how channel in the vicinity of Twin Gulch confluence and 3,000 feet downstream is the highest elevation (i.e., shallowest) portion of La Grange Reservoir.

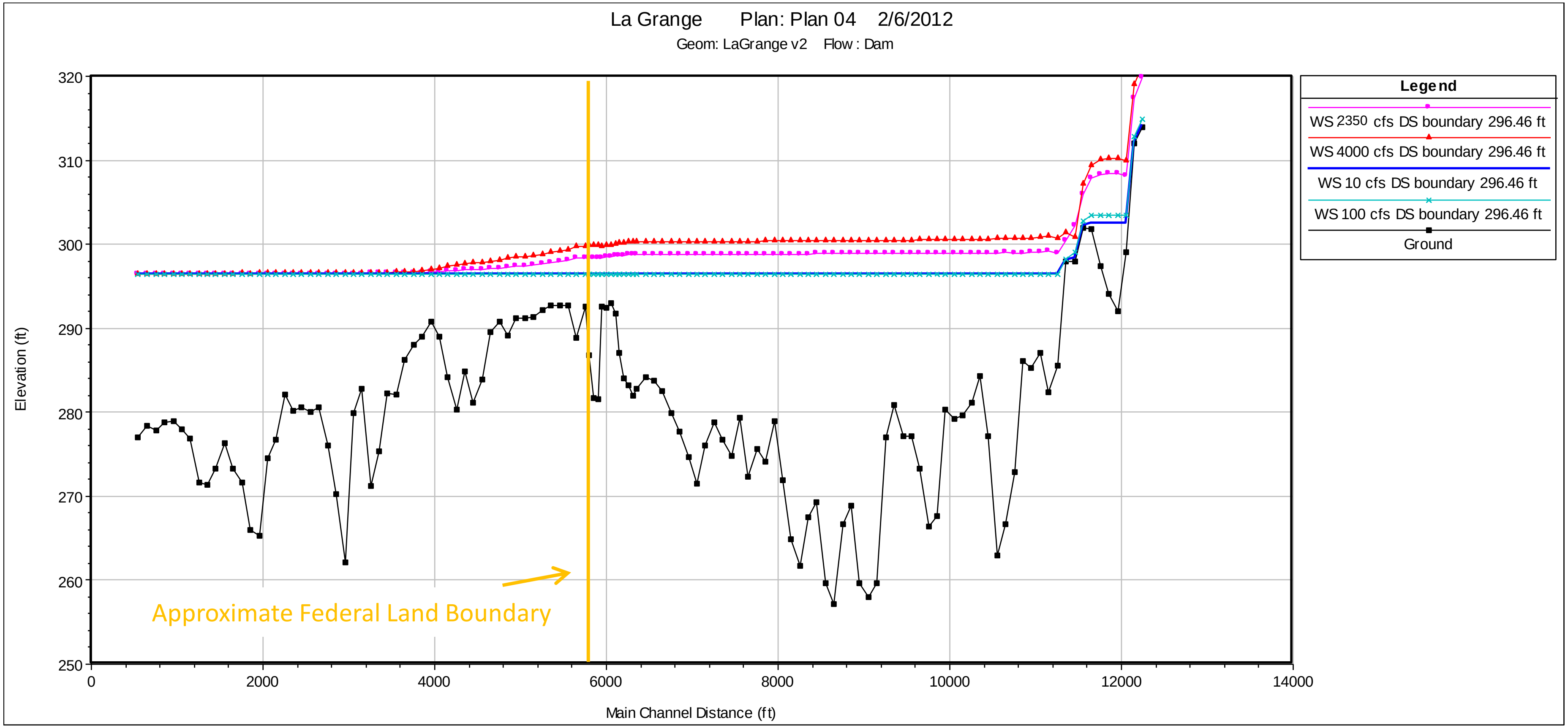


Figure 3: Water surface profiles generated with the TID's HEC-RAS model at 10, 100, 2,350, and 4,000 cfs. Profiles illustrate how steeper water surface gradients at Twin Gulch sediment deposit only occur at higher flows, and water surface profiles at lower flows (e.g., 10 and 100 cfs) are completely flat and indicative of a reservoir backwater for about a mile upstream of the federal land boundary.

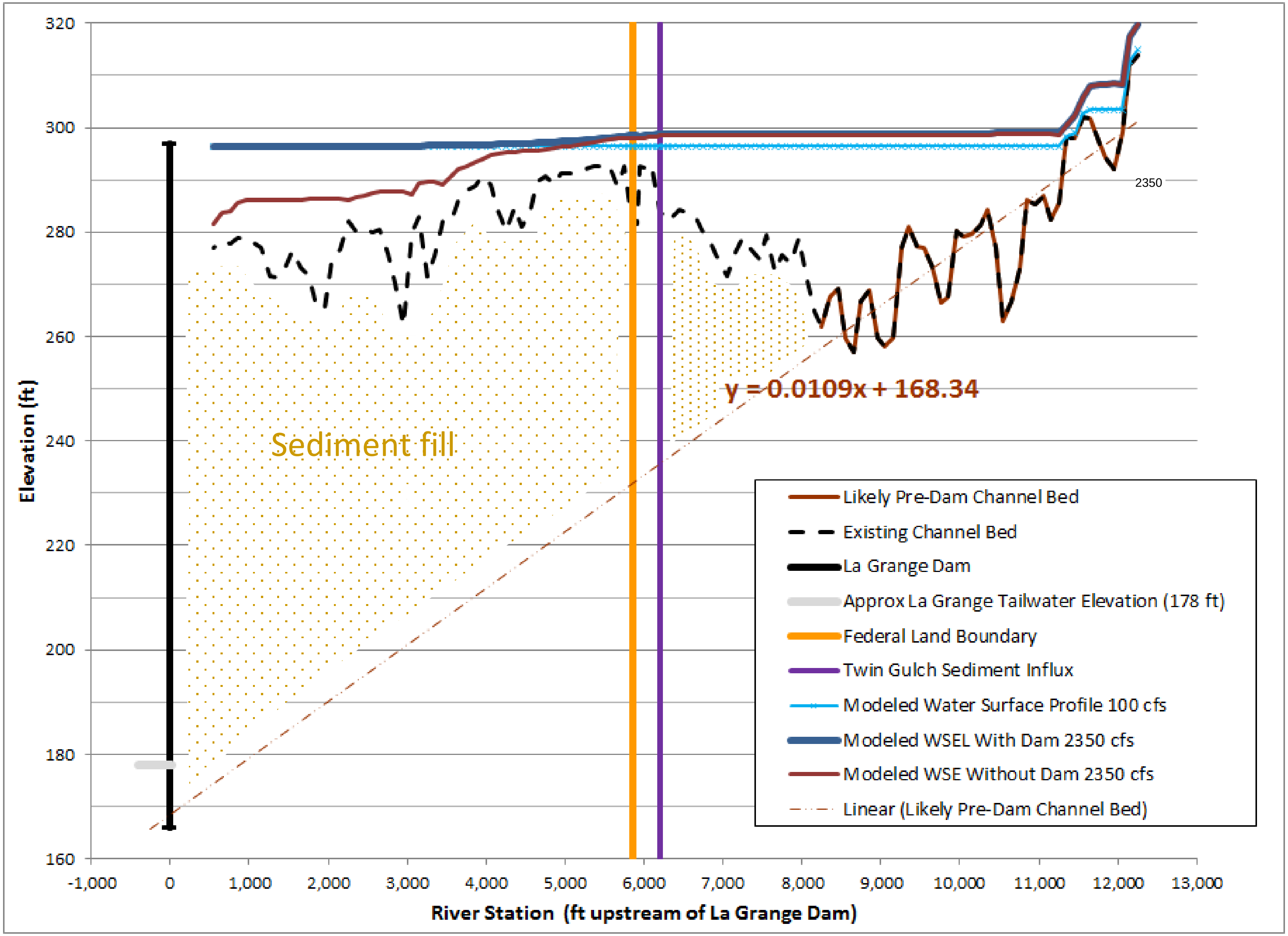


Figure 4: Water surface profiles generated with the TID's HEC-RAS model at 100 and 2,350 cfs and TID's "without-dam 2,350 cfs" profile. In addition, La Grange Dam and its approximate tailwater elevation are plotted, as well as an estimate of the pre-dam channel bed and a linear fit of that data that independently intersects near the base of La Grange Dam.

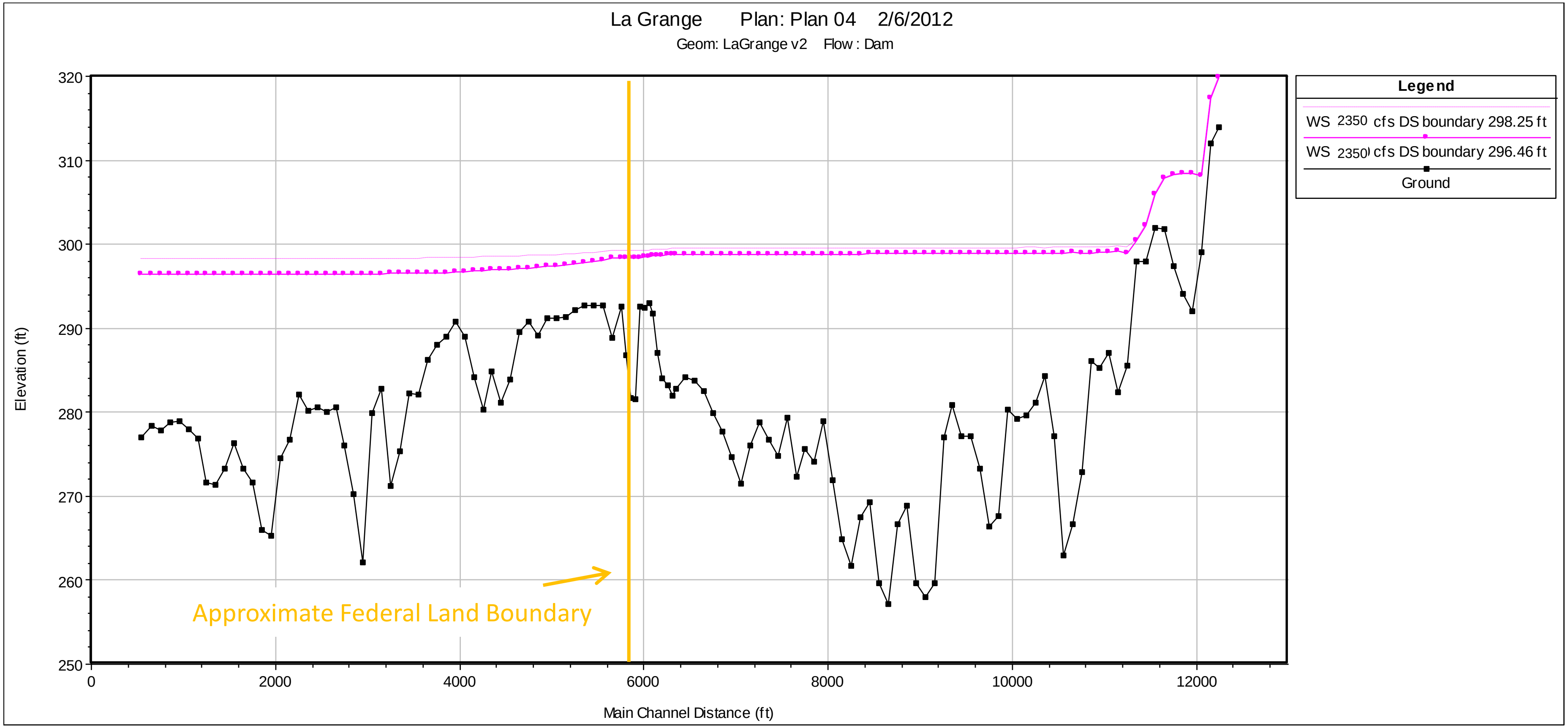


Figure 5: Water surface profiles generated with the TID's HEC-RAS model at 2,350 with a downstream boundary set at 296.46 feet (La Grange Dam crest) and at 298.25 feet (indicative of water surface elevation if 2,350 cfs were spilling over the crest of La Grange Dam). Profiles illustrate how the water surface gradient flattens out over the Twin Gulch sediment deposit when the downstream boundary is adjusted to reflect the increased water surface elevation when spill goes over La Grange Dam.

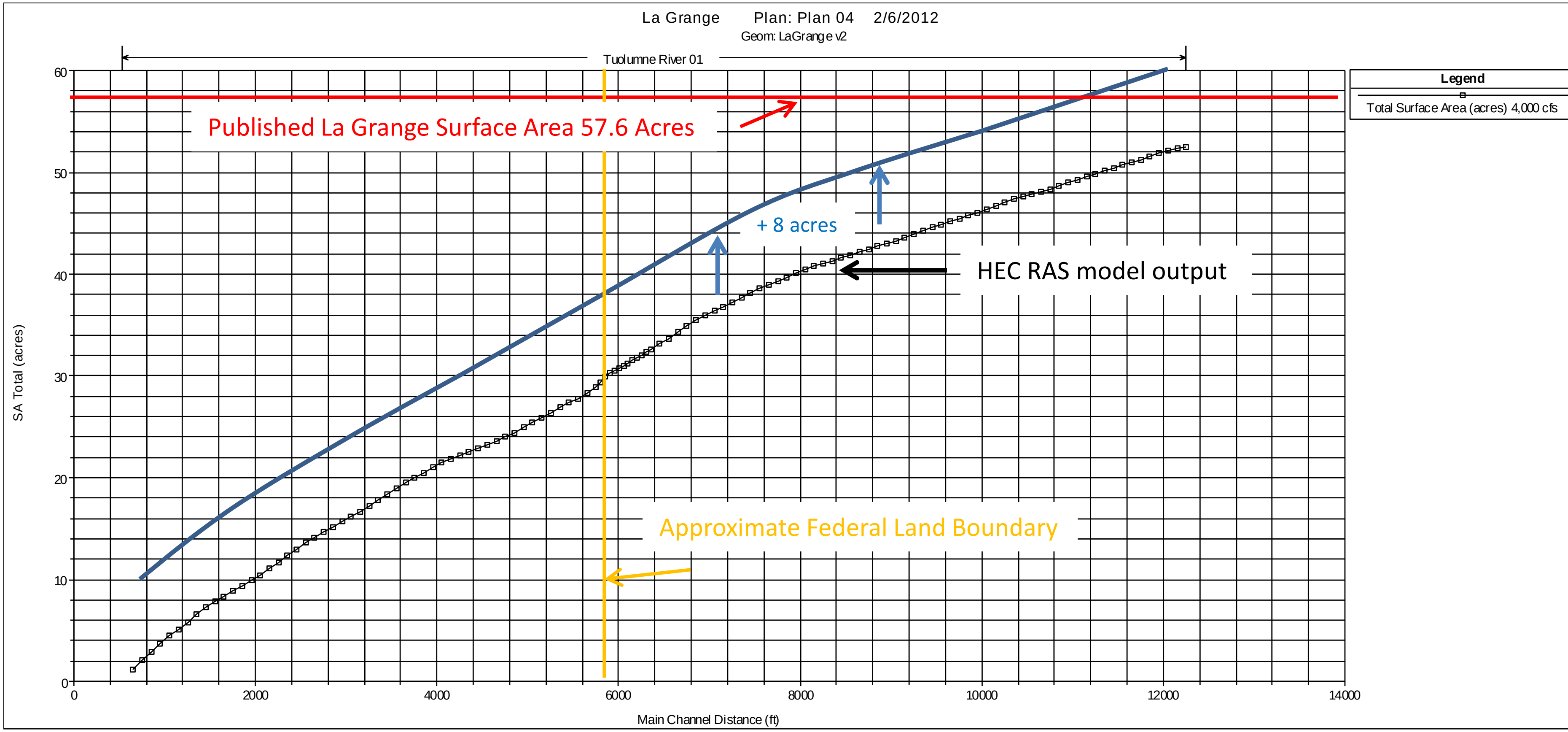


Figure 6: Total Surface Area (acres) generated with the TID's HEC-RAS model at 4,000 cfs with a downstream boundary set at 296.46 feet (La Grange Dam crest). Total surface area is adjusted up by 8 acres to account for the reservoir area between La Grange Dam and XS Station 538 ft, which is not accounted for in the HEC-RAS model (this area was measured as 6.3 acres in ArcGIS, but was conservatively plotted at an 8 acre increase). The published inundation area of La Grange Reservoir (57.6 acres) intersects the total surface area + 8 acres at about river station 11,600 feet and about 1 mile upstream of the approximate federal land boundary – this is a similar station to what the flat backwater profiles (10 and 100 cfs) indicate in Figure 3 as the upstream backwater extent.

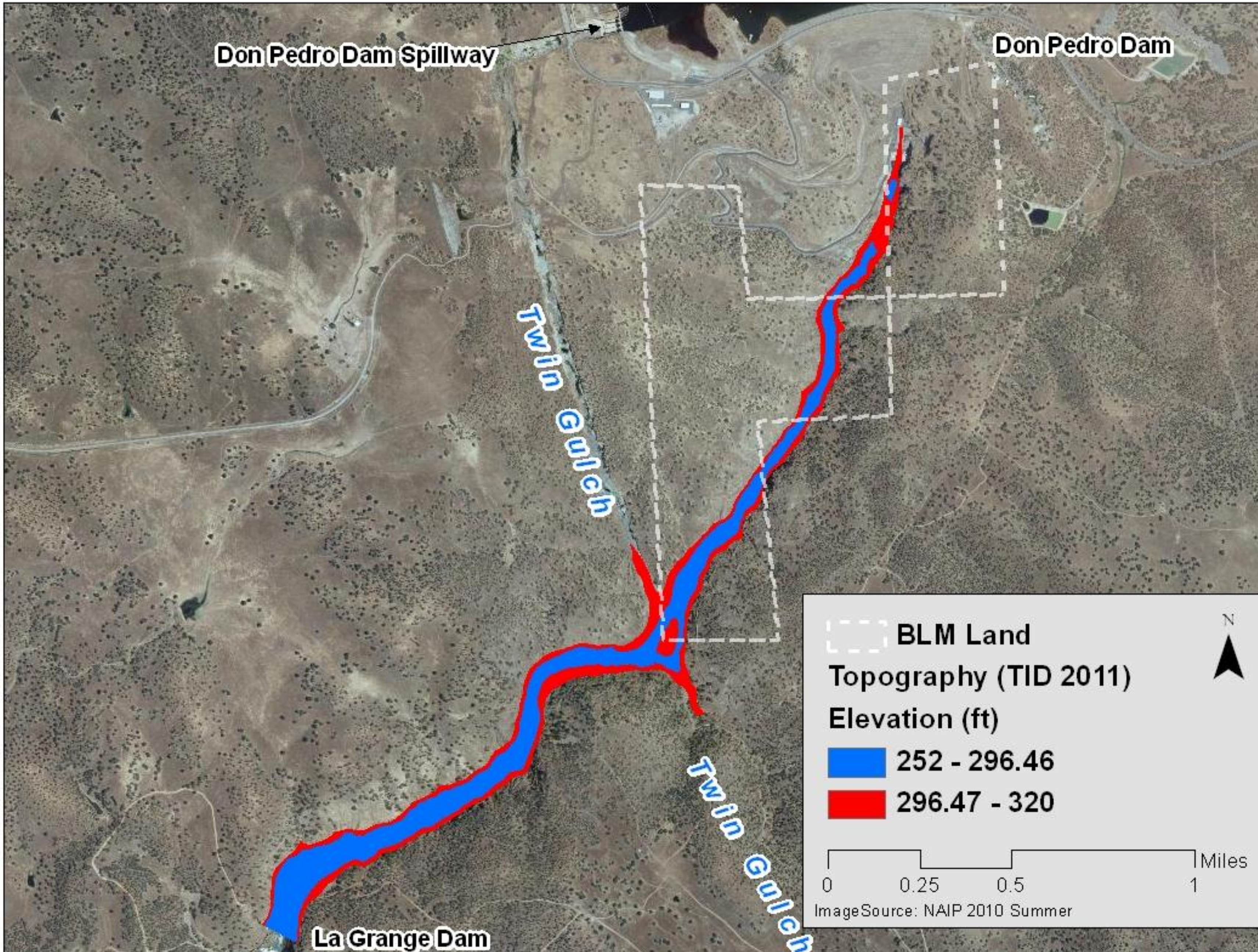


Figure 7: Digital elevation model of La Grange Reservoir, data source TID 2011 and image source NAIP 2010. All topography at elevation 296.46 feet or less is colored blue, indication a continuous backwater surface from La Grange Dam when at 296.46 feet that extends far beyond federal land boundary.

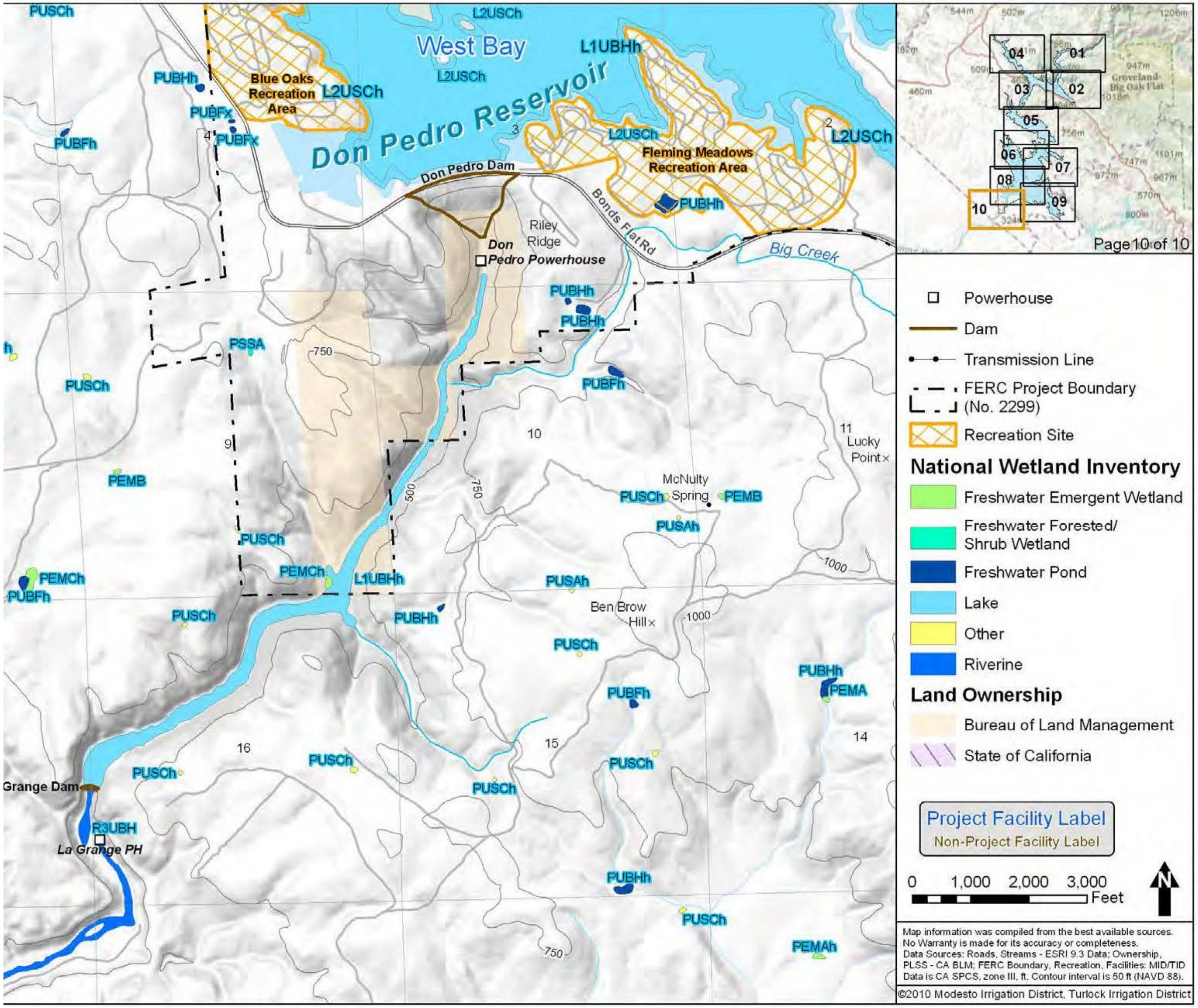


Figure 8: National Wetland Inventory map in the vicinity of La Grange Dam filed in the Districts' PAD in 2011. Note the "Lake" polygon from La Grange Dam extending nearly to Don Pedro Dam, the backwater zones at Twin Gulch tributary junctions, and the freshwater emergent wetland at the northern Twin Gulch tributary.

Attachment B: Additional HEC-RAS Plots

Source: TID La Grange HEC-RAS Model 2011

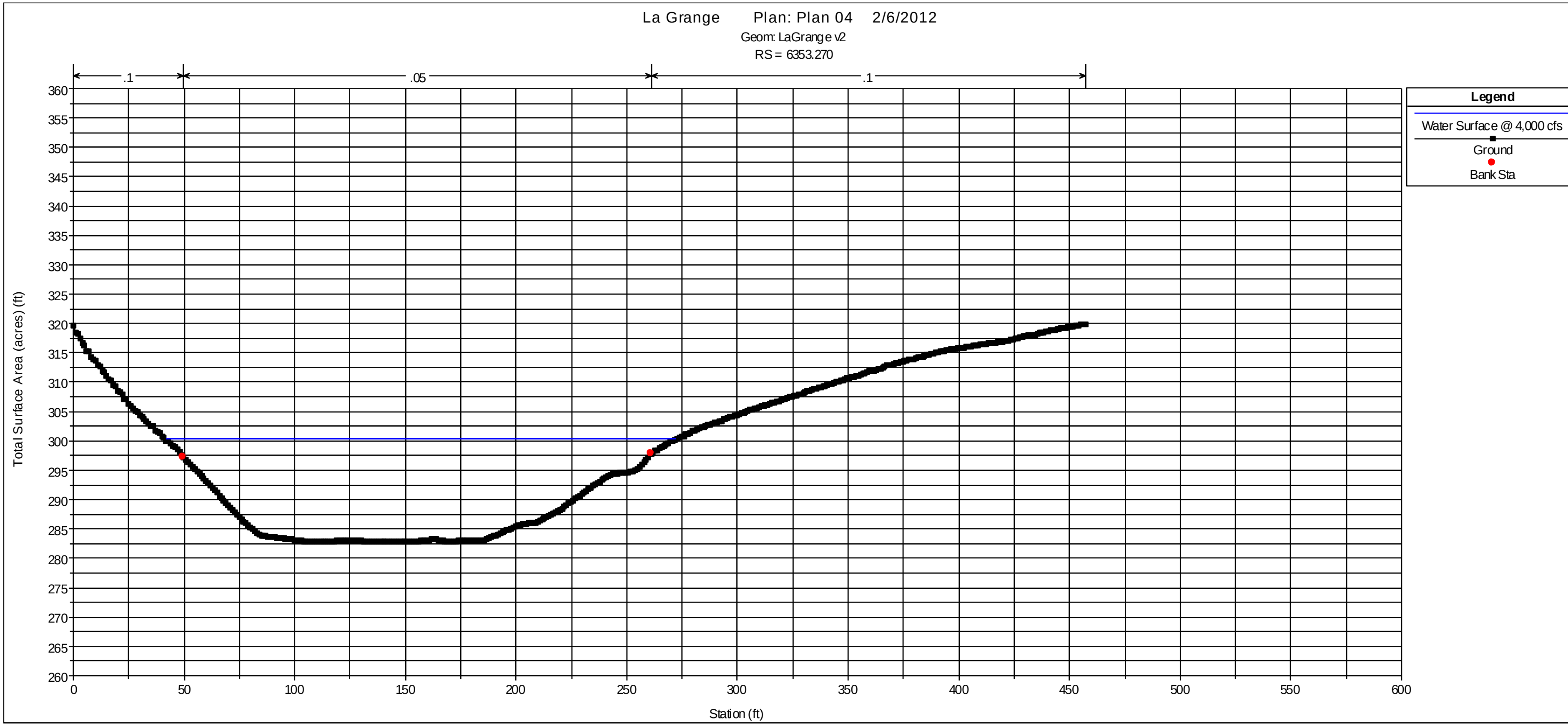


Figure B-1: Cross-section at river station 6,353 ft in La Grange Reservoir generated with the TID's HEC-RAS model at 4,000 cfs with a downstream boundary set at 296.46 feet (La Grange Dam crest). Cross-section is located just upstream of sediment influx from Twin Gulch, note typical water depths of about 17 ft.

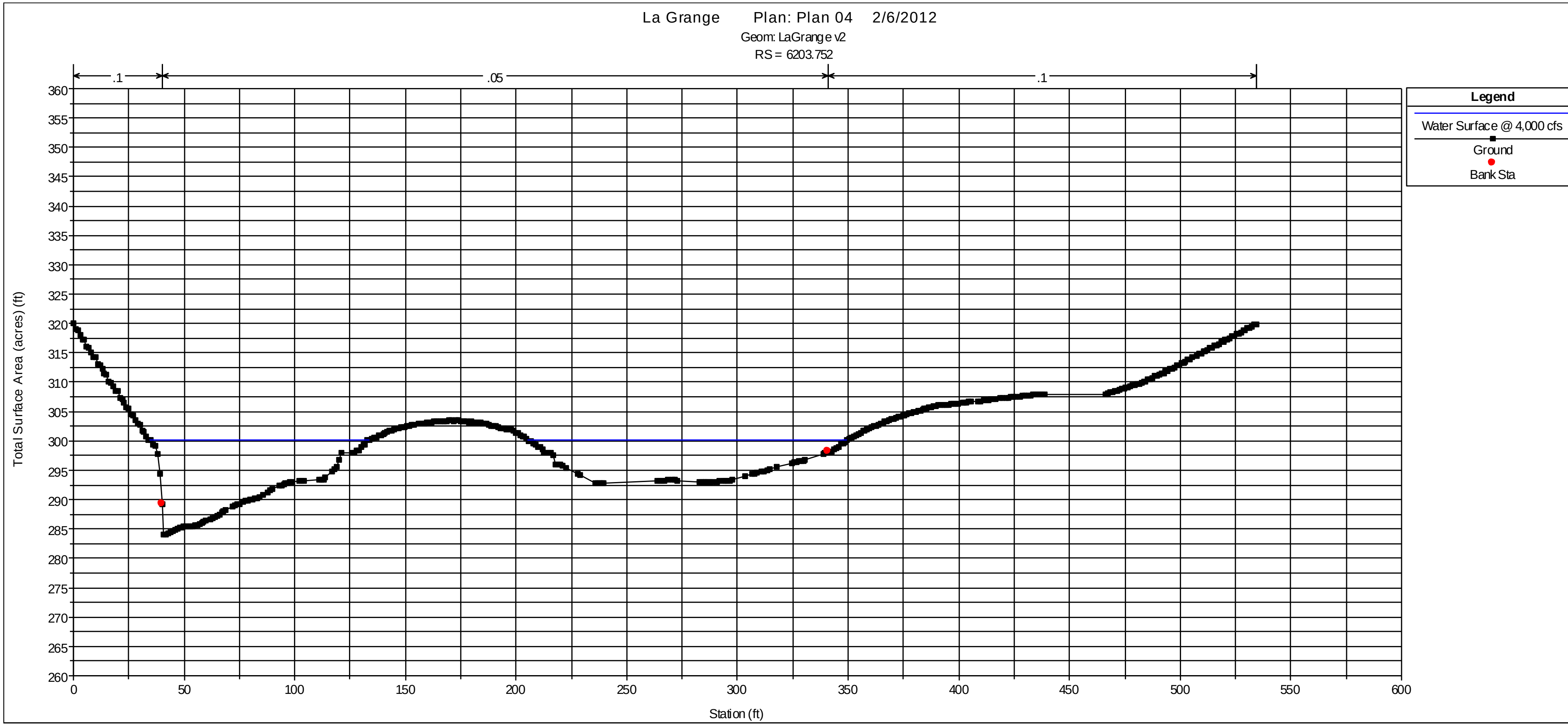


Figure B-2: Cross-section at river station 6,203 ft in La Grange Reservoir generated with the TID's HEC-RAS model at 4,000 cfs with a downstream boundary set at 296.46 feet (La Grange Dam crest). Cross-section is located just downstream of sediment influx from Twin Gulch, note mid-channel bar splitting the flow into two channels.

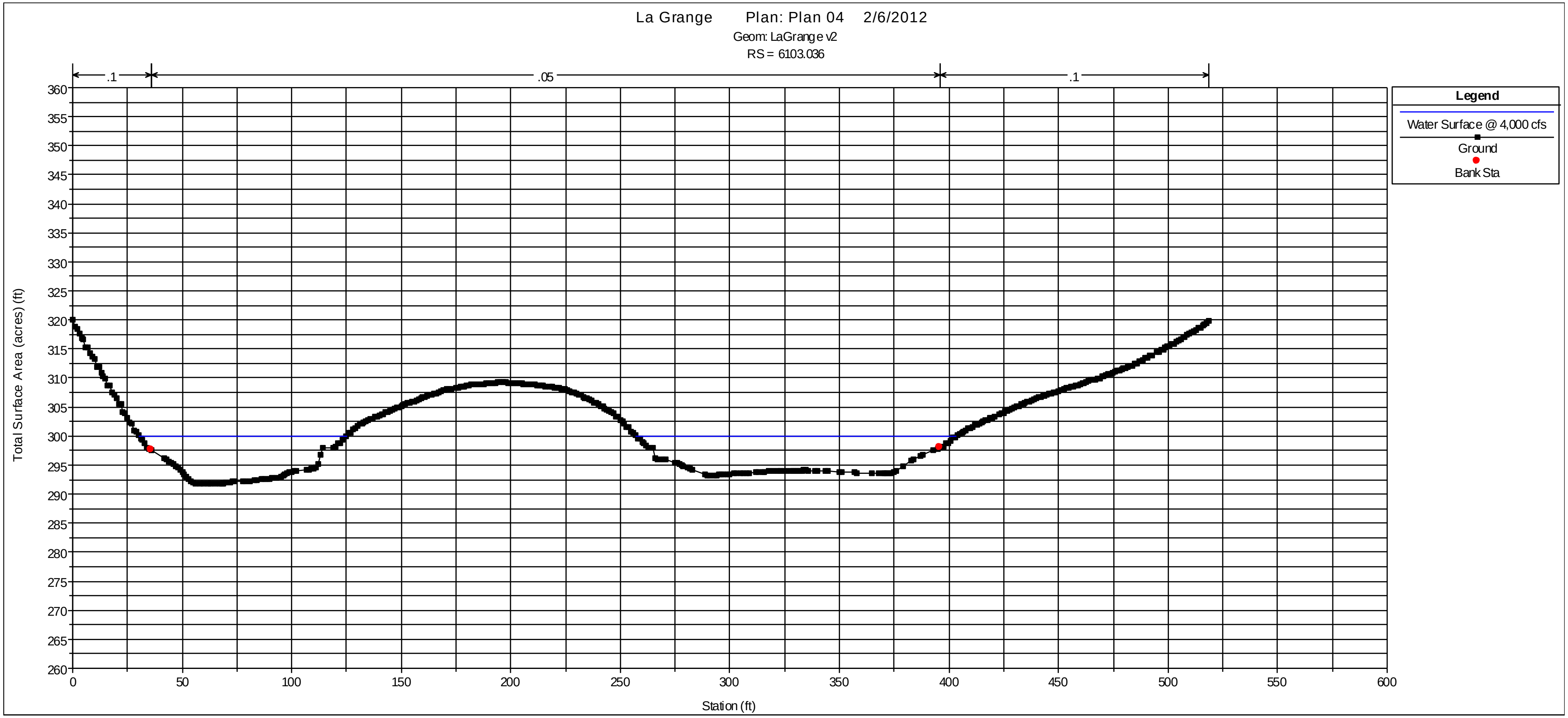


Figure B-3: Cross-section at river station 6,103 ft in La Grange Reservoir generated with the TID's HEC-RAS model at 4,000 cfs with a downstream boundary set at 296.46 feet (La Grange Dam crest). Cross-section is located just downstream of sediment influx from Twin Gulch, note mid-channel bar splitting the flow into two channels and typical flow depths of 5 to 7 ft.

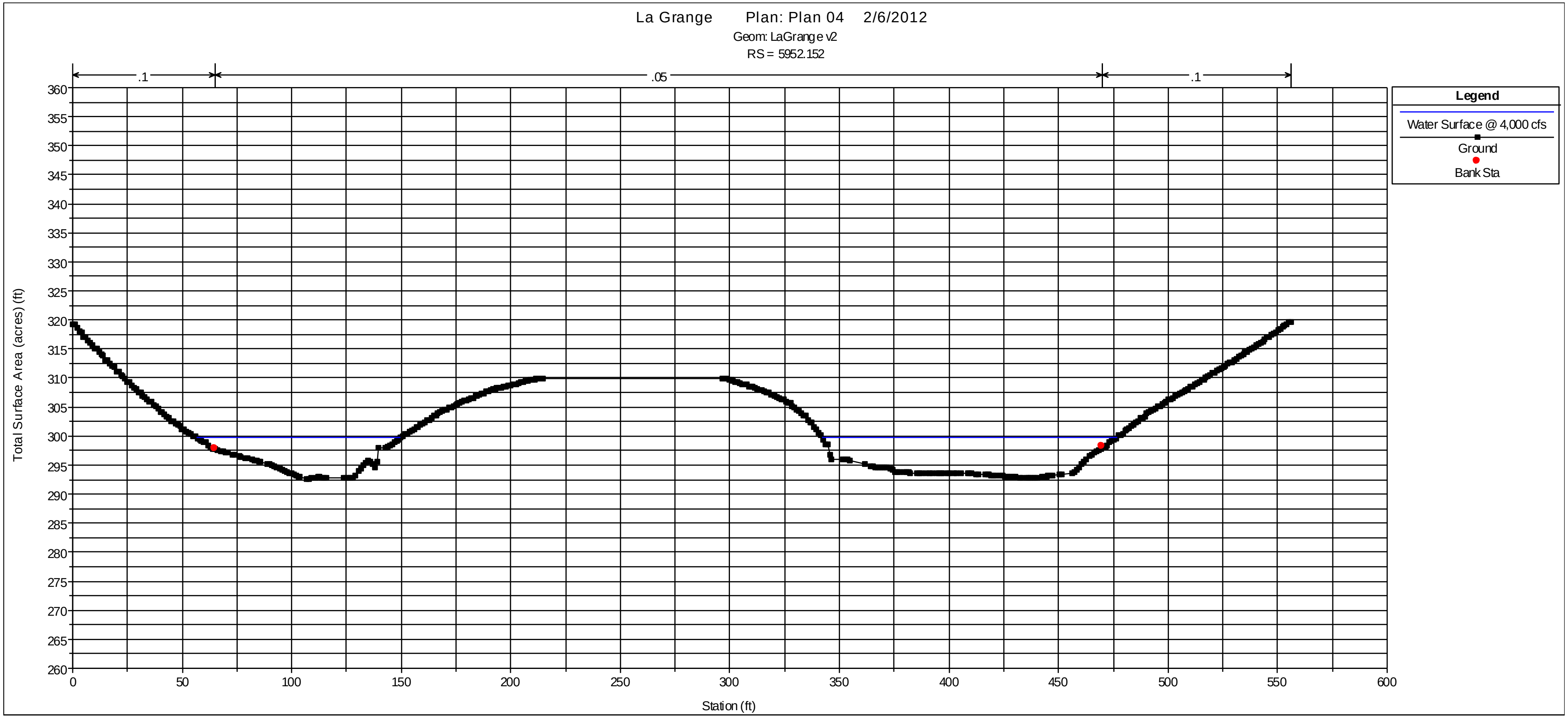


Figure B-4: Cross-section at river station 5,952 ft in La Grange Reservoir generated with the TID's HEC-RAS model at 4,000 cfs with a downstream boundary set at 296.46 feet (La Grange Dam crest). Cross-section is located downstream of sediment influx from Twin Gulch, note mid-channel bar splitting the flow into two channels and typical flow depths of 5 to 7 ft.

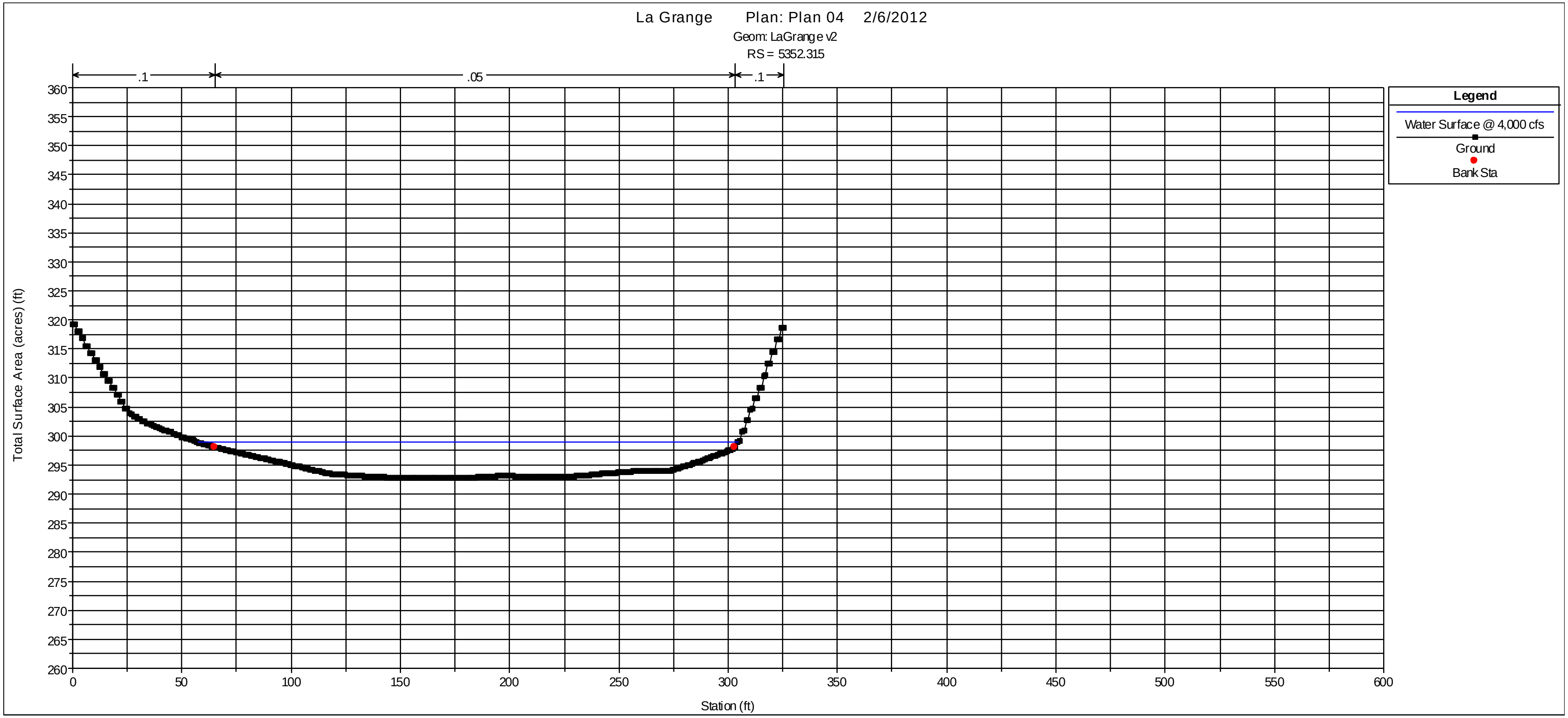


Figure B-5: Cross-section at river station 5,352 ft in La Grange Reservoir generated with the TID's HEC-RAS model at 4,000 cfs with a downstream boundary set at 296.46 feet (La Grange Dam crest). Cross-section is located downstream of sediment influx from Twin Gulch, note mid-channel bar is no longer evident but the reservoir still is strongly influenced by sediment deposition from Twin Gulch as flow depths remain 5 to 6 ft.

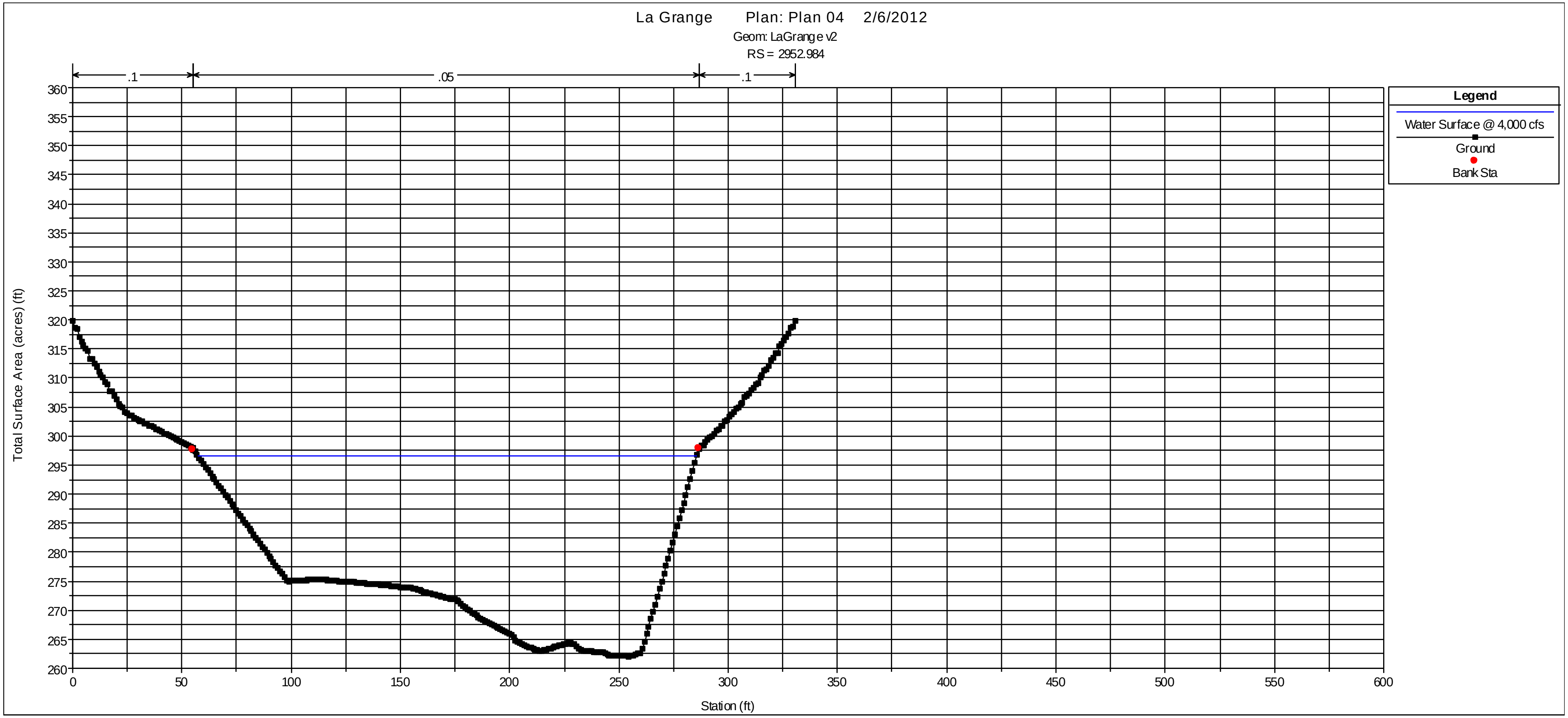


Figure B-6: Cross-section at river station 2,952 ft in La Grange Reservoir generated with the TID's HEC-RAS model at 4,000 cfs with a downstream boundary set at 296.46 feet (La Grange Dam crest). Cross-section is located more than 3,000 ft downstream of sediment influx from Twin Gulch and appears to be out of the influence of the primary sediment deposit from Twin Gulch as flow depths return to the range of 20 to 30 ft.

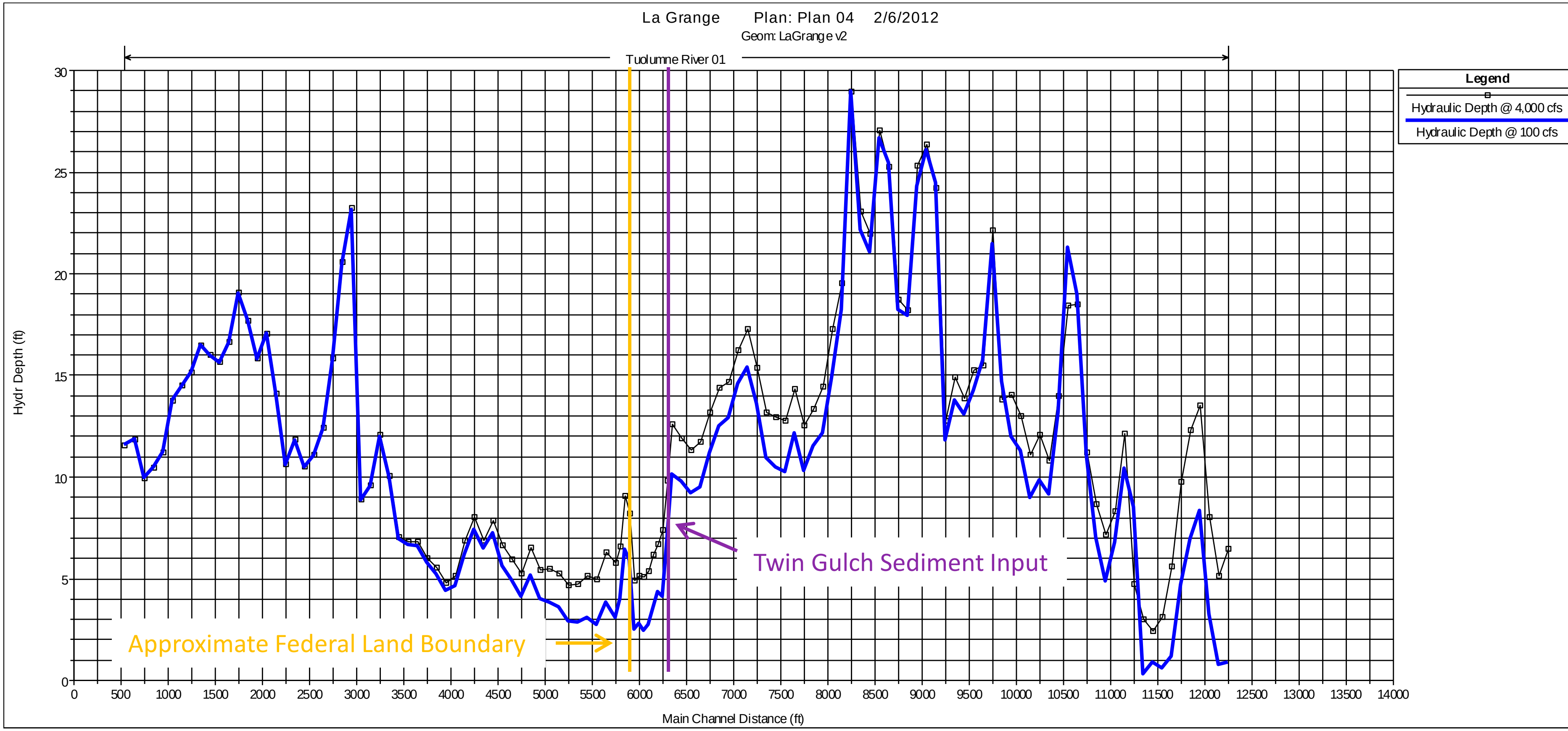


Figure B-7: Hydraulic depth (ft) at all model cross-sections in La Grange Reservoir generated with the TID's HEC-RAS model at 4,000 cfs and 100 cfs with a downstream boundary set at 296.46 feet (La Grange Dam crest). Hydraulic depth profiles illustrate how depths decrease immediately downstream of the Twin Gulch sediment influx due to the influence of the sediment input and associated decrease in channel capacity.

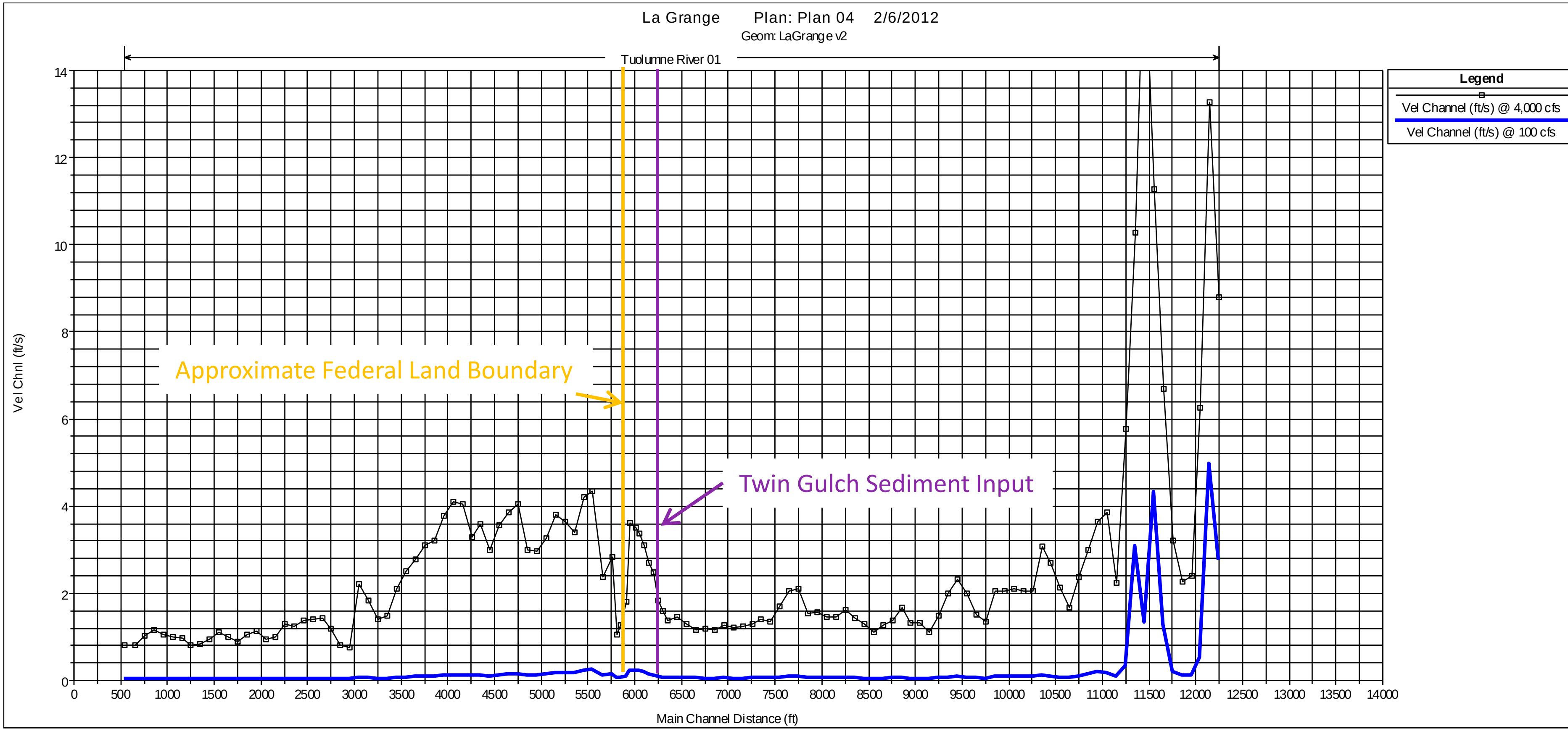


Figure B-8: Main channel velocity in La Grange Reservoir generated with the TID's HEC-RAS model at 4,000 cfs and 100 cfs with a downstream boundary set at 296.46 feet (La Grange Dam crest). Velocity profiles illustrate how velocities at 4,000 cfs increase immediately downstream of the Twin Gulch sediment influx due to the influence of the sediment input and associated decrease in channel capacity; although the velocities do not increase to near the magnitude of velocities in the riverine section upstream of station 11,000 ft. Note that velocities at 100 cfs show minimal change at the Twin Gulch sediment deposit, remaining less then 0.25 ft/s from La Grange Dam to river station 11,000 ft.

Attachment C: Historical La Grange Reports

Sources: (1) USGS RESIS-II Database

(2) California Department of Water Resources

Division of Safety of Dams Archives

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

RESERVOIR SEDIMENTATION DATA SUMMARY

NAME OF RESERVOIR: La Grange

DATA SHEET NO.: 71 - 12

DAM	1. OWNER Turlock & Modesto Irr. Dist.	2. RIVER Tuolumne River	3. STATE California
	4. SEC. 16 TWP. 3S RANGE 14E	5. NEAREST TOWN	6. COUNTY Stanislaus
	7. STREAM BED ELEV. -	8. TOP OF DAM ELEV. -	9. SPILLWAY CREST ELEV. 299

RESERVOIR	10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. SURFACE AREA ACRES	13. STORAGE ACRE-FEET	14. ACCUMULATED ACRE-FEET	15. DATE STORAGE BEGAN
	a. FLOOD CONTROL					
	b. POWER					Sept. 1895
	c. WATER SUPPLY					16. DATE NORMAL OPER. BEGAN
	d. IRRIGATION	300	56.1	2,332	2,332	
	e. CONSERVATION					
	f. INACTIVE					
	17. LENGTH OF RESERVOIR		MILES	AV. WIDTH OF RESERVOIR		MILES

WATERSHED	18. TOTAL DRAINAGE AREA 1,501 SQ. MI.	22. MEAN ANNUAL PRECIPITATION 18 - 50 INCHES
	19. NET SEDIMENT CONTRIBUTING AREA 1,501 1/ SQ. MI.	23. MEAN ANNUAL RUNOFF INCHES
	20. LENGTH MILES AV. WIDTH MILES	24. MEAN ANNUAL RUNOFF AC.-FT.
	21. MAX. ELEV. 10,500 MIN. ELEV.	25. CLIMATIC CLASSIFICATION Semi-arid to humid

SURVEY DATA

26. DATE OF SURVEY	27. PERIOD YEARS	28. ACCL. YEARS	29. TYPE OF SURVEY	30. NO. OF RANGES OR CONTOUR INT.	31. SURFACE AREA ACRES	32. CAPACITY ACRE-FEET	33. C/W RATIO AC.-FT. PER SQ. MI.
Sept. 1895	-	-	-	-	56.1	2,332	1.6
Oct. 1905	10.1	10.1	Contour detailed 2/	10 ft.	54.1	1,068	0.7

26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIPITATION	35. PERIOD WATER INFLOW ACRE-FEET: a. MEAN ANNUAL	b. MAX. ANNUAL	c. PERIOD TOTAL	36. WATER INFL. TO DATE AC-FT.: a. MEAN ANNUAL	b. TOTAL TO DATE

26. DATE OF SURVEY	37. PERIOD SEDIMENT DEPOSITS ACRE-FEET: a. PERIOD TOTAL	b. AV. ANNUAL	c. PER SQ. MI.-YEAR	38. TOTAL SED. DEPOSITS TO DATE ACRE-FEET: a. TOTAL TO DATE	b. AV. ANNUAL	c. PER SQ. MI.-YEAR
Oct. 1905	1,264	125	0.083	1,264	125	0.083

26. DATE OF SURVEY	39. AV. DRY WGT. LBS. PER CU. FT.	40. SED. DEP. TONS PER SQ. MI.-YR.: a. PERIOD	b. TOTAL TO DATE	41. STORAGE LOSS PCT.: a. AV. ANNUAL	b. TOT. TO DATE	42. SED. INFLOW PPM: a. PERIOD	b. TOT. TO DATE
Oct. 1905	70 *	127	127	5.36	54.20		

* Assumed

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET ABOVE, AND BELOW, CREST ELEVATION											
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION											

26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGH OF RESERVOIR													
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	-105	-110	-115	-120	-125
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION														

45. RANGE IN RESERVOIR OPERATION

WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW AC.-FT.	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW AC.-FT.

46. ELEVATION—AREA—CAPACITY DATA

ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY

47. REMARKS AND REFERENCES

1/ Before construction of Don Pedro Reservoir in 1923. 2/ Survey by U.S.G.S.

Brown, C. B. and Thorp, E. M. Reservoir sedimentation in the Sacramento-San Joaquin Drainage Basins, California. U. S. Soil Conserv. Serv. Special Report No. 10, 69 pp., illus., processed, Washington, D. C. July 1947.

48. AGENCY SUPPLYING DATA Region 7, Soil Conservation Service
U. S. Dept. of Agriculture
Portland, Oregon

49. DATE January 26, 1951

AGR-SCS-BELTSVILLE, MD. 2323 MARCH 1952

State of California
The Resources Agency
Department Water Resources
DIVISION OF SAFETY OF DAMS

save water
DWR

DIVISION OF
SAFETY OF DAMS

SAFETY REVIEW
SECTION

LA GRANGE DAM
SAFETY REVIEW REPORT

JUNE 1982

At the points where the dam rests against the abutments, the latter were cut to the radial lines of the curve. This was done to prevent vibrations caused by the water.

6.2.1 Enlargement of the Reservoir and Performance of the Dam

During 1931 the owners, under Application to the Division of Water Resources, State of California filed on September 3, 1930, raised the height of the dam by 2 feet. This was accomplished by adding reinforced concrete and gunite on the crest of the old dam. This enlargement increased the surface area of the reservoir from 56.5 to 57.6 acres.

The total storage behind the 131 foot high dam is approximately 3,000 acre-feet. However, about 83% of its capacity is filled with silt and the top 10 to 15 feet of the dam contains all the permitted storage (500 acre-feet).

The DSOD records indicate that, prior to the enlargement, this dam was overtopped by 16½ feet (60,000 cfs) during the 1911 flood.

An underwater inspection conducted on May 14, 1970, (Reference 6) of the upstream face and the toe area indicated no unusual condition which could possibly affect the stability of the dam at that time.

6.3 Stability

6.3.1 General

The stability of the dam will be evaluated later this year by DSOD for seismic loading and for overtopping caused by the SDF. Previously, the stability of La Grange Dam has been evaluated two times. These studies are summarized in the following sections.

6.3.2 Stability Analysis of Pre-1899

Prior to 1899, a simple static stability analysis of this dam was performed without considering any enlargement.

In the parallelogram of forces (Refer to Appendix A) for the entire profile under surcharge-stress, the line of profile is taken from the extreme toe to a point tangential to the flip curve, as indicated by line EH.

State of California
The Resources Agency
Department of Water Resources
DIVISION OF SAFETY OF DAMS

JEB

~~1. Design Branch~~
~~Tech II~~
2. Files

FLOOD ESTIMATE AND SPILLWAY ANALYSIS

Dam Name LA GRANGE Type of Dam GRAVITY ARCH Dam No. 68-2

County STANISLAUS Hazard Class 3 Total Class Weight 22

Located on TUOLUMNE Tributary to San Joaquin River

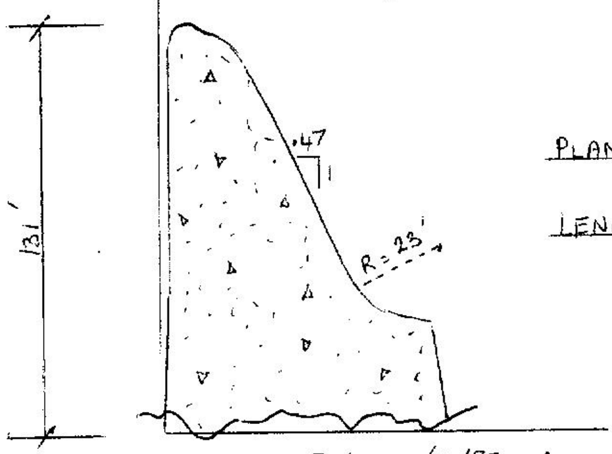
I. DRAINAGE BASIN

1. Drainage Area - Sq. Mi. 1548.0 ✓
2. Impaired? Yes ✓
3. Mean Elevation - USGS 5000.0
4. Mean Latitude 37° 54'
5. Mean Longitude 120° 17'
6. Annual Precip. - In. 42.0 (Weighted)
7. Elevation Index N/A
8. Cover Factor, C N/A

II. DAM AND RESERVOIR

1. Reservoir Area @ S/W-Ac 58.0 ✓
2. Res. Capac. to S/W-AF 500.0 ✓
3. Surcharge Storage - AF 0
4. Spillway Crest El.- USGS 296.46
5. Dam Crest El.- USGS 296.46
6. a. Total Freeboard 0
   b. Operating Freeboard 0
7. Max. Storage Level 296.46
8. Gating Code 1
9. Spillway Rating Q = $CLH^{3/2}$

Sketch of Spillway, according to drawing titled "2 ft increased in height of La Grange dam" Date August 1930 Revised Sept 30, 1930



PLAN VIEW RADIUS = 300'

LENGTH of CREST = 310'

Calculated by GJ DEnzler Date 5/9/85 Approved by Ballitt Project Engineer Date 5/23/85

DWR 852 (Rev. 6/82)

Attachment D: HEC-RAS Output Data For 10 and 100 cfs model runs

Source: TID La Grange HEC-RAS Model 2011

HEC-RAS Summary Table

Profile Output Table - Standard Table 1

HEC-RAS Plan: Plan 03 River: Tuolumne River Reach: 01

Rivers = 1
Hydraulic Reaches = 1
River Stations = 124
Plans = 1
Profiles = 2

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
01	12248.66	PF 3	10.00	314.00	314.25	314.14	314.27	0.010110	1.14	8.75	36.97	0.41
01	12248.66	PF 4	100.00	314.00	314.94	314.62	315.06	0.010801	2.76	36.25	42.66	0.53
01	12152.80	PF 3	10.00	311.95	312.19	312.19	312.28	0.064171	2.40	4.16	23.00	1.00
01	12152.80	PF 4	100.00	311.95	312.83	312.83	313.21	0.041454	4.95	20.19	26.94	1.01
01	12052.03	PF 3	10.00	299.05	302.45	299.43	302.45	0.000002	0.07	147.68	61.40	0.01
01	12052.03	PF 4	100.00	299.05	303.43	300.05	303.44	0.000061	0.52	209.74	65.12	0.05
01	11953.07	PF 3	10.00	292.00	302.45		302.45	0.000000	0.01	894.18	117.70	0.00
01	11953.07	PF 4	100.00	292.00	303.44		303.44	0.000001	0.11	1011.39	121.17	0.01
01	11852.53	PF 3	10.00	294.14	302.45		302.45	0.000000	0.01	823.52	134.33	0.00
01	11852.53	PF 4	100.00	294.14	303.44		303.44	0.000001	0.11	957.99	138.68	0.01
01	11752.77	PF 3	10.00	297.47	302.45		302.45	0.000000	0.03	437.43	112.39	0.00

01	11752.77	PF 4	100.00	297.47	303.44		303.44	0.000006	0.20	550.33	117.67	0.02
01	11653.47	PF 3	10.00	301.82	302.45		302.45	0.000565	0.42	24.44	54.85	0.11
01	11653.47	PF 4	100.00	301.82	303.41		303.43	0.001293	1.26	85.81	72.47	0.20
01	11552.81	PF 3	10.00	302.00	302.17	302.17	302.26	0.066826	2.27	4.40	27.31	1.00
01	11552.81	PF 4	100.00	302.00	302.73	302.73	303.02	0.044366	4.33	23.12	40.16	1.00
01	11452.99	PF 3	10.00	298.00	298.36	298.09	298.36	0.000789	0.40	25.91	80.54	0.12
01	11452.99	PF 4	100.00	298.00	299.00	298.39	299.03	0.002026	1.31	81.49	91.02	0.23
01	11352.50	PF 3	10.00	298.00	298.06	298.06	298.10	0.100184	1.46	6.83	111.18	1.04
01	11352.50	PF 4	100.00	298.00	298.29	298.29	298.44	0.054667	3.06	32.77	113.04	1.00
01	11253.02	PF 3	10.00	285.58	296.46	286.24	296.46	0.000000	0.03	305.13	36.00	0.00
01	11253.02	PF 4	100.00	285.58	296.47	287.47	296.47	0.000011	0.33	305.54	36.00	0.02
01	11152.84	PF 3	10.00	282.36	296.46		296.46	0.000000	0.01	1226.58	118.06	0.00
01	11152.84	PF 4	100.00	282.36	296.47		296.47	0.000000	0.08	1228.04	118.10	0.00
01	11052.94	PF 3	10.00	287.01	296.46		296.46	0.000000	0.02	614.89	91.40	0.00
01	11052.94	PF 4	100.00	287.01	296.47		296.47	0.000003	0.16	615.99	91.45	0.01
01	10952.46	PF 3	10.00	285.31	296.46		296.46	0.000000	0.02	559.31	115.44	0.00

01	10952.46	PF 4	100.00	285.31	296.47		296.47	0.000001	0.18	560.64
115.54	0.01									
01	10852.50	PF 3	10.00	286.08	296.46		296.46	0.000000	0.01	803.53
115.16	0.00									
01	10852.50	PF 4	100.00	286.08	296.47		296.47	0.000001	0.12	804.85
115.22	0.01									
01	10752.41	PF 3	10.00	272.90	296.46		296.46	0.000000	0.01	1183.45
107.44	0.00									
01	10752.41	PF 4	100.00	272.90	296.47		296.47	0.000000	0.08	1184.68
107.53	0.00									
01	10653.34	PF 3	10.00	266.67	296.46		296.46	0.000000	0.01	1931.14
101.75	0.00									
01	10653.34	PF 4	100.00	266.67	296.47		296.47	0.000000	0.05	1932.31
101.77	0.00									
01	10552.56	PF 3	10.00	262.90	296.46		296.46	0.000000	0.01	1563.83
73.48	0.00									
01	10552.56	PF 4	100.00	262.90	296.47		296.47	0.000000	0.06	1564.67
73.50	0.00									
01	10452.52	PF 3	10.00	277.08	296.46		296.46	0.000000	0.01	1122.46
85.18	0.00									
01	10452.52	PF 4	100.00	277.08	296.47		296.47	0.000000	0.09	1123.43
85.20	0.00									
01	10352.47	PF 3	10.00	284.25	296.46		296.46	0.000000	0.01	887.82
97.10	0.00									
01	10352.47	PF 4	100.00	284.25	296.47		296.47	0.000001	0.11	888.92
97.12	0.01									
01	10252.46	PF 3	10.00	281.16	296.46		296.46	0.000000	0.01	1353.77
138.06	0.00									
01	10252.46	PF 4	100.00	281.16	296.47		296.47	0.000000	0.07	1355.32
138.09	0.00									
01	10153.17	PF 3	10.00	279.57	296.46		296.46	0.000000	0.01	1315.15
146.51	0.00									

HEC-RAS Summary Table

01	10153.17	PF 4	100.00	279.57	296.47	296.47	0.000000	0.08	1316.80	146.59	0.00
01	10052.40	PF 3	10.00	279.22	296.46	296.46	0.000000	0.01	1379.50	122.50	0.00
01	10052.40	PF 4	100.00	279.22	296.47	296.47	0.000000	0.07	1380.87	122.54	0.00
01	9952.308	PF 3	10.00	280.27	296.46	296.46	0.000000	0.01	1449.47	120.95	0.00
01	9952.308	PF 4	100.00	280.27	296.47	296.47	0.000000	0.07	1450.83	120.99	0.00
01	9852.591	PF 3	10.00	267.65	296.46	296.46	0.000000	0.01	1459.45	99.16	0.00
01	9852.591	PF 4	100.00	267.65	296.47	296.47	0.000000	0.07	1460.56	99.37	0.00
01	9753.061	PF 3	10.00	266.35	296.46	296.46	0.000000	0.00	2502.15	116.81	0.00
01	9753.061	PF 4	100.00	266.35	296.47	296.47	0.000000	0.04	2503.45	116.83	0.00
01	9653.100	PF 3	10.00	273.33	296.46	296.46	0.000000	0.00	2087.89	132.91	0.00
01	9653.100	PF 4	100.00	273.33	296.47	296.47	0.000000	0.05	2089.38	132.94	0.00
01	9552.933	PF 3	10.00	277.08	296.46	296.46	0.000000	0.01	1553.18	109.32	0.00
01	9552.933	PF 4	100.00	277.08	296.47	296.47	0.000000	0.06	1554.40	109.35	0.00
01	9453.291	PF 3	10.00	277.16	296.46	296.46	0.000000	0.01	1310.36	100.36	0.00
01	9453.291	PF 4	100.00	277.16	296.47	296.47	0.000000	0.08	1311.47	100.38	0.00
01	9352.654	PF 3	10.00	280.91	296.46	296.46	0.000000	0.01	1553.72	113.14	0.00

01	9352.654	PF 4	100.00	280.91	296.47		296.47	0.000000	0.06	1554.97	113.15	0.00
01	9252.535	PF 3	10.00	277.05	296.46		296.46	0.000000	0.01	1983.97	168.19	0.00
01	9252.535	PF 4	100.00	277.05	296.47		296.47	0.000000	0.05	1985.84	168.26	0.00
01	9153.051	PF 3	10.00	259.60	296.46		296.46	0.000000	0.00	3109.94	127.36	0.00
01	9153.051	PF 4	100.00	259.60	296.47		296.47	0.000000	0.03	3111.35	127.38	0.00
01	9052.961	PF 3	10.00	258.00	296.46		296.46	0.000000	0.00	2642.38	101.32	0.00
01	9052.961	PF 4	100.00	258.00	296.47		296.47	0.000000	0.04	2643.51	101.34	0.00
01	8952.710	PF 3	10.00	259.64	296.46		296.46	0.000000	0.00	2611.55	107.48	0.00
01	8952.710	PF 4	100.00	259.64	296.47		296.47	0.000000	0.04	2612.74	107.50	0.00
01	8853.159	PF 3	10.00	268.87	296.46		296.46	0.000000	0.01	1947.23	108.72	0.00
01	8853.159	PF 4	100.00	268.87	296.47		296.47	0.000000	0.05	1948.44	108.75	0.00
01	8752.915	PF 3	10.00	266.65	296.46		296.46	0.000000	0.00	2348.19	128.94	0.00
01	8752.915	PF 4	100.00	266.65	296.47		296.47	0.000000	0.04	2349.62	128.98	0.00
01	8653.603	PF 3	10.00	257.15	296.46		296.46	0.000000	0.00	2721.08	106.90	0.00
01	8653.603	PF 4	100.00	257.15	296.47		296.47	0.000000	0.04	2722.26	106.94	0.00
01	8553.380	PF 3	10.00	259.63	296.46		296.46	0.000000	0.00	3175.13	119.23	0.00

HEC-RAS Summary Table

01	8553.380	PF 4	100.00	259.63	296.47	296.47	0.000000	0.03	3176.45
119.25	0.00								
01	8452.511	PF 3	10.00	269.29	296.46	296.46	0.000000	0.00	2598.20
123.43	0.00								
01	8452.511	PF 4	100.00	269.29	296.47	296.47	0.000000	0.04	2599.57
123.45	0.00								
01	8353.335	PF 3	10.00	267.54	296.46	296.46	0.000000	0.00	2382.16
107.56	0.00								
01	8353.335	PF 4	100.00	267.54	296.47	296.47	0.000000	0.04	2383.35
107.58	0.00								
01	8253.062	PF 3	10.00	261.75	296.46	296.46	0.000000	0.00	2473.58
85.50	0.00								
01	8253.062	PF 4	100.00	261.75	296.47	296.47	0.000000	0.05	2474.52
85.51	0.00								
01	8152.658	PF 3	10.00	264.88	296.46	296.46	0.000000	0.00	2250.16
123.51	0.00								
01	8152.658	PF 4	100.00	264.88	296.47	296.47	0.000000	0.04	2251.52
123.55	0.00								
01	8053.315	PF 3	10.00	271.86	296.46	296.46	0.000000	0.00	2143.57
143.14	0.00								
01	8053.315	PF 4	100.00	271.86	296.47	296.47	0.000000	0.05	2145.15
143.19	0.00								
01	7953.628	PF 3	10.00	278.94	296.46	296.46	0.000000	0.01	1914.35
157.45	0.00								
01	7953.628	PF 4	100.00	278.94	296.47	296.47	0.000000	0.05	1916.10
157.50	0.00								
01	7852.686	PF 3	10.00	274.09	296.46	296.46	0.000000	0.01	1891.69
164.79	0.00								
01	7852.686	PF 4	100.00	274.09	296.47	296.47	0.000000	0.05	1893.52
164.87	0.00								
01	7753.077	PF 3	10.00	275.59	296.46	296.46	0.000000	0.01	1351.63
131.74	0.00								

HEC-RAS Summary Table

01	7753.077	PF 4	100.00	275.59	296.47	296.47	0.000000	0.07	1353.08
131.81	0.00								
01	7653.309	PF 3	10.00	272.39	296.46	296.46	0.000000	0.01	1456.75
120.17	0.00								
01	7653.309	PF 4	100.00	272.39	296.47	296.47	0.000000	0.07	1458.07
120.22	0.00								
01	7553.430	PF 3	10.00	279.39	296.46	296.46	0.000000	0.01	1676.33
164.26	0.00								
01	7553.430	PF 4	100.00	279.39	296.47	296.47	0.000000	0.06	1678.13
164.34	0.00								
01	7453.104	PF 3	10.00	274.83	296.46	296.46	0.000000	0.00	2158.09
206.51	0.00								
01	7453.104	PF 4	100.00	274.83	296.47	296.47	0.000000	0.05	2160.36
206.59	0.00								
01	7352.605	PF 3	10.00	276.78	296.46	296.46	0.000000	0.00	2093.98
192.20	0.00								
01	7352.605	PF 4	100.00	276.78	296.47	296.47	0.000000	0.05	2096.08
192.25	0.00								
01	7252.172	PF 3	10.00	278.75	296.46	296.46	0.000000	0.00	2413.26
177.44	0.00								
01	7252.172	PF 4	100.00	278.75	296.47	296.47	0.000000	0.04	2415.21
177.48	0.00								
01	7152.505	PF 3	10.00	276.06	296.46	296.46	0.000000	0.00	2571.22
167.10	0.00								
01	7152.505	PF 4	100.00	276.06	296.47	296.47	0.000000	0.04	2573.05
167.14	0.00								
01	7053.227	PF 3	10.00	271.46	296.46	296.46	0.000000	0.00	2582.19
177.35	0.00								
01	7053.227	PF 4	100.00	271.46	296.47	296.47	0.000000	0.04	2584.14
177.40	0.00								
01	6953.108	PF 3	10.00	274.62	296.46	296.46	0.000000	0.00	2397.20
186.28	0.00								

01	6953.108	PF 4	100.00	274.62	296.47	296.47	0.000000	0.04	2399.24	
									186.33	0.00
01	6852.407	PF 3	10.00	277.64	296.46	296.46	0.000000	0.00	2611.87	
									209.21	0.00
01	6852.407	PF 4	100.00	277.64	296.47	296.47	0.000000	0.04	2614.17	
									209.30	0.00
01	6752.354	PF 3	10.00	279.85	296.46	296.46	0.000000	0.00	2469.70	
									221.22	0.00
01	6752.354	PF 4	100.00	279.85	296.47	296.47	0.000000	0.04	2472.13	
									221.32	0.00
01	6652.854	PF 3	10.00	282.54	296.46	296.46	0.000000	0.00	2442.74	
									257.52	0.00
01	6652.854	PF 4	100.00	282.54	296.47	296.47	0.000000	0.04	2445.56	
									257.62	0.00
01	6552.841	PF 3	10.00	283.81	296.46	296.46	0.000000	0.00	2170.56	
									236.81	0.00
01	6552.841	PF 4	100.00	283.81	296.47	296.47	0.000000	0.05	2173.16	
									236.88	0.00
01	6452.963	PF 3	10.00	284.16	296.46	296.46	0.000000	0.01	1965.81	
									201.40	0.00
01	6452.963	PF 4	100.00	284.16	296.47	296.47	0.000000	0.05	1968.02	
									201.45	0.00
01	6353.270	PF 3	10.00	282.82	296.46	296.46	0.000000	0.00	2082.48	
									206.19	0.00
01	6353.270	PF 4	100.00	282.82	296.47	296.47	0.000000	0.05	2084.74	
									206.25	0.00
01	6306.106	PF 3	10.00	282.01	296.46	296.46	0.000000	0.01	1606.70	
									232.04	0.00
01	6306.106	PF 4	100.00	282.01	296.47	296.47	0.000000	0.06	1609.23	
									232.11	0.00
01	6254.747	PF 3	10.00	283.26	296.46	296.46	0.000000	0.01	1120.65	
									275.24	0.00

HEC-RAS Summary Table

01	6254.747	PF 4	100.00	283.26	296.47	296.47	0.000001	0.09	1123.63	275.31 0.01
01	6203.752	PF 3	10.00	284.05	296.46	296.46	0.000000	0.01	827.71	190.60 0.00
01	6203.752	PF 4	100.00	284.05	296.47	296.47	0.000002	0.12	829.74	190.78 0.01
01	6152.725	PF 3	10.00	287.11	296.46	296.46	0.000000	0.01	694.25	198.31 0.00
01	6152.725	PF 4	100.00	287.11	296.47	296.47	0.000005	0.14	696.31	198.43 0.01
01	6103.036	PF 3	10.00	291.79	296.46	296.46	0.000000	0.02	524.06	191.94 0.00
01	6103.036	PF 4	100.00	291.79	296.47	296.47	0.000011	0.19	525.94	192.04 0.02
01	6053.125	PF 3	10.00	293.05	296.46	296.46	0.000000	0.02	453.25	187.46 0.00
01	6053.125	PF 4	100.00	293.05	296.47	296.47	0.000017	0.22	454.91	187.61 0.02
01	6004.700	PF 3	10.00	292.40	296.46	296.46	0.000000	0.02	477.73	171.80 0.00
01	6004.700	PF 4	100.00	292.40	296.47	296.47	0.000013	0.21	479.14	171.91 0.02
01	5952.152	PF 3	10.00	292.64	296.46	296.46	0.000000	0.02	448.58	180.56 0.00
01	5952.152	PF 4	100.00	292.64	296.47	296.47	0.000017	0.22	449.90	180.68 0.02
01	5905.513	PF 3	10.00	281.57	296.46	296.46	0.000000	0.01	1369.15	233.33 0.00
01	5905.513	PF 4	100.00	281.57	296.47	296.47	0.000001	0.07	1370.95	233.38 0.01
01	5853.087	PF 3	10.00	281.74	296.46	296.46	0.000000	0.00	2061.14	322.84 0.00

01	5853.087	PF 4	100.00	281.74	296.47	296.47	0.000000	0.05	2063.64
322.91	0.00								
01	5803.897	PF 3	10.00	286.74	296.46	296.46	0.000000	0.00	2030.99
507.57	0.00								
01	5803.897	PF 4	100.00	286.74	296.47	296.47	0.000000	0.05	2034.91
507.61	0.00								
01	5752.783	PF 3	10.00	292.51	296.46	296.46	0.000000	0.01	811.80
263.76	0.00								
01	5752.783	PF 4	100.00	292.51	296.47	296.47	0.000005	0.15	813.74
264.15	0.01								
01	5653.746	PF 3	10.00	288.85	296.46	296.46	0.000000	0.01	872.41
228.49	0.00								
01	5653.746	PF 4	100.00	288.85	296.47	296.47	0.000003	0.11	874.02
228.59	0.01								
01	5550.736	PF 3	10.00	292.75	296.46	296.46	0.000000	0.02	421.08
154.78	0.00								
01	5550.736	PF 4	100.00	292.75	296.47	296.47	0.000017	0.24	421.97
154.87	0.03								
01	5454.063	PF 3	10.00	292.67	296.46	296.46	0.000000	0.02	485.72
157.77	0.00								
01	5454.063	PF 4	100.00	292.67	296.46	296.47	0.000011	0.21	486.45
157.82	0.02								
01	5352.315	PF 3	10.00	292.72	296.46	296.46	0.000000	0.02	586.41
209.38	0.00								
01	5352.315	PF 4	100.00	292.72	296.46	296.46	0.000008	0.17	587.22
209.46	0.02								
01	5253.451	PF 3	10.00	292.14	296.46	296.46	0.000000	0.02	580.75
200.41	0.00								
01	5253.451	PF 4	100.00	292.14	296.46	296.46	0.000008	0.17	581.36
200.47	0.02								
01	5152.751	PF 3	10.00	291.30	296.46	296.46	0.000000	0.02	639.34
179.69	0.00								

01	5152.751	PF 4	100.00	291.30	296.46		296.46	0.000003	0.16	639.78	179.71	0.01
01	5052.860	PF 3	10.00	291.24	296.46		296.46	0.000000	0.01	780.20	203.19	0.00
01	5052.860	PF 4	100.00	291.24	296.46		296.46	0.000003	0.13	780.64	203.21	0.01
01	4951.887	PF 3	10.00	291.26	296.46		296.46	0.000000	0.01	883.62	220.55	0.00
01	4951.887	PF 4	100.00	291.26	296.46		296.46	0.000002	0.11	884.05	220.57	0.01
01	4853.206	PF 3	10.00	289.11	296.46		296.46	0.000000	0.01	964.67	187.25	0.00
01	4853.206	PF 4	100.00	289.11	296.46		296.46	0.000001	0.10	965.01	187.27	0.01
01	4752.622	PF 3	10.00	290.78	296.46		296.46	0.000000	0.01	694.62	168.76	0.00
01	4752.622	PF 4	100.00	290.78	296.46		296.46	0.000004	0.14	694.85	168.77	0.01
01	4652.081	PF 3	10.00	289.55	296.46		296.46	0.000000	0.01	790.47	161.04	0.00
01	4652.081	PF 4	100.00	289.55	296.46		296.46	0.000002	0.13	790.66	161.05	0.01
01	4552.893	PF 3	10.00	283.89	296.46		296.46	0.000000	0.01	901.58	160.88	0.00
01	4552.893	PF 4	100.00	283.89	296.46		296.46	0.000001	0.11	901.75	160.88	0.01
01	4451.251	PF 3	10.00	281.10	296.46		296.46	0.000000	0.01	1124.00	156.06	0.00
01	4451.251	PF 4	100.00	281.10	296.46		296.46	0.000001	0.09	1124.16	156.07	0.01
01	4352.007	PF 3	10.00	284.87	296.46		296.46	0.000000	0.01	937.53	145.22	0.00

HEC-RAS Summary Table

01	4352.007	PF 4	100.00	284.87	296.46		296.46	0.000001	0.11	937.66	145.23	0.01
01	4254.511	PF 3	10.00	280.31	296.46		296.46	0.000000	0.01	1052.39	142.29	0.00
01	4254.511	PF 4	100.00	280.31	296.46		296.46	0.000001	0.10	1052.51	142.30	0.01
01	4152.314	PF 3	10.00	284.17	296.46		296.46	0.000000	0.01	862.87	139.21	0.00
01	4152.314	PF 4	100.00	284.17	296.46		296.46	0.000001	0.12	862.96	139.21	0.01
01	4054.496	PF 3	10.00	289.04	296.46		296.46	0.000000	0.01	846.34	182.97	0.00
01	4054.496	PF 4	100.00	289.04	296.46		296.46	0.000001	0.12	846.43	182.98	0.01
01	3952.820	PF 3	10.00	290.73	296.46		296.46	0.000000	0.01	946.89	215.56	0.00
01	3952.820	PF 4	100.00	290.73	296.46		296.46	0.000001	0.11	946.94	215.57	0.01
01	3853.731	PF 3	10.00	288.94	296.46		296.46	0.000000	0.01	1152.51	221.11	0.00
01	3853.731	PF 4	100.00	288.94	296.46		296.46	0.000001	0.09	1152.55	221.11	0.01
01	3753.923	PF 3	10.00	288.00	296.46		296.46	0.000000	0.01	1225.37	211.02	0.00
01	3753.923	PF 4	100.00	288.00	296.46		296.46	0.000001	0.08	1225.40	211.02	0.01
01	3653.709	PF 3	10.00	286.22	296.46		296.46	0.000000	0.01	1394.29	211.20	0.00
01	3653.709	PF 4	100.00	286.22	296.46		296.46	0.000000	0.07	1394.30	211.20	0.00
01	3552.729	PF 3	10.00	282.06	296.46		296.46	0.000000	0.01	1549.74	232.47	0.00

HEC-RAS Summary Table

01	3552.729	PF 4	100.00	282.06	296.46		296.46	0.000000	0.06	1549.74	232.47	0.00
01	3451.923	PF 3	10.00	282.20	296.46		296.46	0.000000	0.01	1852.92	268.18	0.00
01	3451.923	PF 4	100.00	282.20	296.46		296.46	0.000000	0.05	1852.93	268.18	0.00
01	3352.522	PF 3	10.00	275.31	296.46		296.46	0.000000	0.00	2649.81	265.04	0.00
01	3352.522	PF 4	100.00	275.31	296.46		296.46	0.000000	0.04	2649.81	265.04	0.00
01	3252.603	PF 3	10.00	271.21	296.46		296.46	0.000000	0.00	2832.79	236.78	0.00
01	3252.603	PF 4	100.00	271.21	296.46		296.46	0.000000	0.04	2832.79	236.78	0.00
01	3154.309	PF 3	10.00	282.81	296.46		296.46	0.000000	0.00	2140.66	225.07	0.00
01	3154.309	PF 4	100.00	282.81	296.46		296.46	0.000000	0.05	2140.66	225.07	0.00
01	3052.674	PF 3	10.00	279.85	296.46		296.46	0.000000	0.01	1794.34	202.53	0.00
01	3052.674	PF 4	100.00	279.85	296.46		296.46	0.000000	0.06	1794.33	202.53	0.00
01	2952.984	PF 3	10.00	262.07	296.46		296.46	0.000000	0.00	5270.90	227.92	0.00
01	2952.984	PF 4	100.00	262.07	296.46		296.46	0.000000	0.02	5270.90	227.92	0.00
01	2852.270	PF 3	10.00	270.19	296.46		296.46	0.000000	0.00	4958.36	242.12	0.00
01	2852.270	PF 4	100.00	270.19	296.46		296.46	0.000000	0.02	4958.36	242.12	0.00
01	2752.238	PF 3	10.00	276.01	296.46		296.46	0.000000	0.00	3371.95	214.14	0.00

01	2752.238	PF 4	100.00	276.01	296.46	296.46	0.000000	0.03	3371.95
214.14	0.00								
01	2652.964	PF 3	10.00	280.58	296.46	296.46	0.000000	0.00	2786.96
225.02	0.00								
01	2652.964	PF 4	100.00	280.58	296.46	296.46	0.000000	0.04	2786.95
225.02	0.00								
01	2553.181	PF 3	10.00	280.00	296.46	296.46	0.000000	0.00	2816.69
254.68	0.00								
01	2553.181	PF 4	100.00	280.00	296.46	296.46	0.000000	0.04	2816.68
254.68	0.00								
01	2452.388	PF 3	10.00	280.65	296.46	296.46	0.000000	0.00	2867.69
273.52	0.00								
01	2452.388	PF 4	100.00	280.65	296.46	296.46	0.000000	0.03	2867.69
273.52	0.00								
01	2352.789	PF 3	10.00	280.16	296.46	296.46	0.000000	0.00	3189.69
269.97	0.00								
01	2352.789	PF 4	100.00	280.16	296.46	296.46	0.000000	0.03	3189.69
269.97	0.00								
01	2253.253	PF 3	10.00	282.06	296.46	296.46	0.000000	0.00	3058.13
288.40	0.00								
01	2253.253	PF 4	100.00	282.06	296.46	296.46	0.000000	0.03	3058.12
288.40	0.00								
01	2153.031	PF 3	10.00	276.77	296.46	296.46	0.000000	0.00	3956.27
281.63	0.00								
01	2153.031	PF 4	100.00	276.77	296.46	296.46	0.000000	0.03	3956.27
281.63	0.00								
01	2052.562	PF 3	10.00	274.48	296.46	296.46	0.000000	0.00	4181.19
245.51	0.00								
01	2052.562	PF 4	100.00	274.48	296.46	296.46	0.000000	0.02	4181.19
245.51	0.00								
01	1953.647	PF 3	10.00	265.28	296.46	296.46	0.000000	0.00	3482.41
220.58	0.00								

01	1953.647	PF 4	100.00	265.28	296.46		296.46	0.000000	0.03	3482.41	
220.58	0.00										
01	1853.095	PF 3	10.00	265.94	296.46		296.46	0.000000	0.00	3773.62	
213.56	0.00										
01	1853.095	PF 4	100.00	265.94	296.46		296.46	0.000000	0.03	3773.62	
213.56	0.00										
01	1752.339	PF 3	10.00	271.64	296.46		296.46	0.000000	0.00	4451.78	
233.81	0.00										
01	1752.339	PF 4	100.00	271.64	296.46		296.46	0.000000	0.02	4451.78	
233.81	0.00										
01	1652.697	PF 3	10.00	273.26	296.46		296.46	0.000000	0.00	4047.10	
243.85	0.00										
01	1652.697	PF 4	100.00	273.26	296.46		296.46	0.000000	0.02	4047.10	
243.85	0.00										
01	1553.469	PF 3	10.00	276.35	296.46		296.46	0.000000	0.00	3640.21	
233.05	0.00										
01	1553.469	PF 4	100.00	276.35	296.46		296.46	0.000000	0.03	3640.21	
233.05	0.00										
01	1452.101	PF 3	10.00	273.25	296.46		296.46	0.000000	0.00	4177.50	
261.70	0.00										
01	1452.101	PF 4	100.00	273.25	296.46		296.46	0.000000	0.02	4177.50	
261.70	0.00										
01	1353.043	PF 3	10.00	271.33	296.46		296.46	0.000000	0.00	5364.78	
326.21	0.00										
01	1353.043	PF 4	100.00	271.33	296.46		296.46	0.000000	0.02	5364.78	
326.21	0.00										
01	1253.101	PF 3	10.00	271.58	296.46		296.46	0.000000	0.00	4900.06	
323.52	0.00										
01	1253.101	PF 4	100.00	271.58	296.46		296.46	0.000000	0.02	4900.06	
323.52	0.00										
01	1153.199	PF 3	10.00	276.88	296.46		296.46	0.000000	0.00	4160.34	
287.36	0.00										

01	1153.199	PF 4	100.00	276.88	296.46		296.46	0.000000	0.02	4160.34	287.36	0.00
01	1052.517	PF 3	10.00	277.98	296.46		296.46	0.000000	0.00	4042.26	294.02	0.00
01	1052.517	PF 4	100.00	277.98	296.46		296.46	0.000000	0.02	4042.26	294.02	0.00
01	952.8556	PF 3	10.00	278.89	296.46		296.46	0.000000	0.00	3749.85	334.41	0.00
01	952.8556	PF 4	100.00	278.89	296.46		296.46	0.000000	0.03	3749.85	334.41	0.00
01	853.8458	PF 3	10.00	278.81	296.46		296.46	0.000000	0.00	3841.13	367.55	0.00
01	853.8458	PF 4	100.00	278.81	296.46		296.46	0.000000	0.03	3841.13	367.55	0.00
01	752.5596	PF 3	10.00	277.87	296.46		296.46	0.000000	0.00	3889.46	390.67	0.00
01	752.5596	PF 4	100.00	277.87	296.46		296.46	0.000000	0.03	3889.46	390.67	0.00
01	654.1551	PF 3	10.00	278.35	296.46		296.46	0.000000	0.00	4960.33	418.65	0.00
01	654.1551	PF 4	100.00	278.35	296.46		296.46	0.000000	0.02	4960.33	418.65	0.00
01	538.1648	PF 3	10.00	277.00	296.46	277.41	296.46	0.000000	0.00	5025.10	435.59	0.00
01	538.1648	PF 4	100.00	277.00	296.46	278.08	296.46	0.000000	0.02	5025.10	435.59	0.00

Enclosure C

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Turlock Irrigation District
Modesto Irrigation District
LaGrange Hydroelectric Project **UL11-1-000**

CERTIFICATE OF SERVICE

I hereby certify that I have this day served, by electronic filing, a letter to Secretary Bose, Federal Energy Regulatory Commission, containing additional information for the Commission's jurisdictional review of the La Grange Hydroelectric Project (UL11-1-000).

Dated this 12th day of April, 2012

Larry Thompson
National Marine Fisheries Service

Document Content(s)