04/02/2015

CITY OF MODESTO

SUTTER TREATMENT FACILITY FEASIBILITY STUDY

FINAL
April 2015

2700 YGNACIO VALLEY ROAD, SUITE 300 • WALNUT CREEK, CALIFORNIA 94598 • P. 925.932.1710 • F. 925.930.0208

CITY OF MODESTO

SUTTER TREATMENT FACILITY
FEASIBILITY STUDY

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

The City of Modesto (City) will be making an important decision regarding the future of the Sutter Avenue Primary Treatment Facilities (Sutter Plant). The primary treatment and solids handling facilities at the Sutter Plant are aging and will require major upgrades to maintain long-term, reliable service. In addition, the Sutter Plant site is vulnerable to flooding from the adjacent Tuolumne River. The Sutter Plant site and its proximity to the river are shown in Figure 1.

Two options for the Sutter Plant were evaluated. The first option (the Sutter Option) is to maintain the primary treatment and solids-handling facilities at the current site. This would entail major upgrades to the facilities and providing flood protection. The second option (the Jennings Option) is to discontinue the use of the primary treatment and solids-handling facilities at the Sutter Plant and replace them with new facilities at the City's Jennings Road Secondary/Tertiary Facilities (Jennings Plant). The Jennings Plant is located about 6.5 miles southwest from Modesto along the San Joaquin River. The Jennings Plant site is shown in Figure 2. The relocation concept was first evaluated in the 2007 Wastewater Master Plan and re-evaluated for the Sutter Plant Facility Layout Plan (FLP) in January 2013.

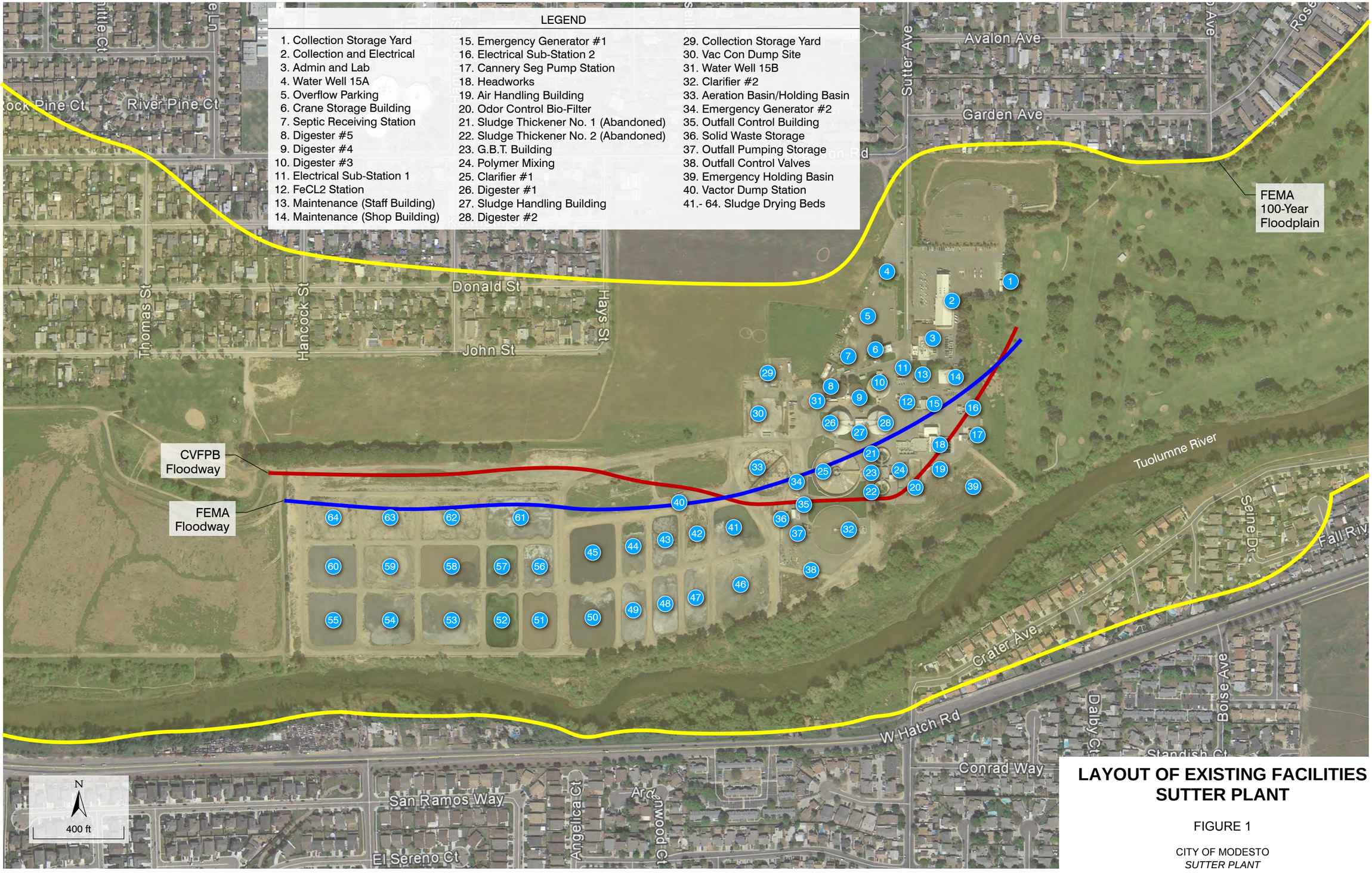
The purpose of the Primary Treatment Facility Relocation Feasibility Study is to further analyze the alternatives to provide the City a basis for selecting one option to be carried forward in the Wastewater Treatment Master Plan, which is currently in progress. The scope of the study includes:

- Perform a peer-review of the analyses performed for the FLP.
- Prepare a flood protection analysis for the Sutter Plant.
- Conduct additional evaluations that resulted from the peer review.
- Perform a preliminary environmental assessment of the Sutter Option.

1.2 Conclusions and Recommendations

The feasibility analysis resulted in the following conclusions and recommendations:

- Flood protection of the Sutter Plant does not appear to be feasible. This is considered a fatal flaw for the Sutter Option.



LAYOUT OF EXISTING FACILITIES SUTTER PLANT

FIGURE 1

CITY OF MODESTO
SUTTER PLANT
SUTTER TREATMENT FACILITY FEASIBILITY STUDY

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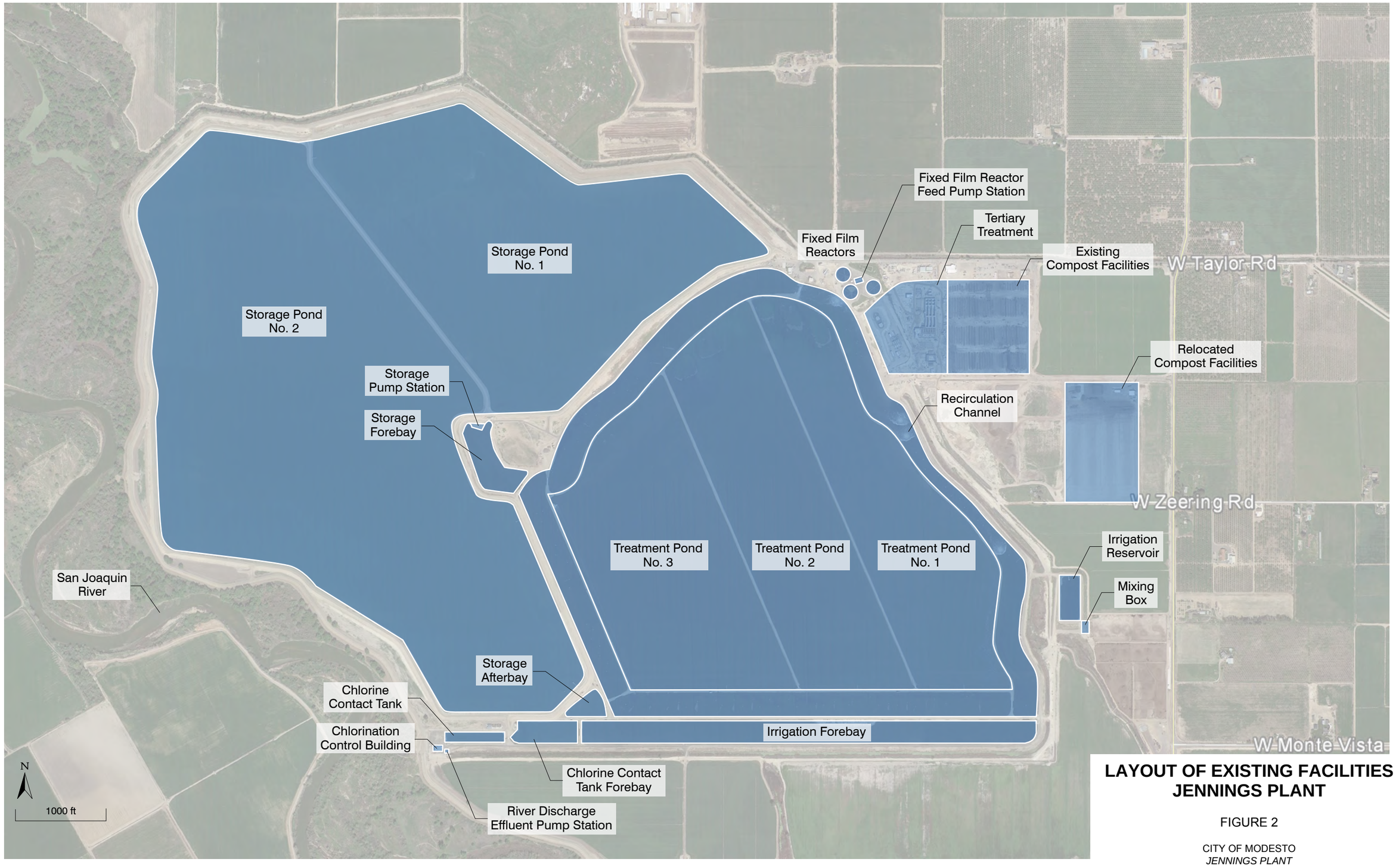

LAYOUT OF EXISTING FACILITIES JENNINGS PLANT

FIGURE 2

CITY OF MODESTO
JENNINGS PLANT
SUTTER TREATMENT FACILITY FEASIBILITY STUDY

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- Continuing to provide primary treatment and solids handling at the Sutter Plant is considered environmentally unsound because of environmental justice considerations stemming from the risk of significant impacts on nearby residences.

- Estimated costs for the Jennings Option are significantly lower than the Sutter Option. As shown in Table 1, the capital cost for the Jennings Option is estimated to be about $29 million less than the Sutter Option. Recurring operation and maintenance (O&M) costs for the Sutter Option are estimated to be about $1.3 million per year more than the Jennings Option. This adds another $16.4 million in equivalent present value dollars. Total life cycle costs, including O&M costs, are estimated to be $45.2 million less for the Jennings Option.

- Based on the above conclusions, the recommendation is to carry the Jennings Option forward for refinement as part of the Wastewater Treatment Master Plan.

Table 1 Cost Comparison – Sutter Option vs. Jennings Option
Sutter Treatment Facility Feasibility Study
City of Modesto

	Sutter Option	Jennings Option
Capital Costs	$128,556,000	$99,660,000
Annual O&M Cost Differential above Jennings Option(1)	$1,313,000/Yr	---
Present Value O&M Cost Differential	$16,362,000	---
Total Present Value	**$144,918,000**	**$99,660,000**

Note:
(1) Sludge hauling, pond dredging at Jennings Plant, and reduced power production potential at the Sutter Plant because waste activated sludge (WAS), and its associated heat value, would not be available to be digested as it would be at the Jennings Plant. All other O&M costs were assumed equal for each option. Refer to Section 5 for detailed cost estimates.

2.0 PEER REVIEW OF FACILITY LAYOUT PLAN

2.1 Introduction

Previous studies identified several challenges associated with maintaining primary treatment and solids handling at the Sutter Plant:

- The primary clarifiers are over 60 years old and the two active anaerobic digesters (steel tanks) are 31 to 46 years old. These facilities need major improvements or replacement will be required to extend their useful life.

- The site is not protected from flooding – a major flood from the Tuolumne River inundated the site in 1997. Per the City's current NPDES permit, the City is prohibited from discharging untreated or partially treated wastewater to the waters of the US,

which would occur in the event of another flood. Additionally, the Standard Provisions of the NPDES permit do not include flooding as an excusable event that would allow the City to release untreated or partially treated wastewater without penalties. Therefore, flood protection should be provided to protect the environment and public health from the release of untreated or partially treated wastewater, as well as prevent enforcement actions from the Regional Water Quality Control Board. The City has established a 100-year storm as the level of protection for the Sutter Plant site. Major flood protection structures and other infrastructure improvements would be required to provide this level of protection. As described in Section 3 of this study, the required flood protection at the Sutter Plant would consist of a concrete floodwall, earthen levees, and excavations of the river bank to widen the cross sectional area of the river channel to reduce floodwater elevations.

- The sludge drying beds at the Sutter Plant are unlined and underlain by pervious, sandy soils. The liquid fraction of the sludge drains into the soil as the sludge dries. The liquid contains ammonia and nitrates that could impact the quality of the groundwater. Heavy metals may also be concentrated in the underlying soils. Continued use of the existing drying beds in their current condition will likely not be permitted by the regulatory agencies in the near future. The waste discharge permit for the sludge drying beds expires in 2015. Based on recent permit renewals for wastewater agencies in the Central Valley, the new permit could include the requirement to line the drying beds with an impermeable liner to protect the water table.

- Flood protection for new drying beds would be required to prevent washout of the solids to the River. This approach would be very costly because the beds are spread over a wide area (21.2 acres) and they are located in the flood plain. Assuming the existing beds will need to be lined, new beds will need to be constructed. To reduce the cost for flood protection, the new drying beds would need to be located further north to higher ground. However, this would place the drying beds closer to residences, which would increase the risk of public exposure to odors and wind-blown solids.

- The new biological nutrient removal (BNR)/tertiary treatment facilities at the Jennings Plant will produce waste activated sludge (WAS), which needs to be treated and removed from the process. Currently, the City is sending WAS from the Phase 1A BNR/Tertiary Facilities to the facultative ponds for processing. Continuing this approach after Phase 2 BNR/Tertiary Facilities are operational will be unsustainable over the long term because the inert solids of the WAS that are not decomposed will remain in the ponds and build up over time. Accumulating solids would reduce the effective treatment volume and capacity of the ponds. Therefore, periodic dredging would be required to maintain treatment capacity for the ponds. The conventional and most cost-effective method to process WAS is to combine it with primary solids and

reduce the organic fraction with the anaerobic digestion process. Anaerobic digesters do not perform well when processing WAS alone; they perform best when processing a mixture of primary solids and WAS. Adding new primary clarifiers at the Jennings Plant would produce the required primary solids to enhance anaerobic digestion of WAS. The digested WAS and primary sludge would be dried in lined drying beds and spread over the City's ranch land at the Jennings Plant each fall after the canning season, as currently practiced. Transporting primary sludge from the Sutter Plant to digesters at the Jennings Plant, either by trucking or pipeline, is not feasible because of the long distance between the plants.

- The Sutter Plant site is bordered on the north by residences, schools, and the future Tuolumne River Regional Park (TRRP). Homes on the south side of the Tuolumne River are also impacted by the Sutter Plant. Continued operation and the required upgrades to renovate the Sutter Plant may be incompatible with surrounding land uses. Of most concern are odors, dust, and wind-blown debris from sludge drying beds, whether in their current location or positioned further to the north. Wind-blown sludge is a potential health concern because the solids could contain residual pathogens.

2.2 Peer Review of the Sutter Facilities Layout Plan (FLP)

The peer review was performed by West Yost & Associates. The scope of the review included the following objectives:

- Identify any potentially erroneous assumptions or conclusions presented in the FLP.
- Review cost estimates and identify potential changes or additions.
- Identify potential "fatal flaws" that would render either alternative infeasible.

The peer review also addressed two additional developments since publication of the FLP:

- The City determined that for the long term, the operation of existing sludge drying beds at Sutter Plant should be discontinued and replaced with new drying beds. High costs to provide flood protection for the current drying beds and potential conflicts with the future TRRP were the basis for this decision. In addition, the new sludge drying beds would need to be located on higher ground to reduce flood protection costs. However, the available land at the higher elevation would be close to residential properties, which would increase the risk of impacts from odors, noise, dust, and wind-blown solids. The peer review study concluded that the most practical approach to handle solids generated at the Sutter Plant would be to mechanically dewater the digested solids (in a contained building equipped with odor control) and haul them directly to the Jennings Plant. Sludge drying beds at the Sutter Plant would be eliminated. New drying beds would be constructed at the Jennings Plant to receive the hauled dewatered sludge and solar-dry the solids. Once dried, the solids would

be spread on the City's ranch land at the Jennings Plant in the fall, as currently practiced.

- Recent updates of the Federal Emergency Management Agency (FEMA) floodway maps now show that all of Primary Clarifier 2 and most of Clarifier 1 are within the floodway, along with the Headworks, Dryden Box, and portions of the associated support infrastructure. Previous FEMA maps used during the preparation of the FLP showed that Clarifier 2 was partially in the floodway and Clarifier 1 was not in the floodway. The FLP suggested that Clarifier 2 be abandoned and replaced by a new clarifier to the north and east on higher ground. However, in light of the new flood maps, the City preferred to maintain the use of Clarifier 2 and provide flood protection around the south end of the plant site to protect as much of the Sutter Plant as possible.

2.3 Peer Review Conclusions

Peer review results are summarized in a technical memorandum (Appendix A). In general, the peer review supported the conclusions in the FLP with regard to the recommendation to relocate the facilities to the Jennings Plant. In addition, the Jennings Option would eliminate potential increased environmental impacts and major flood protection needs associated with maintaining the facilities at the Sutter Plant. The peer review recommended that the Feasibility Study include evaluation of the following additional considerations:

- Land purchase needs at the Jennings Plant site for the relocation of the primary facilities to the Jennings Plant (potential cost above FLP).
- The value of the land at the Sutter Plant that would be required to accommodate the needed facilities (potential cost above FLP).
- Sizing of new primary facilities at the Jennings Plant site for domestic and commercial wastewater as opposed to designing for Can Seg flows (potential savings over FLP).
- Sizing of new solids handling facilities (potential cost above FLP, but still less than a revised cost for the Sutter Option if the same level of treatment and control for the BNR secondary solids is provided in both alternatives).
- Flood protection of remaining facilities and sulfide control at the Sutter Plant site under the relocation alternative (potential cost above FLP).
- Support system requirements at the Jennings Plant site for the proposed primary treatment and solids processing facilities, such as power, plant water, storm drainage, and future laboratory needs (unclear whether this would be a savings or cost increase over the FLP).

- Flood protection requirements at the Jennings Plant site (potential cost above FLP but may be required regardless of which alternative is selected).

3.0 FLOOD PROTECTION ANALYSIS FOR SUTTER PLANT SITE

The purpose of the Flood Protection Analysis (FPA) is to assess the feasibility of constructing a levee or floodwall to protect the Sutter Plant from a 100-year flood. Results of the FPA are presented in Appendix B. The evaluation, performed by HDR, focused on the feasibility of constructing flood protection without causing an upstream rise in the river elevation during flood conditions. The Federal Emergency Management Agency (FEMA) and the Central Valley Flood Protection Board (CVFPB) both have jurisdiction over the Tuolumne River Floodway, and any flood control work along the river bank that would project into the floodway must be permitted by these agencies. FEMA prohibits construction within the floodway that would "…result in any increase in flood levels…" When considering an encroachment permit, the CVFPB must notify nearby residences of the proposed project and any protests may be made in a public hearing. Before approving the permit, the CVFPB will consider public testimony and the degree of the rise in the river level that would result from the encroachment.

3.1 Hydraulic Modeling

The FPA was performed using an existing HEC_RAS hydraulic model of the river and riverbed cross-sections obtained from GIS data. The model was developed for an assumed combination of a vertical floodwall founded on a concrete footing and an earthen levee. The assumed flood protection system is shown in Figure 3. The floodwall was assumed instead of a levee at the narrowest reach of the river to avoid restricting the cross-sectional area of the river channel. Bank cutting downstream of the modeled floodwall was also included in the model to test if widening the river channel would prevent river rise by lowering downstream velocities.

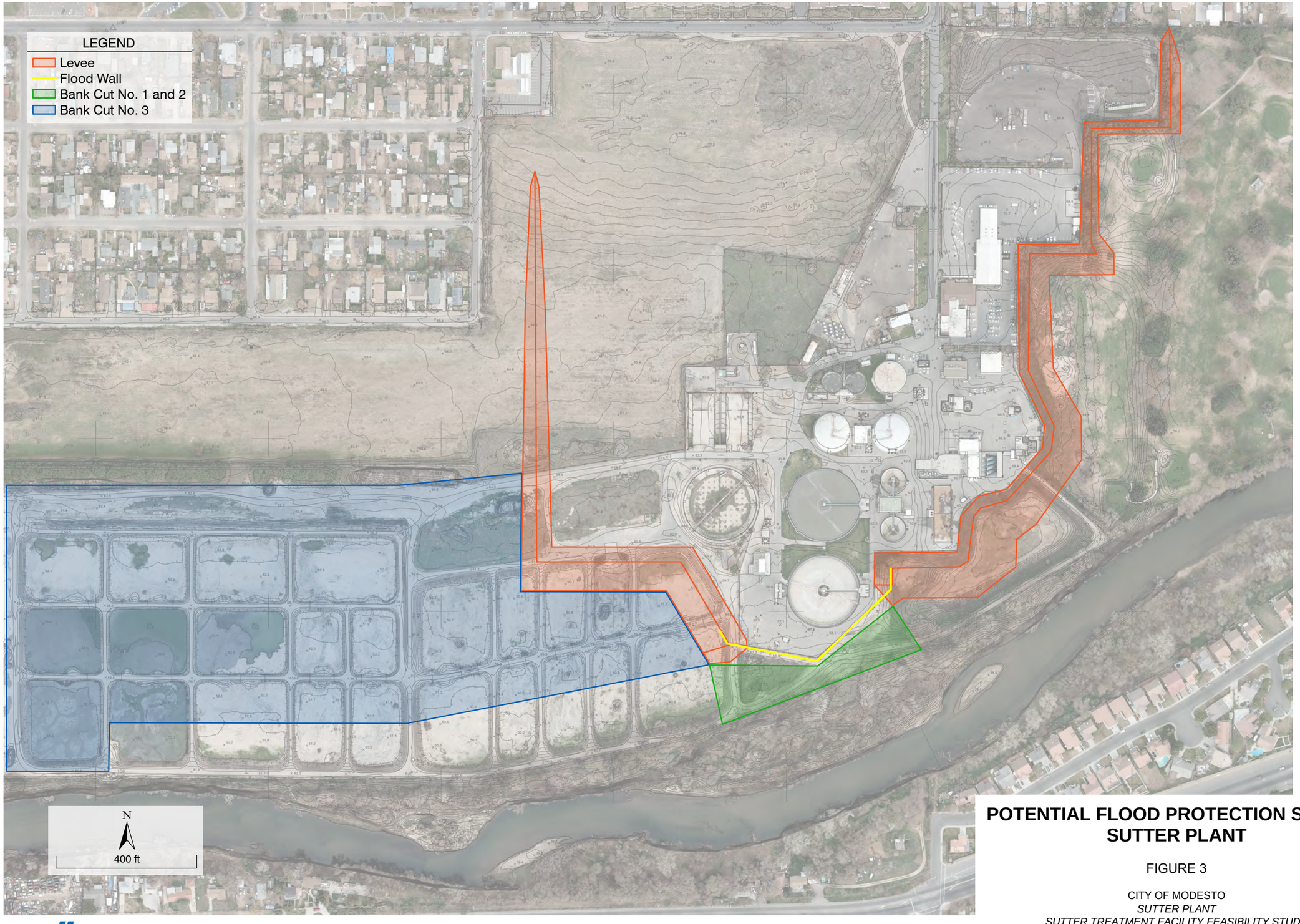
3.2 Seepage Analysis

Because the soils in the Sutter Plant site are believed to be predominately sandy material, a seepage analysis was performed in conjunction with the hydraulic analysis. A finite element model SEEP/W, part of the GeoStudio Version 8.13 software package, was used to model floodwall and levee under seepage. Limited historical geotechnical information was used to simulate actual soils conditions.

3.3 Bank Cutting

Cutting the riverbank downstream of the floodwall/levee system could potentially reduce the upstream rise in the river elevation. Three bank cut scenarios (Figure 3) were modeled:

- Back Cut 1 was made at a 5:1 slope. The cut was setback 30 feet from the floodwall and terminated at the tree line to the south of the floodwall.



POTENTIAL FLOOD PROTECTION SYSTEM SUTTER PLANT

FIGURE 3

CITY OF MODESTO
SUTTER PLANT
SUTTER TREATMENT FACILITY FEASIBILITY STUDY

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- Bank Cut 2 was made at a 3:1 slope starting at about 20 feet from the wall and terminated at the tree line to the south of the floodwall. Moving the cut closer would open up the river channel more and reduce head losses in the river.
- Bank Cut 3, the most aggressive cut, extended the cut line from Cut 2 further west and inland into the area of the existing sludge dying beds. The depth of Cut 3 would match the bottom of the river channel, so it would be equivalent to widening the river channel at this location. The bank cut location also took into consideration the need to minimize disturbance of the soil around the Primary Outfall and Cannery Segregation Line.

It was assumed for all three bank cut scenarios that the cuts would be graded to prevent damage to the elderberry bushes that are growing along the riverbank. Elderberry bushes are indirectly protected under the Endangered Species Act because they are habitats for the Valley elderberry longhorn beetle, which is on the endangered species list. Recently, the U.S. Fish and Wildlife Service considered removing the beetle from the list, but the agency decided not to change its status.

Table 2 summarizes the results of the hydraulic model that simulated excavations of the river bank to widen the river flow path during flooding. Bank Cuts 1 and 2, relatively shallow cuts, did not appreciably reduce the river rise. Bank Cut 3, the deepest cut, also did not eliminate a river rise. It should be noted that the analysis for Bank Cut 3 was based on an approximation – more sophisticated modeling, outside the scope of this study, would be required to improve the accuracy of river rise calculations. Nonetheless, the analysis is a good indication that bank cutting, including the most extreme cut, would not prevent a river rise upstream of the flood protection system.

Table 2 Hydraulic Modeling Results of the Proposed Levee/Floodwall at the Sutter Plant
Sutter Treatment Facility Feasibility Study
City of Modesto

River Bank Cutting Alternative	Upstream River Water Surface Rise (ft)
No Bank Cut	0.55
Bank Cut 1 – 5:1 slope, 30 feet from floodwall	0.47
Bank Cut 2 – 3:1 slope, 20 feet from floodwall	0.44
Bank Cut 3 – Extension of Bank Cut 3 with removal of sludge drying bed area to depth of existing river bottom.	0.11

There are other issues related to the practicality of constructing a flood protection system at the Sutter Plant. Making a deep cut as suggested under the Bank Cut 3 scenario would require extensive permitting, including permits from the U.S. Army Corps of Engineers, California Department of Fish and Wildlife, and the California State Lands Commission. The bank cut would also eliminate a large portion of the planned TRRP land. Further, it is unlikely that flow from sewers that are inundated during flooding can be fully prevented from

overflowing manholes on the Sutter Plant site. Thus, flood water would still circumvent the flood protection system.

3.4 Flood Protection Analysis Summary

Conclusions derived from the hydraulic, seepage, and bank-cutting analyses are as follows:

- For the condition of adding a vertical floodwall, the model calculated an upstream river rise of 0.55 feet. This violates FEMA's requirement to prevent any river rise.
- Neither of the more two modest bank cutting alternatives would eliminate a river rise upstream of the flood protection facilities.
- Bank Cut 3, the most aggressive bank cut scheme, would reduce the river rise to a calculated 0.11 feet. This approximation would need to be verified with a more sophisticated analysis that is beyond the scope of this study. However, the results are an indication that a river rise cannot be eliminated even with this most severe approach. In summary, it can be concluded that bank cutting would not eliminate a river rise.
- The feasibility of making Bank Cut 3 is questionable apart from hydraulic considerations. The challenges of permitting requirements, excessive costs (see Cost Analysis section), and impacts on the TRRP land are likely insurmountable.
- Based on the above findings, providing flood protection at the Sutter Plant is not feasible, which is a fatal flaw for the Sutter Option.

4.0 FLOOD PROTECTION ANALYSIS FOR JENNINGS PLANT SITE

The current FEMA Flood Insurance Rate Map (FIRM) that covers the Jennings Plant is Map Number 06099C0540E (see Figure 4). This FIRM shows that the Facultative Ponds, Recirculation Channel, and Storage Ponds are inside of Special Flood Hazard Areas (SFHAs) subject to inundation by the 1 percent annual chance flood (100-year flood). They are categorized as Zone A, or areas that the 100-year flood elevations have not been determined. The FIRM shows that the area to the east of the East Recirculation Channel, where the FFRs, Phase 1A, and Phase 2 Facilities are located, are in the category of Other Areas and categorized as Zone X, which FEMA defines as "areas determined to be outside the 0.2 percent annual chance floodplain."

A flood risk analysis for the Jennings Plant Site is being performed for the current update to the Wastewater Treatment Master Plan. The analysis will assess the risks of flooding from a 100-year flood event and the risk caused by breaches in the Reclamation District (RD) Levee 2091 and RD Levee 2063 during a 100-year flood event. This analysis will identify the floodway and flood plain at the Jennings Plant Site resulting from a breach of the levee. Additional analysis will be required at the preliminary design level to define the flood protection improvements and costs.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was California State Plane, Zone III. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit their website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from multiple sources. This information was compiled from the National Geodetic Survey, 2002, Federal Emergency Management Agency, 2004, and U.S. Geological Survey, 1989 and 1993. Additional information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated 2002.

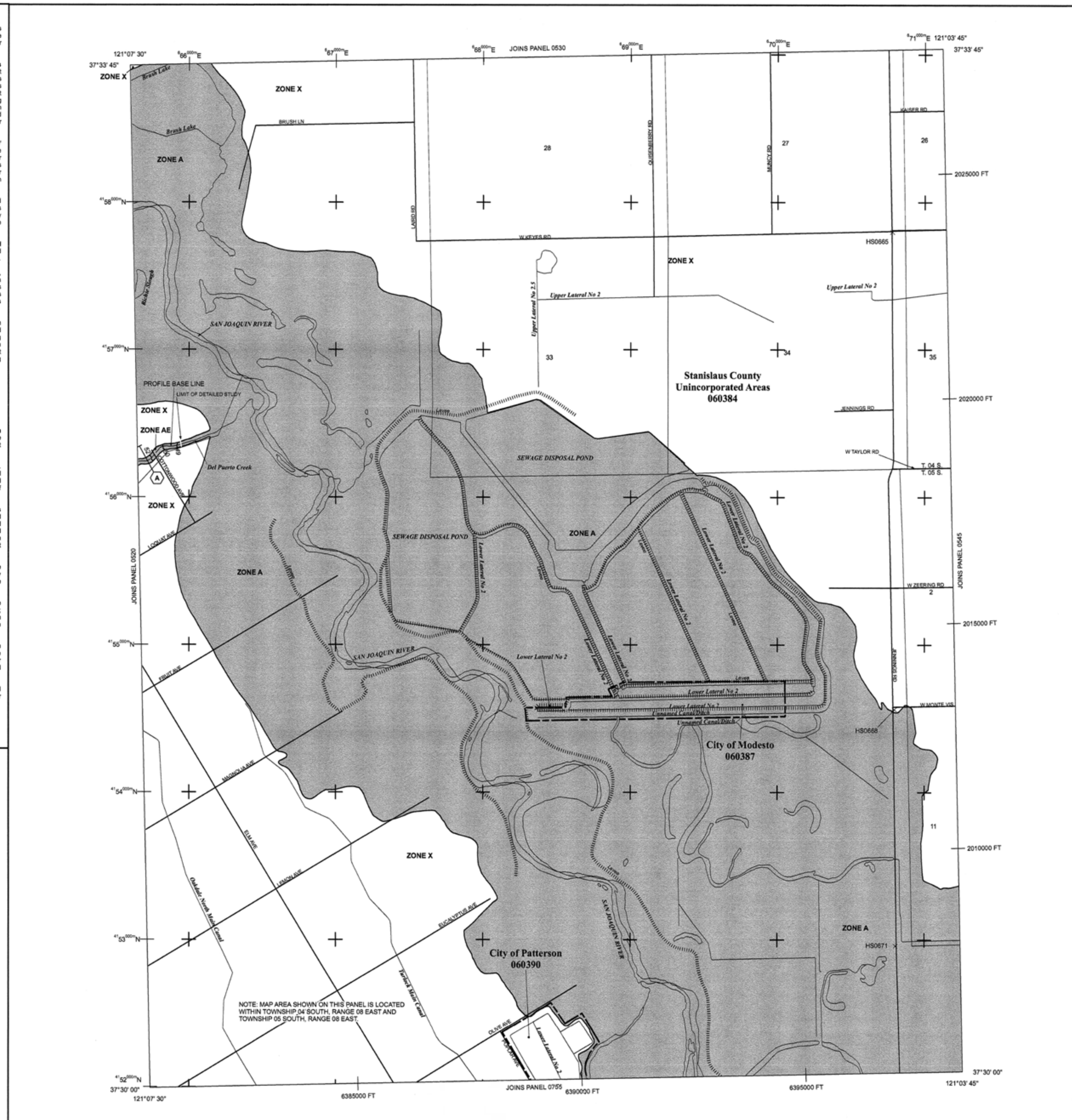
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and their website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA Boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
A—A Cross section line
23- - - -23 Transect line
97° 07' 30", 32° 22' 30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4276000mE — 1000-meter Universal Transverse Mercator grid values, zone 10
600000 FT — 5000-foot grid ticks: California State Plane coordinate system, zone III (FIPSZONE 0403), Lambert Conformal Conic Projection
DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index.

EFFECTIVE DATE OF COUNTYWIDE FLOOD
INSURANCE RATE MAP PANEL
SEPTEMBER 26, 2008

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0540E

FIRM

FLOOD INSURANCE RATE MAP

STANISLAUS COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 540 OF 1075

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MODESTO, CITY OF	060387	0540	E
PATTERSON, CITY OF	060390	0540	E
STANISLAUS COUNTY	060384	0540	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06099C0540E

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

FEMA FLOOD INSURANCE RATE MAP

FIGURE 4

CITY OF MODESTO
JENNINGS PLANT
SUTTER TREATMENT FACILITY FEASIBILITY STUDY

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5.0 ENVIRONMENTAL SCREENING ANALYSIS

West Yost Associates prepared an environmental screening matrix (Appendix C) that lists anticipated environmental and permitting issues associated with maintaining primary treatment operations at the Sutter Plant. The purpose of the screening analysis is to identify potential costly issues and potential fatal flaws to be considered in deciding whether or not treatment operations should continue at the Sutter Plant.

Per the flood protection analysis, it was assumed that a combination of a floodwall and levee would be constructed to protect existing operations other than the existing sludge drying beds. In addition, it is estimated that dewatered sludge would need to be hauled to the Jennings Plant twice a day (at 2030 flow and load conditions).

Environmental constraints that were considered potential fatal flows include:

- **Odors.** Odors from new sludge dewatering facilities (which would be located near residences to the north of the current plant facilities) and from the existing primary clarifiers may be a fatal flaw. Odor control could be provided but such systems have limitations in completely controlling odors, especially for the Sutter Plant because the wastewater contains high levels of odorous hydrogen sulfide that result from long sewer runs in Modesto's expansive collection system.
- **Flood Protection.** Flood control measures may not be feasible with respect to permitting from the State and Federal flood control agencies. In addition, it may not be feasible from a structural point of view, to construct concrete floodwalls and earthen levees without major impacts to the current Sutter Plant as well as the golf course to the east of the site.
- **Environmental Justice**. Environmental justice impacts may include noise, traffic, and air quality (odors and dust).

Environmental mitigations that would require major expenditures include:

- **Flood Protection.** Construction of the flood protection system (floodwall, levees, and riverbank cuts) suggested by the Flood Protection Analysis.
- **Sludge Dewatering Facility**. Construction of a mechanical sludge dewatering facility and haul road would be required to replace the current sludge drying beds. The dewatering facility would need to be designed to mitigate odors, noise, and traffic impacts. A new haul road would be required from the Sutter Plant to Carpenter Road, a distance of about 1.04 miles. The road would need to be paved to control dust and protected with block walls to mitigate noise and interferences with the planned Tuolumne River Regional Park. Underpasses could be required to provide pedestrian access to playing fields that would be located north and south of the haul road. A new traffic signal and security gate would be required at the intersection of the haul road and Carpenter Road.

- **Other Environmental Mitigations.** Mitigation of environmental impacts, including odor, noise, and visual impacts, would be required for the existing primary clarifiers and new anaerobic digesters.

6.0 COST ANALYSIS

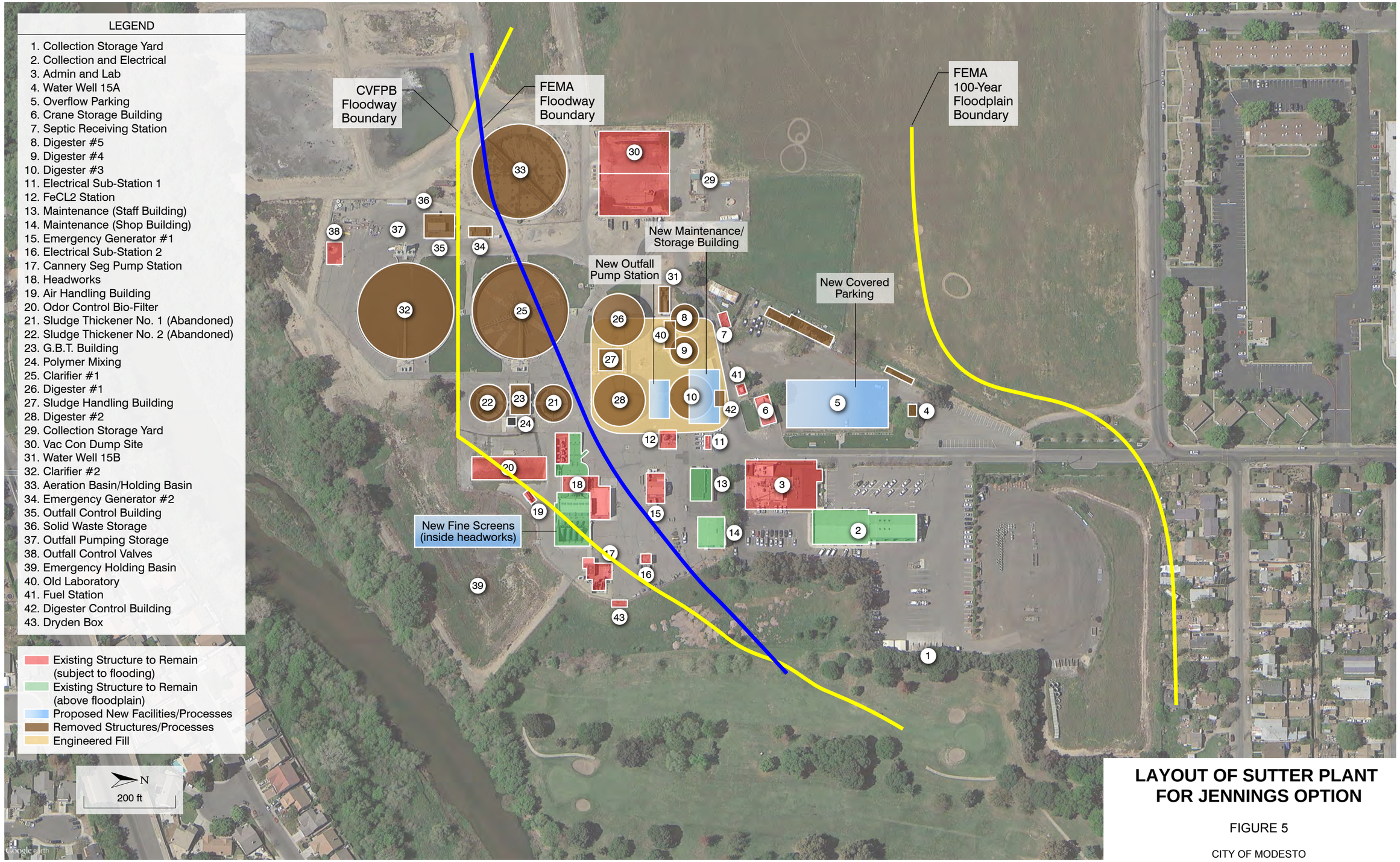
A cost analysis was performed to compare the Sutter Option and the Jennings Option. The site plan of the Sutter Plant for the Jennings Option, shown in Figure 5, identifies the facilities that would remain, be removed, or added. Figures 6 through 8 illustrate three alternative site plans for adding primary treatment and solids handling facilities at the Jennings Plant. Table 3 summarizes the costs for the three site plans. Site Plan B, which represents the lowest cost approach, will be assumed for the cost comparison of the Sutter and Jennings Options. Additional study will be required to refine the site layout and design criteria for the primary treatment and solids handling facilities at the Jennings Plant. Development of Site B would require purchasing new land. If purchasing land is not feasible, the next best alternative would be Site Plan C. These issues and the selection of the site plan will be evaluated further in the Wastewater Master Plan.

Table 3 Cost Estimate for the Jennings Option Alternatives
Sutter Treatment Facility Feasibility Study
City of Modesto, CA

Alternative	Cost
Alternative A – East Side of Storage Pond #1	$115,789,000
Alternative B – Field to the North of the Plant	$99,660,000
Alternative C – East of the Tertiary Treatment Facilities	$100,853,000

Table 4 summarizes the capital cost comparison for the Sutter Option and the Jennings Option. The cost estimate for the Sutter Option contained the following elements:

- Demolition of the following treatment facilities: Digesters 1, 2, 3, 4, and 5, Digester Control Building, Sludge Thickeners 1 and 2, Thickener Process Building, Spiro-Vortex Basin, and the Sludge Drying Beds.
- Flood protection improvements at the Sutter Plant, including the construction of a levee/floodwall, flood proofing incoming utilities, and bank cutting.
- Renovating the two existing primary clarifiers at the Sutter Plant, including replacing the clarifier mechanisms and coating the concrete walls.
- Two new 105-foot diameter anaerobic digesters with a new Digester Control Building at the Sutter Plant.
- Sludge dewatering contained in a building at the Sutter Plant. Sludge hauling trucks and trailers to haul the sludge from the Sutter Plant to the Jennings Plant were also included in the cost estimate.



LAYOUT OF SUTTER PLANT FOR JENNINGS OPTION

FIGURE 5

CITY OF MODESTO
SUTTER PLANT
SUTTER TREATMENT FACILITY FEASIBILITY STUDY

carollo

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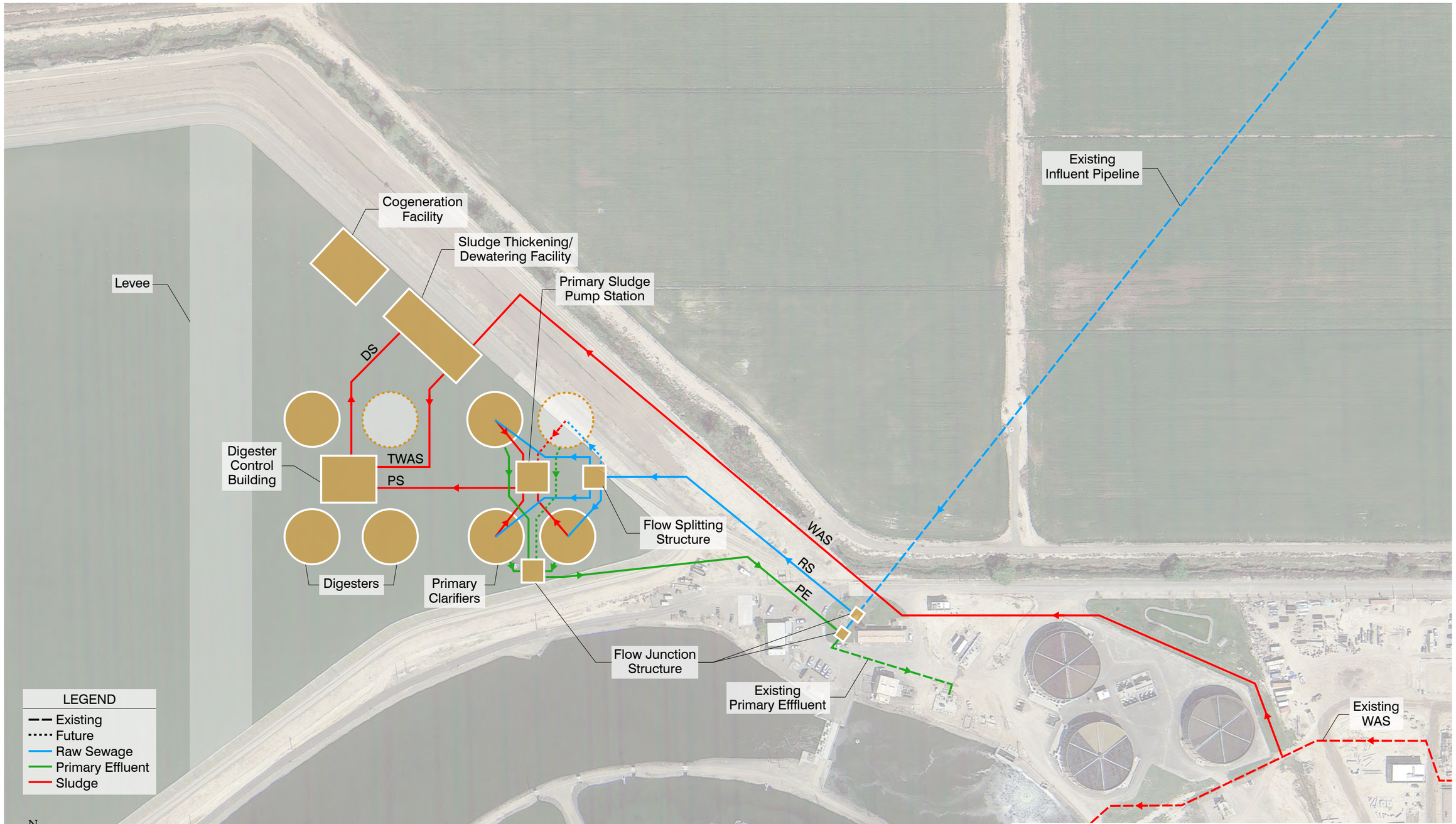

LAYOUT OF JENNINGS OPTION ALTERNATIVE A

FIGURE 6

CITY OF MODESTO
JENNINGS PLANT
SUTTER TREATMENT FACILITY FEASIBILITY STUDY

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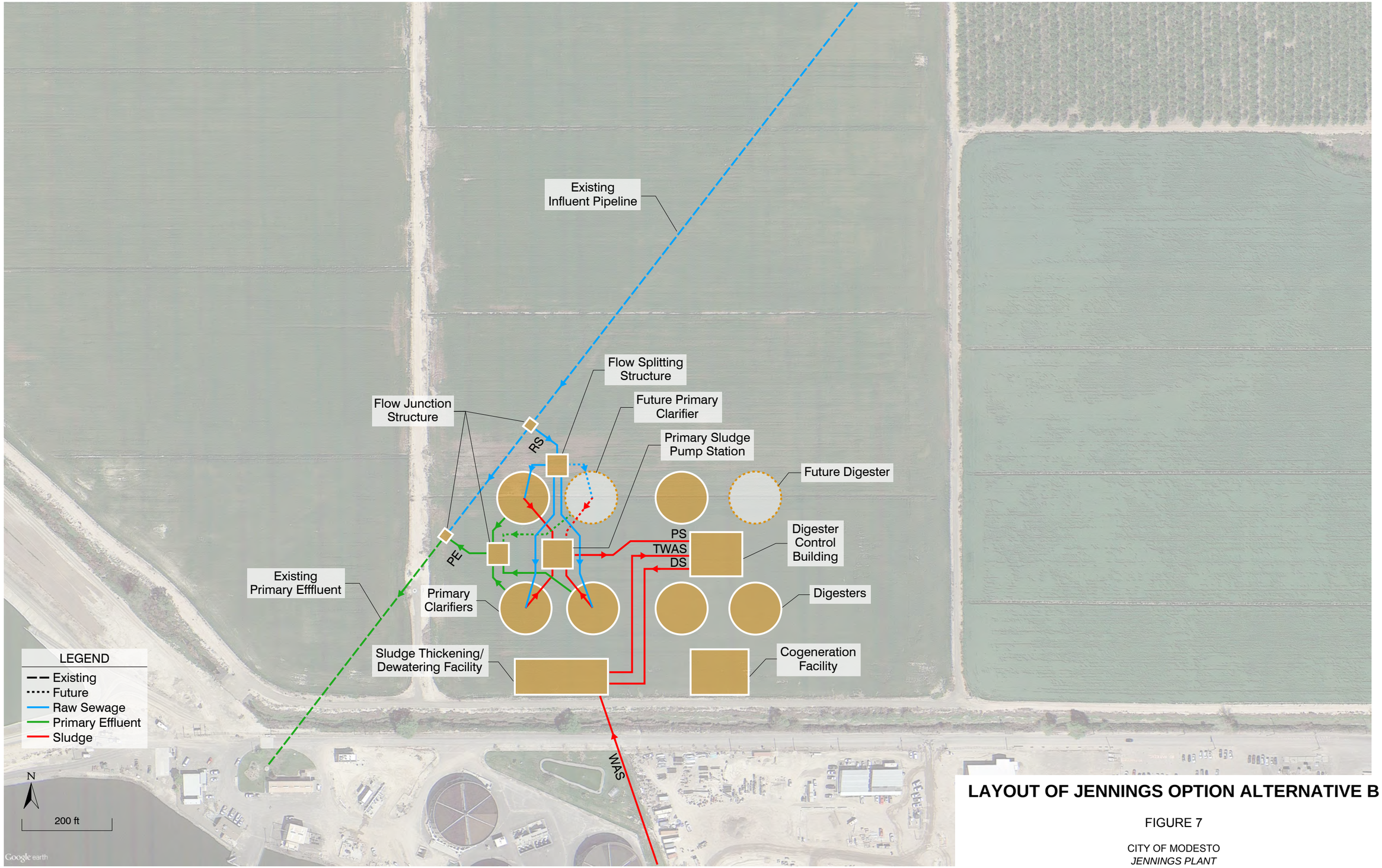

LAYOUT OF JENNINGS OPTION ALTERNATIVE B

FIGURE 7

CITY OF MODESTO
JENNINGS PLANT
SUTTER TREATMENT FACILITY FEASIBILITY STUDY

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Existing Influent Pipeline

Flow Junction Structure

RS

PE

Existing Primary Effluent

RS

PE

Flow Splitting Structure

Future Primary Clarifier

Primary Sludge Pump Station

Future Digester

Cogeneration Facility

PS

Digester Control Building

Flow Junction Structure

Digesters

Primary Clarifiers

TWAS

DS

WAS

Sludge Thickening/ Dewatering Facility

LEGEND

- Existing
- Future
- Raw Sewage
- Primary Effluent
- Sludge

N

200 ft

Google earth

LAYOUT OF JENNINGS OPTION ALTERNATIVE C

FIGURE 8

CITY OF MODESTO
JENNINGS PLANT
SUTTER TREATMENT FACILITY FEASIBILITY STUDY

carollo

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Table 4 Comparison of Capital Costs for the Sutter Option and Jennings Option Sutter Treatment Facility Feasibility Study City of Modesto, CA		
Project Elements at Sutter Plant	**Sutter Option**	**Jennings Option**
Demolition of Sutter Treatment Facilities	$10,979,000	$12,180,000
Floodplain Improvements at Sutter Plant	$52,119,000	-
Rehabilitation of Primary Clarifiers at Sutter Plant	$4,633,000	-
New Anaerobic Digesters at Sutter Plant	$20,169,000	-
Sludge Dewatering at Sutter Plant	$12,202,000	-
Sludge Haul Road at Sutter Plant	$1,007,000	-
Total Estimated Construction Cost at Sutter Plant	**$101,109,000**	**$12,180,000**
Engineering, Legal, Administrative Fees, Permitting, and Construction Management, 20% of Construction Cost	$20,222,000	$2,436,000
Total Estimated Project Cost for Sutter Plant	**$121,331,000**	**$14,616,000**
Project Elements at Jennings Plant		
Site Improvements at Jennings Plant	-	$2,681,000
New Primary Clarifiers, Sludge Pumping Station and Scum Pumping Station at Jennings Plant	-	$16,598,000
New Anaerobic Digesters at Jennings Plant	-	$30,247,000
Sludge Dewatering at Jennings Plant	-	$11,645,000
WAS Thickening at Jennings Plant	-	$3,678,000
Sludge Cake Drying Beds at Jennings Plant	$6,021,000	$6,021,000
Total Estimated Construction Cost for Jennings Plant	**$6,021,000**	**$70,870,000**
Engineering, Legal, Administrative Fees, Permitting, and Construction Management, 20% of Construction Cost	$1,204,000	$14,174,000
Total Estimated Project Cost for Jennings Plant	**$7,225,000**	**$85,044,000**
Total Estimated Project Cost	**$128,556,000**	**$99,660,000**

- Sludge hauling road from the Sutter Plant to Carpenter Road.
- New sludge drying beds at the Jennings Plant.

The cost estimates for the Jennings Option contained the following elements:

- Demolition of the following treatment facilities: Primary Clarifiers 1 and 2, Digesters 1, 2, 3, 4, and 5, Digester Control Building, Sludge Thickeners 1 and 2, Thickener Process Building, Spiro-Vortex Basin, and the Sludge Drying Beds.
- The cost estimate for the Jennings Option does not include flood protection improvements for the support facilities at the Sutter Plant site that would remain after the relocation of the primary facilities. A separate analysis should be prepared to develop a plan for protecting these facilities. In addition, the estimate does not include

flood protection of the existing facilities at the Jennings Plant. This will also require additional study.

- Expansion of the Administration Building at the Jennings Plant.
- Three new 105-foot diameter primary clarifiers at the Jennings Plant.
- Three new 105-foot diameter anaerobic digesters with a Digester Control Building at the Jennings Plant.
- Sludge dewatering contained in a building at the Jennings Plant.
- Sludge thickening contained in a building at the Jennings Plant.
- New sludge drying beds at the Jennings Plant.

Table 5 presents the life cycle cost analysis. Detailed estimates are provided in Appendix D. Capital costs were estimated at a planning level of accuracy. The costs are presented in October 2014 dollars and based on a 20-City Average Engineering News Record Construction Cost Index (ENR CCI) of 9886. Actual dimensions of the floodwall and levees cannot be determined without additional structural calculations, which were outside the scope of this study. Therefore, flood protection structures were estimated based on examples of similar projects under similar conditions.

Table 5 Additional Recurring O&M Costs for Sutter Option(1)
Sutter Treatment Facility Feasibility Study
City of Modesto, CA

Element Description	Annual Cost	Present Value Cost(2)
Dredging to Remove WAS Handling Costs at Jennings Plant	$795,000	$9,908,000
Loss of Benefit of Power Production by Cogeneration	$315,000	$3,930,000
Sludge Hauling from Sutter Plant to Jennings Plant	$202,000	$2,524,000
Total Estimated Life Cycle Cost for Sutter Option (PV)		**$16,362,000**

Notes:
(1) Annual costs for both options were assumed to be the same except for the items listed. Does not include levee maintenance costs.
(2) Based on 20-year term and 5% discount rate.

Capital costs for the Sutter Option are estimated to be $128,556,000. Capital costs for the Jennings Option (assuming Site B) are estimated at $99,660,000, or $28,896,000 less than the Sutter Option. These costs estimates are for comparison only – additional refinement will be required before progressing further with the project. Annual sludge hauling costs associated with operating a sludge dewatering system at the Sutter Plant, pond dredging costs at the Jennings Plant, and the loss of potential energy production contributed to the

additional costs for the Sutter Option. The additional costs for the Sutter Option are estimated to be $1,313,000 per year, which is equivalent to a present value of $16,362,000.

7.0 SUMMARY AND CONCLUSIONS

The feasibility of maintaining primary facilities at the Sutter Plant was evaluated by performing a peer-review analysis, flood protection analysis, environmental screening, and cost analysis. The evaluations supported the conclusion that the Sutter Option is not feasible for the long term. The preferred alternative is the Jennings Option – to construct new primary treatment and solids handling facilities at the Jennings Plant and remove primary treatment and solids handling facilities from the Sutter Plant. Key findings that support this conclusion include:

- Major upgrades to existing facilities would be required for continued long-term operation of the Sutter Plant. The primary treatment facilities at the Sutter Plant (primary clarifiers, primary clarifiers, anaerobic digesters, and sludge drying beds) are near or exceeding their useful life and their design is outmoded. The City is currently rehabilitating the digesters to extend their use for just another 10 years. Use of the digesters beyond 10 more years would require full replacement of the digester tanks. The primary clarifiers at the Sutter Plant were originally designed to treat cannery process water in addition to domestic wastewater flows. Cannery flows are now treated at the Jennings Plant, so the clarifiers are now larger than needed. Over-sized clarifiers cause odors and other operational issues. If primary treatment were to continue at the Sutter Plant, the clarifiers would need to be rehabilitated, including replacing the sludge collector mechanism and repairing the concrete walls and basin bottom grout. Ultimately, the clarifiers may need to be replaced with smaller clarifiers to improve efficiency and reduce odors. Additionally, the sludge drying beds will likely need to be lined to comply with upcoming biosolids regulations.

- Providing flood protection for the Sutter Plant is not feasible for several reasons: it would cause a rise in the river surface upstream (which is not allowable under FEMA regulations), permitting would likely be unobtainable, environmental impacts would be too extensive for acceptance by reviewing agencies and private parties, and the costs for flood protection would be excessive.

- Operation of a solids handling facility at the Sutter Plant, including daily hauling of dewatered solids, odors, and noise, would be in opposition to federal environmental justice policies, because it would impact residences of lower-income areas. This was considered a fatal flaw with respect to environmental requirements.

- Continuing to operate anaerobic digesters at the Sutter Plant and not adding new digesters at the Jennings Plant would preclude the ability to digest WAS generated by the new BNR facilities at the Jennings site. Without anaerobic digesters at the Jennings Plant, a portion of the WAS solids would continue to accumulate in the

facultative ponds. The solids would need to be dredged out and disposed of every five to ten years.

- Apart from the fatal flaws noted above, the costs to remain at the Sutter Plant are significantly higher than moving the facilities to the Jennings Plant. Capital costs for the Sutter Option (assuming flood protection would be technically feasible) are estimated at $128,556,000 compared to a cost of $99,660,000 for the Jennings Option.

- Recurring O&M costs would add another $16,362,000 in present value to the cost of the Sutter Option.

- On the basis of total life cycle costs, the Sutter Option would cost over $45 million more than the Jennings Option.

8.0 RECOMMENDATIONS

- The recommended alternative is the Jennings Option – to construct new primary treatment and solids handling facilities at the Jennings Plant. Under this approach, the Sutter Plant would continue to provide influent pumping, screening, and grit removal. A new screened effluent pump station, designed to be above 100-year flood levels, would replace the outdated and flood prone primary effluent pump station. All other treatment facilities, including the sludge drying beds, would be removed from the Sutter Plant site.

- It is recommended that the Jennings Option be carried forward in the Wastewater Master Plan. Development of the master plan will include further analysis and refinement of the Jennings Option. Figure 4 shows the proposed site plan for the Sutter Plant, which identifies the facilities that would remain, be removed, or added. Figures 5 through 7 present preliminary site plans for the Jennings Plant, including the proposed new primary treatment and solids processing facilities.

APPENDIX A – PEER REVIEW RESULTS TECHNICAL MEMORANDUM

WEST YOST ASSOCIATES
Consulting Engineers

TECHNICAL MEMORANDUM

DATE: September 12, 2014 Project No.: 125-06-14-08.003

TO: Miguel Alverez, City of Modesto

CC: Mike Britten, Carollo Engineers
Rick Chan, Carollo Engineers

FROM: Jim Waters, R.C.E. #28363

REVIEWED BY: Kathryn Gies, R.C.E. #65022
Jeff Pelz, R.C.E. #46088

SUBJECT: Peer Review of Final Facility Layout Plan – January 2013

The purpose of this Technical Memorandum (TM) is to document an independent peer review of the Final Facility Layout Plan (FLP) prepared in January of 2013 for the City of Modesto's (City's) Sutter Avenue Wastewater Treatment Plant. This work is being performed as part of the Sutter Avenue Plant Relocation Study. It is understood that the scope of the FLP analysis was limited to a planning level initial assessment. Among other tasks, the FLP evaluated two alternatives relative to the future of the primary treatment and solids handling facilities. The two alternatives were (1) to retain and upgrade the primary and solids handling facilities at the Sutter Plant (herein referred to as the Sutter Avenue Plant Retention alternative) or (2) relocate the facilities to the City's Jennings Road Wastewater Plant (herein referred to as the Sutter Avenue Plant Relocation alternative). This memorandum identifies additional issues and costs that could potentially change, otherwise or influence the recommendations regarding primary treatment and solids handling as presented in the FLP. The principal objectives of this peer review are to:

1. Identify any potentially erroneous assumptions or conclusions identified in the FLP that have contributed to a recommendation to relocate the facilities to the Jennings Road Plant.
2. Review the costs in the FLP and identify potential changes.
3. Identify potential "fatal flaws" that would render either alternative infeasible.

A brief overview of the FLP and subsequent City-directed revisions is presented below. The overview is followed by a review of both the Sutter Avenue Plant Retention and Sutter Avenue Plant Relocation alternatives. This TM then concludes with a brief summary of our findings.

BACKGROUND

The FLP summarized the condition and adequacy of the existing Sutter Avenue Plant facilities to provide continuing service to the City for the foreseeable future. Possible facility layouts were identified for both the Sutter Avenue Plant Retention alternative and the Sutter Avenue Plant Relocation alternative, which were then used to compare costs of these two alternatives. In addition to the information presented in the FLP, the following three developments subsequent to the issuance of the FLP are addressed in this assessment:

1. The City has determined that the use of sludge drying beds in the open space area west of the main Sutter Avenue Plant treatment facilities is not a preferred approach due to the high cost of protecting the beds from flooding and because long-term plans for the Tuolumne River Regional Park (TRRP) property surrounding the drying beds area involves construction of new, high-use public access areas. Eliminating the drying beds from this location will minimize the area that requires flood protection and reduces potential impacts on the floodway. It also keeps the treatment facilities within one, compact space – potentially reducing impacts on the adjacent neighborhoods and the public use facilities on the TRRP property.

   Several options for replacing the drying beds are available. These include, but are not necessarily limited to:

   - Mechanically dewatered solids could be directly hauled to the Jennings Road Plant for drying/storage, which is estimated to require 8 (average) to 11 (maximum month) truckloads of solids hauled per day at the anticipated 2030 flow and load conditions[1].
   - New (concrete-lined) drying beds could constructed immediately adjacent to the western boundary of the Sutter Avenue Plant treatment facilities (but still separated from adjacent neighborhoods).
   - As mentioned in the FLP, solar greenhouses could be used in lieu of drying beds to dry the dewatered solids, and thus reduce the footprint required. Solids would still need to be hauled from the Sutter Avenue Plant on a fairly frequent basis (the greenhouses would provide some storage, but are not meant to be operated as a storage facility). However, the volume that would need to be hauled from the Sutter Avenue Plant would be significantly reduced (possibly cut in half).
   - A mechanical heat drying facility could be installed that would reduce the volume of solids that need to be hauled from the Sutter Avenue Plant to the Jennings Road Plant, possibly reducing the number of truckloads to 3 (average) or 4 (maximum month) per day[2].

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[1] Based on the 2030 average primary solids production rate of 60,000 lb VSS/day and maximum month production rate of 88,000 lb VSS/day, as presented in New Anaerobic Digester Preliminary Design Report (Brown and Caldwell, September 2012), and the following assumptions: 40 percent VSS reduction in the digesters, VSS/TSS ratio of 80 percent, dewatered biosolids average 20 percent solids, 15 wet tons per truckload.

[2] Same assumptions as above, except the dewatered biosolids are assumed to average 50 percent solids.

If drying beds were used, high winds could result in the movement of dried material from the drying beds into the adjacent neighborhoods or to areas used by the public on the TRRP property. These impacts would be compounded if the drying beds were located further to the north on land currently owned by the TRRP, as they would be separated from potential public areas by only the flood control levee that would be constructed between the WWTP property and the TRRP property.

The digested solids would also not be odor free. Enclosure of the beds in greenhouses would help mitigate this, as would installation of mechanical dewatering. However, vented air from the greenhouses would still need to be captured and scrubbed to remove odors, which would be costly because the greenhouses would need to be large structures.

Given the possible impacts associated with a drying bed or greenhouse drying approach, direct hauling of mechanical dewatered or mechanically dried solids may be the best approach. Ultimately, the City would need to complete additional analysis to define a preferred long-term approach for handling the biosolids. For purposes of this Study, it is assumed that mechanically dewatered solids would be directly hauled to the Jennings Road Plant for further drying/storage in lieu of the FLP concept of using drying beds for the storage and drying mechanically dewatered solids.

2. When the FLP was completed, Primary Clarifier No. 2 was identified as being partially within the Federal Emergency Management Agency (FEMA) Floodway. Under a separate Sutter Avenue Plant Relocation Study task, the City is evaluating the measures required to protect the Sutter Avenue Plant from a 100-year flood event under the Sutter Avenue Plant Retention alternative[3]. As part of this study, it has been determined that the entirety of Primary Clarifier No. 2, the Headworks, the Dryden Box, most of Primary Clarifier No. 1, and other supporting Sutter Avenue Plant infrastructure is located in the FEMA Floodway. In addition, the entirety of Primary Clarifier No. 2 is located in the Central Valley Flood Protection Board (CVFPB) Designated Floodway.

3. As part of the Flood Protection Analysis being completed under this Sutter Avenue Plant Relocation Study, it was decided to evaluate the impacts of building a floodwall around the existing infrastructure and to present this to the FEMA and CVFPB staff to determine if it would be possible to keep all of the facilities in their existing location, whereas the FLP assumed Primary Clarifier No. 2 would need to be relocated to minimize potential floodway impacts. Therefore, the analysis presented for this Sutter Avenue Plant Relocation Study should be based on the assumption that Primary Clarifier No. 2 will remain in its present location.[4].

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[3] Draft Sutter Primary Treatment Facility Flood Protection Analysis report (HDR, August 2014).

[4] The draft Sutter Primary Treatment Facility Flood Protection Analysis report (HDR, August 2014) concludes that water surface elevations in the Tuolumne River would increase from 0.27 to 0.55 feet (depending on the methodology employed) if the current location of the Clarifier No. 2 is retained. The extent that the protection of Clarifier No. 2 contributed to these increases is unclear. However, since the FEMA and CVFPB must approve of the project, the feasibility of retaining Clarifier No. 2 in its present location is uncertain.

SUTTER AVENUE PLANT RETENTION ALTERNATIVE

Review comments regarding the Sutter Avenue Plant Retention alternative are organized under the following topics:

- Compatibility with Surrounding Land Uses
- Liquid Treatment Processes
- Solids Handling Facilities
- Plant Utilities and Support Systems
- Flood Protection
- Regionalization, Cogeneration, and Water Reuse Opportunities
- Major Project Considerations

Compatibility with Surrounding Land Uses

The Sutter Avenue Plant site is adjacent to residential areas and areas designated for a park that are owned and managed by the TRRP. It is also adjacent to and within currently designated floodways and floodplains. Impacts on these surrounding land uses should be considered further in evaluating the desirability of maintaining treatment facilities at the Sutter Avenue Plant site. Additional, significant near term costs beyond those identified in the FLP are likely to be required to improve the compatibility of the plant with the surrounding land uses. Many of these costs (e.g. odor control, flood protection) have been identified elsewhere in this TM. Furthermore, future additional on-going operational costs will likely be required to maintain the facilities needed to enhance the compatibility of the plant with its surroundings.

Liquid Treatment Processes

The existing liquid treatment processes at the Sutter Avenue Plant consist of: influent pumping, influent screening, grit removal, primary clarification, Can-Seg pumping, and primary effluent pumping. Under the Sutter Avenue Plant Retention alternative, these treatment processes would remain the same as existing.

The following are potential additional costs beyond those identified in the FLP that may be incurred for the treatment processes if full operations are maintained at the Sutter Avenue Plant:

1. Primary Clarifier No. 1 is the oldest clarifier in the plant (almost 60 years). Although there has been some recent recoating work done on this unit, major rehabilitation of the clarifier's mechanical equipment and the clarifier's associated pumping systems would likely be required during a 20-year life cycle cost analysis of alternatives.
2. Primary Clarifier No. 2 will also require rehabilitation at some point, and these costs should be considered in the Sutter Avenue Plant Retention alternative.
3. Most plants with neighboring residential areas capture odors from the primary clarifiers. It is recommended that the potential for providing primary clarifier odor

control measures be recognized in the consideration to retain the plant (in addition to the odor capture facilities already considered in the FLP).

Solids Handling Facilities

The existing and proposed solids handling facilities at the Sutter Avenue Plant consist of: screenings washing and dewatering, grit washing and dewatering, primary sludge and scum pumping, dissolved air flotation thickening (decommissioned), gravity belt thickening, anaerobic digestion, mechanical dewatering (proposed), and cake drying on paved drying beds (proposed). The FLP recommended discontinuing the current practice of dewatering digested solids on unlined drying beds. The proposed alternative approach was to dewater the digested solids with mechanical dewatering and haul the dewatered solids to new lined solar drying beds at the Sutter Plant. Dried solids would be hauled seasonally to the Jennings Plant as currently practiced. One of the drivers for this change is that fact that it is expected that when the new Waste Discharge Requirements are adopted for the City's biosolids and land application activities in 2016, the City will be required to discontinue the current use of the unlined drying beds (a timeline for completing this improvement is expected).

The following are potential additional costs beyond those identified in the FLP that may be incurred for the solids handling processes maintained at the Sutter Avenue Plant:

1. As discussed previously, the City has determined that the solids handling facilities should be brought closer to the main treatment facility area to minimize the overall facility footprint. Therefore, the costs should be updated to reflect this revised approach. Specifically, it is assumed that mechanically dewatered solids would be directly hauled to the Jennings Road Plant for further drying/storage in lieu the FLP concept of using drying beds at the Sutter Plant for the storage of mechanically dewatered solids. This approach would reduce the amount of area that would require flood protection (and potentially the cost of flood protection shown in the FLP). However, because there would still need to be new lined drying beds constructed at the Jennings Road Plant, the cost of this item would remain.

   With the proposed biosolids handling approach, 8 to 11 truckloads of solids would need to be hauled to the Jennings Road Plant per day at the 2030 design conditions (resulting in 16 to 22 one-way trips per day). Because the current route between the Sutter Avenue Plant and Jennings Road Plant is through a neighborhood and passes a school, it is expected that an alternate entrance to the plant would likely be required as the neighborhood to the north would be severely impacted by the addition of daily hauling truck operations.

   The most likely route for a new haul road would be along the existing access road that borders the northern boundary of open space to the east of the Sutter Avenue Plant (i.e. the TRRP property) and connecting to South Carpenter Road – a major thoroughfare – at the existing access road driveway entrance. If this were done, the plant entrance for major truck traffic could be changed to this location and the current entrance at Sutter Avenue and Robertson Road could be open only to personal vehicle traffic to eliminate all heavy plant-related traffic from the adjacent neighborhood. This

would have an offsetting beneficial impact on the neighborhood, and would be safer for plant personnel and visitors.

The costs for the construction of the haul road should be included in the analysis, as should the annual costs of regular hauling and disposal of the dewatered solids. Per discussions with City engineers responsible for street improvements, the haul road costs will need to include: warning signs along Carpenter Road and extension of the pavement south of the driveway by 8 feet for an approximate distance of 100 feet (to allow trucks to make right-hand turns into the driveway). In addition, Carpenter Road is slated to ultimately be widened to 4 lanes, which will require installation of a drop-curb type driveway. The City could elect to install this portion of the driveway now, which would require widening a short section of Carpenter Road at the driveway entrance.

Ultimately, the ability to construct a major truck route through the TRRP property would need to be discussed as part of the land exchange discussion. However, given the proposed long-term uses of the TRRP property, it is reasonable to assume that a visual screen (e.g. trees) as well as a physical barrier (e.g. fencing) would be necessary between the roadway and the public use areas. A review of the TRRP Master Plan (EDAW, December 2001) also indicates that the current plan for the TRRP property would be to use the existing driveway entrance and a portion of the access road as the access route for the new park facilities. Thus, coordination on a possible dual use, or working with TRRP to identify an access route for the park facilities elsewhere would be required.

Finally, a portion of the TRRP property on both the west and east sides of Carpenter Road, and in between Kenneth and Robertson Roads and the Tuolumne River, is the closed Carpenter Road Landfill. This landfill was operated by the City between 1956 and 1968, and consists of two unlined cells. It is assumed that the existing access road lies outside of the actual landfill area, and upgrading the existing access road to allow for truck traffic will not be an issue. However, further investigation is needed to confirm this assumption. At this time, it is not recommended that cost be included to account for special construction or materials removal. Should it be determined that the existing road is within the landfill area, this option would need to be revisited.

2. Even with daily hauling of biosolids, some on-site storage of dewatered solids is needed. It is expected under this scenario that dewatered solids would be discharged directly into hauling trucks via a hopper system. In areas sensitive to odors, this type of dewatering and storage operation is often provided in an enclosed building that has odor control. (Examples of this type of facility can be found at the City of Brentwood and Union Sanitary District wastewater treatment facilities.) It is recommended that costs for this type of dewatering and storage facility also be included in the economic analysis.

3. Even with daily hauling of biosolids, some on-site storage of dewatered solids is needed. It is expected under this scenario that dewatered solids would be discharged directly into hauling trucks via a hopper system. In areas sensitive to odors, this type of dewatering and storage operation is often provided in an enclosed building that has odor control. (Examples of this type of facility can be found at the City of Brentwood and Union Sanitary District wastewater treatment facilities.) It is recommended that

costs for this type of dewatering and storage facility also be included in the economic analysis.

4. Waste Activated Sludge (WAS) generated by the Phase 1A and Phase 2 biological nutrient removal (BNR) plants at Jennings Road are (or will be) returned to the pond system for disposal. In the long term, a more conventional approach to handling the solids produced in these plants is likely to be advantageous or necessary (particularly as solids generation rates increase). When both primary and secondary solids are generated, combined anaerobic digestion of primary and secondary solids is typically the most cost effective means of handling the secondary solids. Therefore, if all solids handling facilities were moved to the Jennings Road Plant site, the relocated anaerobic digestion facilities could be used to treat the secondary solids. Under the Sutter Avenue Plant Retention alternative, combining primary and secondary solids treatment would not be an option. Therefore, the Sutter Avenue Plant Retention alternative should consider the potential costs for future solids handling facilities to serve the BNR plants at Jennings Road.

   The following table provides a comparison of the solids handling requirements under the existing conditions and under the Sutter Avenue Plan Retention Alternative:

Table 1. Comparison of Solids Handling Facilities for Existing Conditions and the Sutter Avenue Plant Retention Alternative

Facility	Existing Conditions	Sutter Avenue Plant Retention Alternative
Sutter Avenue Plant		
Dedicated Primary Sludge Anaerobic Digesters	X	X
Digested Primary Sludge Drying Beds	X	
Digested Primary Sludge Mechanical Dewatering		X
Haul Digested Primary Sludge to Jennings	X (Annually)	X (Daily)
Jennings Road Plant		
WAS Returned to Ponds/Dredge Ponds	X	
Dedicated WAS Solids Digestion		X[(a)]
Digested WAS Dewatering/Drying		X[(a)]
Land Application of Digested Primary Sludge	X (Annually)	X (Annually)
Land Application of WAS	X (Infrequent[(b)])	X (Annually)

(a) Additional evaluation is needed to determine the preferred approach for a dedicated WAS treatment and/or dewatering system. Approaches for treatment of WAS solids include aerobic digestion and pretreatment (to split cell membranes) followed by anaerobic digestion. For purposes of this Sutter Avenue Plant Relocation Study, one option should be selected so that a cost can be identified. The evaluation should consider long-term operating costs if significant.

(b) Occurs when ponds are dredged, typically a 5 to 10 year cycle.

5. Costs for odor control facilities to capture off-gassing from the operations of the gravity belt thickener system, which is expected to be operated seasonally during the Can-Seg season, should be included.

Plant Utilities and Support Systems

The following plant utilities and support systems are utilized at the Sutter Avenue Plant: electrical distribution system, administration and analytical laboratory building, maintenance shop and storage, water systems, storm drainage handling, and in-plant traffic circulation, vehicular access, and parking. The site has also been identified for use by other City departments (e.g. Parks & Recreation, Police Department, etc.). These uses would add further demands on the available site and it may not be possible to accommodate all of them when the site is reduced to minimize the needed flood control measures.

The following are potential additional costs beyond those identified in the FLP that may be incurred for the plant utilities and support systems if full operations are maintained at the Sutter Avenue Plant:

1. The FLP describes electrical Substation A as in need of preventative maintenance, yet no line item cost was included for this in either estimate. Several other comments in the text also refer to obsolete or deteriorated electrical gear. It has been our experience that electrical systems in older plants often require a lot of costly work to restore them to desired level of reliability. While the component costs include an allowance factor for electrical and instrumentation work, it is likely that other electrical and instrumentation work would be required that is not associated with a given component. A plant-wide assessment of the long-term integrity of the plant electrical and instrumentation systems is warranted to identify the costs that are likely to be required to maintain operations over the economic planning period.
2. The FLP states that the Administration Building would be renovated and space would be reserved for a future Administration Building. In addition, expanding process control and compliance monitoring are expected, which would increase demands on the analytical laboratory. Unless these costs are common to both alternatives, costs should be shown for both the rehabilitation of the existing building and for the new building if the future building is likely to be needed within the economic planning period.
3. The same contingency allowance was used for the estimates of both retaining and relocating the Sutter Avenue Plant. The likelihood of unforeseen costs under the Sutter Avenue Plant Retention alternative is greater than the Sutter Avenue Plant Relocation alternative due to the site constraints and presence of older facilities. For example, the FLP specifically mentions that repairs are likely needed on the potable water supply line that serves the plant to address damage that has occurred as a result of surge pressures. In addition to the repairs to the pipes themselves, costs for the provision of a surge suppression system should also be considered to prevent future damage from these conditions. Similarly, the plant's non-potable water system may need to be replaced with an alternative system (new wells, connection & isolation to the city water system, or a small-scale water reuse treatment system) and/or this system may require flood protection. For these reasons, as well as other similar issues, the contingency allowance that was included in the Sutter Avenue Plant Retention alternative may not be sufficient to cover incidental costs.
4. If no other potential sites for other City departments are available nearby, retention of treatment at the Sutter Avenue Plant site would have cost impacts on other City

departments which should be acknowledged. Specifically, there would be limited space available at the Sutter Avenue Plant site if the site needed to contain all treatment facilities (while being protected from flooding). If further analysis demonstrated there would be no extra space available at Sutter Avenue Plant, the cost of acquiring and developing alternative sites for other City administrative functions (and the potential additional costs of having to use a site that may be more remote from the service area) would need to be considered. A simple way of accounting for this would be to include the value of the land required at the Sutter and Jennings sites that would be needed to accommodate the needed facilities.

Flood Protection

The entire plant site lies within the currently Federal Emergency Management Agency designated 100-year floodplain and partially falls within the designated floodway. The FLP acknowledges the fact that construction of new facilities (including dikes or floodwalls) within the designated floodway would likely be prohibited due to their impacts on upstream flood elevations, and that construction of new facilities within the designated floodplain would have a lesser impact but may not be necessarily allowed – at least without some mitigating measures that would further add to the costs of maintaining treatment options at the site. Moreover, the feasibility and costs of providing flood protection under the Sutter Avenue Plant Retention Alternative is being further considered by others as part of this Relocation Study. Nevertheless, any future planning analysis of the Sutter Avenue Plant Retention alternative should also consider the following potential additional long-term costs that may be incurred for flood protection measures:

1. The risk of further expansion of the flood zones in the future should be recognized for any consideration of retaining operations at the Sutter Avenue Plant site. These could result from either climatological changes or intensified upstream urbanization – or both.
2. Ongoing costs of upkeep and maintaining the flood protection facilities should be included.

Regionalization, Cogeneration and Water Reuse Opportunities

The City has identified possible opportunities for regionalization (i.e. expansion of the City's wastewater treatment facilities to handle wastewater from surrounding communities that currently operate small treatment works), cogeneration (i.e. generation of energy using gas generated in the anaerobic digesters) and water reuse (i.e. using highly treated wastewater for beneficial purposes and offsetting potable water use) that would be impacted depending on which alternative is selected. If the Sutter Avenue Plant Retention alternative remains viable, the following considerations warrant further attention in the analysis:

1. Since the Sutter Avenue Plant is the first step in the process for handling the domestic/commercial waste stream, the ability to accommodate regionalization with the existing facilities needs to be considered as opportunities for future expansion will be limited for the Sutter Avenue Plant Retention alternative. If regionalization of treatment services could not be accommodated at the Sutter Avenue Plant site, the primary treatment step would need to be provided at another site. This would be

significantly more costly than expanding existing facilities at existing sites as is commonly done with regionalization projects. Consequently, this limitation would adversely affect the economies associated with regionalization of services.

2. The anaerobic digestion process at the Sutter Avenue Plant makes it a candidate for the installation of cogeneration facilities that would utilize the digester gas to generate electricity while meeting the digestion heating needs with the waste heat from the generation process. In addition, the primary solids removed at the Sutter Avenue Plant represent the best source of digester gas generation (and therefore, electrical power generation) associated with the City's wastewater treatment system. However, because energy demands at the Sutter Avenue Plant are relatively low, cogeneration at the Sutter Avenue Plant would likely require a contract with the local electrical utility to utilize the power generated in order to gain the benefit of the energy being generated.

   If a cogeneration system was to be provided at the Sutter Avenue Plant, empty space that may be available for the cogeneration system would be limited to prevent excessive flood protection costs. In addition, cogeneration system operation would need to be compatible with surrounding land uses (e.g. noise should be contained to the site).

3. With the new treatment facilities coming online at the Jennings Road Plant, there will be additional solids generated at the Jennings Road Plant site that will require digestion that could also generate gas for cogeneration. However, the gas generation potential of secondary solids (or WAS) is significantly lower than primary solids. Improvements may be possible with WAS pretreatment; but additional evaluation of this approach would be needed to determine if this is a viable option. Thus, if the plants remain separate, the economies of scale of any potential cogeneration system would be reduced – likely to the extent that a cogeneration system would not be cost effective.

4. If the City determined that water reuse within the City's urban boundary was desired in the future, the City may be able to utilize land made available by the relocation of the Sutter Avenue Plant to construct a small satellite treatment facility (thus saving the cost of pumping treated effluent back from the Jennings Road Plant into the City). Nevertheless, additional investigations would be necessary to determine if satellite treatment reuse opportunities at the Sutter Avenue Plant site would truly be a benefit of the Sutter Avenue Plant Relocation alternative.

Major Project Considerations

The following three significant issues remain to be resolved and could prove to be fatal flaws:

Availability of TRRP Property. As noted, the floodway and floodplain boundaries are currently the subject of a separate investigation. Given the recent experiences with flooding in the United States, it is unlikely that building restrictions in flood zones will be relaxed. Furthermore, incorporation of more recent hydrologic data into the determination of flood zones has often led to more extensive boundaries of flood zones. If expansion in the floodplain is restricted, the City would need to expand onto the TRRP property.

Therefore, the viability of the Sutter Avenue Plant Retention alternative would hinge on the ability to obtain land from TRRP.

On June 11, 2014, City staff met with the TRRP Commission to discuss a possible land exchange, and there was interest by the Commission to continue discussions on the topic. Issues that were brought up for further discussion include: cleanup of the sludge drying beds, regrading the sludge drying bed area, construction and/or maintenance of new soccer fields by the City, and concerns about the biosolids facilities moving closer to residents.

Dewatered Solids Handling. The proposal to utilize concrete lined sludge cake drying beds to store dewatered solids on the site has been determined to be an unacceptable approach due to the proximity of the residential areas to the north and the impacts associated with encroachment on the floodway to the south. Therefore, as mentioned previously, direct hauling of mechanically dewatered solids is the only feasible approach to handling the solids at the Sutter Avenue Plant. If it is not feasible to construct a new road to allow direct access to Carpenter Avenue, local opposition to the increased truck traffic in the neighborhood to the north may make continued operations at the Sutter Avenue Plant untenable.

Space for Future Expansion. The current Sutter Avenue Plant site is constrained on all sides by other land uses. Moreover, some of the site will be lost to plant uses due to the need to remove them from the floodway and, the land requirements to provide flood protection will further reduce the usable area of the plant and constrain the ability of the City to expand or modify the plant in the future. Although some expansion into the TRRP property may be possible if a land exchange can be negotiated, the ability to expand would also be dependent upon how much area could be removed from the floodplain without adversely impacting adjacent areas. Depending on the outcome of the efforts being completed by others to resolve these issues, the Sutter Avenue Plant may not be expandable at the existing site, which could limit its functionality over the long-term as the City grows and/or considers regionalization.

SUTTER AVENUE PLANT RELOCATION ALTERNATIVE

The following items were reviewed for the Sutter Avenue Plant Relocation alternative:

- Compatibility with Surrounding Land Uses
- Treatment Processes
- Plant Utilities and Support Systems
- Flood Protection
- Regionalization, Cogeneration, and Water Reuse Opportunities
- Major Project Considerations

Compatibility with Surrounding Land Use

Unlike the Sutter Avenue Plant property, the Jennings Road Plant is located in an agriculturally-dominated area. Therefore, odors and other nuisance conditions (e.g. truck traffic) that may be associated with a treatment facility are less of an issue for the Jennings Road Plant site than the Sutter Avenue Plant site.

The FLP did not assume that additional land would need to be acquired by the City at the Jennings Road Plant site to accommodate the relocated facilities. However, if the primary facilities were to be located on existing properties, the City would have to take a portion of the land application area (or possibly the storage pond area) out of service – which may not be a viable option given the City's needs to apply blended secondary effluent with Can-Seg flow in accordance with permit requirements (unless an alternative means of handling a portion of the Can-Seg flows is identified). Therefore, the costs and impacts of additional land acquisition should be included in the analysis, and a preferred approach would be to purchase additional land near where the influent sewer enters the Jennings Road Plant. The land acquisition analysis should consider the types of crops being grown on potential expansion sites, as this can impact the cost of acquiring the land and making it available for construction of treatment facilities. For example, if the preferred expansion site is currently planted in a high-value crop like almonds (which is the case for some of the adjacent parcels) it may be more expensive for the City to acquire and modify the property than if on the expansion site was on a property where the crop being grown is alfalfa or some other fodder crop (i.e. crops intended for consumption by animals).

Treatment Processes

The following are potential cost considerations beyond those identified in the FLP related to the treatment processes that should be considered if primary treatment and solids handling facilities are relocated to the Jennings Road Plant:

1. The FLP assumed for comparison purposes that the solids handling units that would be constructed at Jennings Road Plant to replace the Sutter Avenue Plant would be the same size as planned for the Sutter Avenue Plant (i.e. sized to handle primary solids only). However, as mentioned previously in this TM, combined anaerobic digestion of primary and secondary solids is likely to be the most cost-effective option if a more conventional approach to handling the solids from the new BNR plants is needed or desired in the future (which is expected). However, this option is only viable under the Sutter Avenue Plant Relocation alternative. Therefore, the actual sizing of the solids handling facilities under the Sutter Avenue Plant Relocation alternative should be based on the projected needs of handling both primary and secondary solids. It should be noted, however, that while the cost for solids handling would be higher than assumed for the FLP, this cost would still be substantially less than the cost of providing dedicated secondary solids treatment and handling at the Jennings Road Plant site (which would be necessary under the Sutter Avenue Plant Retention alternative).

   The following table provides a comparison of the solids handling requirements under the existing conditions and under the Sutter Avenue Plan Relocation Alternative:

Table 2. Comparison of Solids Handling Facilities for Existing Conditions and the Sutter Avenue Plant Relocation Alternative

Facility	Existing Conditions	Sutter Avenue Plant Relocation Alternative
Sutter Avenue Plant		
Dedicated Primary Sludge Anaerobic Digesters	X	
Digested Primary Sludge Drying Beds	X	
Haul Digested Primary Sludge to Jennings	X (Annually)	
Jennings Road Plant		
WAS Returned to Ponds/Dredge Ponds	X	
Combined Primary Sludge and WAS Anaerobic Digesters		X
Combined Primary Sludge and WAS Dewatering/ Drying		X
Land Application of Digested Primary Sludge	X (Annually)	
Land Application of WAS	X (Infrequent[(a)])	
Land Application of Combined Primary Sludge and WAS		X (Annually)

[(a)] Occurs when ponds are dredged, typically a 5 to 10 year cycle.

2. The City has begun the operation of treating a portion of the Can-Seg flow through the domestic treatment system during the Can-Seg season. This operation may require the use of primary solids thickening facilities to keep the digesters from being hydraulically overloaded. Therefore, cost should be included to relocate the gravity belt thickener to the Jennings Road Plant. However, because the Jennings Road Plant is relatively isolated, it is not expected that the facility would require the same level of odor protection needed at the Sutter Avenue Plant.
3. Some additional costs for sulfide control in the pipeline between the two plant sites may be needed to address potential additional sulfide and odor generation that may occur in the domestic line due to the higher concentration of the wastes that it will be conveying.

Plant Utilities and Support Systems

The following are potential additional costs that may be incurred for the plant utilities and support systems if the primary treatment facilities are relocated to the Jennings Road Plant:

1. Modifications/expansion of the Jennings Road Plant's utilities and support systems are currently being completed to accommodate the changes to the treatment provided. The evaluation should consider whether the modifications will accommodate the relocation (potentially resulting in cost savings).
2. It is not clear that costs associated with administration building functions have been fully considered. At the current time, some of the wastewater operations staff, all of

the wastewater administrative staff, and all of the wastewater laboratory functions are housed at the Sutter Avenue Plant. However, if all of the treatment facilities are relocated to Jennings Avenue, it may be logical to relocate some (if not all) of the wastewater-related functions to the Jennings Road Plant site – particularly the laboratory facilities that serve the wastewater facilities process control. Nevertheless, because some of the administration building facilities are likely to still be necessary at the Sutter Avenue Plant to accommodate other City staff and laboratory functions (like water supply monitoring), it may be necessary to maintain administrative space and laboratory functions at both sites. Therefore, it is recommended that further analysis of the Sutter Avenue Plant Relocation alternative consider future staffing, administrative building and laboratory requirements in more detail.

Flood Protection

Analysis of the Sutter Avenue Plant Relocation alternative should consider the following potential costs associated with flood protection measures:

1. The Sutter Avenue Plant Relocation alternative assumes that a flood control levee/wall would not be provided if the primary facilities were relocated; and instead, the remaining facilities would be modified (as needed) so that they would not be inundated in a flood event. However, with the updated flood level information developed for this Sutter Avenue Plant Relocation Study, portions of the headworks (including the Grit Pump Room), the Air Handling Building, the odor control biofilter, the Can-Seg pump station, the Emergency Generator, Sub Stations #1 and #2, the Crane Storage Building, the Septic Receiving Station, the Ferric Chloride Station, and the Vac Con Dump Site would all require improvements to be protected from flooding that were not considered in the FLP cost estimate.

   Other items that may need to be accounted for in the flood protection cost of Sutter Avenue Relocation include the following:

   - Electrical conduits
   - Digester Building (if maintained)
   - Fueling Station
   - Old Lab
   - Metering Pits (Quantity 2)
   - Dryden Box
   - Valve Distribution Boxes (Quantity 3)

   Moreover, if the flood protection improvements only raise these facilities above the flood line, the operators could not get to the equipment in these facilities during a flood. Thus, the functionality of the equipment may be compromised. This is especially a concern with the screenings and grit handling facilities as they require regular attention. Therefore, it may be required to construct a flood control levee/wall to keep floodwaters away from the Sutter Avenue Plant – even if the primary treatment facilities were relocated.

If it is determined that added flood protection is needed, the feasibility of moving all of the treatment units at the Sutter Avenue Plant to Jennings Road Plant (including the headworks facilities and some or all of the facilities listed above) should be considered so that only a (new) raw wastewater pumping station and the Can-Seg Pump Station (and possibly City administration buildings and/or storage) would remain at the Sutter Avenue Plant site. It is recognized that concern was raised regarding the maintenance of the pipeline if the materials removed by the Sutter Avenue Plant headworks were not taken out prior to pumping into the outfall. Therefore, the analysis would include an evaluation of the pipeline hydraulics to assess the potential for deposition in the pipeline resulting from the loss of headworks facilities at the Sutter Avenue Plant site.

2. Regardless of whether a flood levee/wall is needed at the Sutter Avenue Plant site if the primary facilities are relocated to Jennings Road Plant, flood protection would be needed for upstream trunk mains as it was stated that they become inundated during flood events. Costs for sealing the portions of the trunk mains where this could happen should be included in the analysis. (Note that this work should be done for either alternative, and it is understood that it will be considered as part of the flood protection analysis being performed by others for the Sutter Avenue Plant site).
3. The Jennings Road Plant site is less at risk of flooding than the Sutter Avenue Plant site. However, some costs may be necessary to provide flood protection at Jennings Road Plant either initially or in the future. (Note this may be required regardless of whether the Sutter Avenue Plant facilities are relocated.) The potential for the construction of flood protection should be taken into account in any planning for a relocated plant.

Regionalization, Cogeneration and Water Reuse Opportunities

As mentioned previously, the City has identified possible opportunities for regionalization, cogeneration and water reuse that would be impacted depending on which alternative is selected. Under the Sutter Avenue Plant Relocation alternative, the following considerations should be noted and evaluated if necessary:

1. Opportunities for future expansion will be better under the Sutter Avenue Plant Relocation alternative. The capacity for expansion to accommodate regionalization should be considered in future evaluations of the Sutter Avenue Plant Relocation alternative, which could result in a conclusion that land will need to be purchased to accommodate this alternative.
2. If the two plants are combined, the economies of scale of any potential cogeneration system would be improved. Moreover, because the Jennings Road Plant site is more remote (and thus less susceptible to impacts associated with increased traffic), the City could more readily consider options for enhanced energy production at the Jennings Road Plant site, like fats, oils and grease (FOG) digestion or co-digestion of food/agricultural wastes.
3. Energy requirements for the Jennings Road Plant to power the new BNR/Tertiary facilities will surpass the power that could be produced by a cogeneration system that relies solely on the plant solids to produce methane gas. Therefore, all of the power

generated by a cogeneration system at the Jennings Road Plant could be utilized. This would improve eligibility for self-generation grants.

4. If the City determined that water reuse within the City's urban boundary was desired in the future, there may also be some benefit in maintaining the primary treatment facilities at the Sutter Avenue Plant site. Specifically, the City could build a small secondary/tertiary treatment plant (including disinfection) that could directly treat a portion of the primary effluent generated at the Sutter Avenue Plant site. This approach could have some benefits over satellite treatment (which is another option for urban reuse within City boundaries). Specifically, solids produced in the post-primary treatment steps could be conveyed directly to the digesters at the Sutter Avenue Plant. Nevertheless, the available land that could be dedicated to this use would be limited due to the reductions in the available plant site that would occur to adequately provide flood protection. Thus, additional investigations would be necessary to determine if reuse opportunities at the Sutter Avenue Plant site would truly be a benefit of the Sutter Avenue Plant Retention alternative.

Major Project Considerations

The relocation of the Sutter Avenue Plant facilities to Jennings Road is likely to require greater early capital outlay than if the primary facilities were retained in their current location. This could be a fatal flaw if it were not possible to raise adequate funding in the near term.

Another major concern is the City's ability to acquire adequate land at or near the Jennings Road Plant site. As discussed previously, if the relocated facilities are constructed on the existing City-owned property, some of the City's land application area for Can-Seg flows (or possibly some of the existing area used for storage ponds) would be lost. Because the City must be able to blend Can-Seg flows with secondary effluent and ultimately dispose of Can-Seg flows in accordance with permit requirements, a reduction in land application (or storage) area may not be acceptable unless an alternative means of handling a portion of the Can-Seg flows is identified.

All things considered, preferred approach would likely be to purchase additional land near where the influent sewer enters the Jennings Road Plant and to construct the relocated facilities in this area. However, if land in this desired location is not available for purchase, the City could potentially treat a portion of the Can-Seg flows or purchase land elsewhere for land application of Can-Seg flows – thus freeing up the existing land application area for construction of the relocated facilities.

SUMMARY OF CONCLUSIONS

Based on the review provided herein, there do not appear to be any major erroneous assumptions or conclusions identified in the FLP that have contributed to a recommendation to relocate the facilities to the Jennings Road Plant. Moreover, relocating to the Jennings Road Plant would eliminate many of the constraints and additional cost potentials identified herein. Finally, there are several possible critical issues associated with the Sutter Avenue Plant Retention alternative that could be fatal flaws. Most (if not all) of these items are being considered as part of the City's larger Sutter Avenue Plant Relocation Study.

It is recommended the following considerations not mentioned or accounted for in the FLP for the Sutter Avenue Plant Relocation alternative be evaluated during the next step in assessing the Relocation Alternative:

- Land purchase needs at Jennings Road Plant site (potential cost above FLP),
- Sizing of new primary facilities at Jennings Road Plant site (potential savings over FLP),
- Sizing of new solids handling facilities (potential cost above FLP, but still less than a revised cost for the Sutter Avenue Plant Retention alternative if the same level of treatment and control for the BNR secondary solids is provided in both alternatives),
- Flood protection of remaining facilities and sulfide control at Sutter Avenue Plant site under the relocation alternative (potential cost above FLP),
- Support system requirements at Jennings Road Plant site (unclear whether this would be a savings or cost increase over the FLP),
- Future laboratory needs (unclear whether this would be a savings or cost increase over the FLP),
- Flood protection requirements at Jennings Road Plant site (potential cost above FLP, but may be required regardless of which alternative is selected), and
- The value of the land at the Sutter and Jennings sites that would be required to accommodate the needed facilities.

APPENDIX B – HDR FPA RESULTS

Sutter Primary Treatment Facility
Flood Protection Analysis

City of Modesto, California

November 2014

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Appendices

1.0 Introduction

1.1 Background and Purpose

The City of Modesto (City) is faced with a critical decision regarding its future for providing wastewater treatment. The City owns and operates two wastewater treatment facilities: a primary treatment facility at Sutter Avenue, and a secondary/tertiary treatment facility at Jennings Road, which is about six miles southwest from the Sutter Plant. Many of the treatment facilities at the Sutter Plant are nearing the end of their useful life, and the site is vulnerable to flooding from the adjacent Tuolumne River. The purpose of this flood protection analysis is to determine if constructing a levee or floodwall to protect the Sutter Plant is feasible and/or acceptable to the floodway regulatory agencies – the Federal Emergency Management Agency (FEMA) and the Central Valley Flood Protection Board (CVFPB).

1.2 Project Location Description

The Sutter Plant is located adjacent to the Tuolumne River, just downstream of the Dryden Park Golf Course and upstream of S. Carpenter Road Bridge, within the City of Modesto in Stanislaus County, California. The Tuolumne River flows in a generally east to west direction, with a smaller tributary, Dry Creek, merging with the Tuolumne River just upstream of the 9th Street Bridge. See **Figure 1** for project location.

1.3 Project Approach and Scope of Work

In general, the project scope includes researching, evaluating existing geotechnical information and floodplain mapping studies, hydraulic modeling, and geotechnical modeling at the Sutter Plant.

Specific tasks include:

- Update the hydraulic FEMA HEC-RAS model with additional cross sections at the plant
- Update the hydraulic FEMA HEC-RAS model with proposed levee/floodwall alignment
- Run and check reasonableness of model results
- Prepare water surface profiles
- Model excavation of the bank to offset rise in water surface caused by levee/floodwall
- Evaluate seepage under a new floodwall and levee and identify any necessary remediation measures
- Prepare and submit the Flood Protection Analysis Report

2.0 Planning Level Design Criteria

2.1 Level of Flood Protection

The City has selected a 1-percent annual chance of exceedance (100-year) level of flood protection to be evaluated at the Sutter Plant. Both the FEMA and the CVFPB 1-percent annual chance floods were evaluated. Correspondence related to this decision is included in **Appendix A**. The DWR 0.5% annual chance (200-year) flood was not evaluated for the proposed alignment but 0.5% results for the existing condition are presented for comparison.

2.2 Proposed Levee/Floodwall Alignment

The City selected a proposed levee/floodwall alignment for providing flood protection at the Sutter Plant, as shown in **Appendix B**. The proposed alignment surrounds the entire plant including the lowest primary clarifier (Clarifier No.2). The sludge drying beds would not be protected. The proposed levee/floodwall alignment that has been evaluated is shown on **Figure 2**. Each end of the levee would tie into high ground at approximately elevation 75.0.

A levee is the preferred choice except for the segment between Clarifier No. 2 and Pump Plant 3, “Cannery Segregation Pump Station”. The levee would extend approximately 1,300 feet on the east side of the plant and approximately 1,900 feet on the west side of the plant. Between Clarifier No.2 and the trees, a floodwall is recommended due to insufficient space for a levee. The floodwall would then continue near the vicinity of Pump Plant 3. At Pump Plant 3 there would be insufficient room for a floodwall. Either bank filling or relocation of Pump Plant 3 would be required to make adequate room for a floodwall or levee. The floodwall would extend a total of approximately 1,300 feet and continue for a short distance into each levee, providing a safe transition between the two types of structures.

Another option identified by Carollo Engineers would be to minimize the length of floodwall by filling in the storm pond and bank along the east side of the plant as needed to provide space for a levee. This could reduce the length of floodwall to about 500 feet near Clarifier No. 2. Under this option, the length of floodwall would be about 500 feet and the length of levee along the east side of the plant would be about 2100 feet. The additional cost of fill may be offset by the lower cost of levee construction as compared to floodwall construction. This concept is shown in a figure provided by Carollo, contained in **Appendix C**.

The proposed levee/floodwall alignment would be situated near and over numerous pipelines. United States Army Corps of Engineers (USACE) and CVFPB criteria call for relocation of pipelines that are parallel to the levee/floodwall, so that they are at least 10 feet from the levee/floodwall. Pipelines that cross the levee should be placed within the top of the levee slope and levee crown and meet certain pipe material requirements. Pipelines may also be allowed to cross under the levee/floodwall if encased in reinforced concrete with special measures taken to protect against seepage along the pipeline.

2.3 General

In 2014, a hydrologic and hydraulic analysis for the restudy of Tuolumne River and Dry Creek was completed by HDR for FEMA. The analysis was administered through the California

Department of Water Resources' Cooperating Technical Partner Agreement Number EMF-2009-GR-0908, Statement of Work 2, CTP agreement date March 4, 2009 and Grant Agreement Date August 5, 2009.

The 1-percent, 0.5-percent, and 0.2-percent annual chance of exceedance water-surface elevations for Tuolumne River and Dry Creek were determined using detailed methods. The United States Army Corps of Engineers HEC-RAS 4.1 computer model program, operating in unsteady state, was used to determine the water-surface elevations and the FEMA floodway for the study reach. The cross sections and the work map for the analysis were obtained from Light Detected Aerial Radar (LiDAR) and ground surveys (DWR, 2008 and Andregg Geomatics, 2012).

The hydraulic model was calibrated using observed high watermarks from the January 3-4, 1997 storm event. Manning's n-values and bridge modeling methods were adjusted to calibrate the HEC-RAS model. Roughness coefficients (Manning's "n" values) were estimated based on field visits and guidelines outlined in Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains (U.S. Geologic Survey Water Supply Paper - 2339, 1989). The values selected ranged from 0.045 in the channel, and from 0.055 to 0.090 in the overbank areas. Once calibration was established, the 1- and 0.2-percent annual chance (100- and 500-year) peak hydrographs were run to compute water surface profiles. A 1-percent annual chance (100-year) floodway was also recomputed for the study reach.

Results from this study are not yet published on the FEMA Flood Insurance Rate Maps (FIRMs), however, this is the best available information and therefore used for this evaluation. This 2014 analysis will eventually replace the detailed analysis that is currently shown on the effective FIRMs.

Additional information regarding the FEMA study can be found in the Task Order 105 *FEMA 1-, 0.5 and 0.2-Percent Annual Chance (100-Year, 200-Year and 500-Year) Floodplain Evaluation and Delineation Addendum Final Hydraulic Analyses and Results for Tuolumne River and Dry Creek in Stanislaus County*.

2.4 FEMA and CVFPB Floodway

The proposed levee/floodwall alignment is located within the FEMA and CVFPB floodways. Therefore, representatives of both agencies must provide concurrence on the project before any construction occurs. In order to comply with FEMA, a No-Rise Certification must be submitted and accepted. In order to comply with CVFPB, a permit application with documentation must be submitted and approved. The FEMA and CVFPB floodway boundaries, along with the FEMA 100-year and DWR 200-year floodplains, are designated on **Figure 2**.

2.5 FEMA No-Rise Certification

FEMA's 44 CFR 60.3(d)(3) states that "[In the regulatory floodway, communities must] prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice

that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge."

In order to prevent cumulative impacts on flood stages and damages, no rise is permissible for any encroachment. To comply with FEMA's 44 CFR 60.3(d)(3) and determine whether the encroachment will cause an increase in flood levels, all projects within the floodway must undergo an encroachment review before a permit is issued. Permit files must contain a record of the analysis results. The review must be based on technical data from the same computer model used to develop the floodway. If it is determined that the encroachment will not affect flood heights, the record of the encroachment review may be in the form of a "no-rise" certification signed by a registered professional engineer.

2.6 CVFPB Encroachment Permit

The Central Valley Flood Protection Board exercises encroachment permitting authority in designated floodways on the Sacramento River and San Joaquin River and their tributaries under Section 8609 of the California Water Code. In 1975, the CVFPB adopted a 100-year flood designated floodway on the Tuolumne River. Accordingly, any encroachment within the designated floodway requires an encroachment permit from the CVFPB. Before issuing a permit, the CVFPB would notify adjacent property owners of the project. If the project is considered controversial, such as if any notified nearby property owner were to protest issuance of the permit, the decision to issue a permit would be made at a public meeting of the CVFPB after public discussion. In deciding whether to issue the permit, the CVFPB would consider public testimony and any rise in water surface that would result from the encroachment.

3.0 Topography, Surveying and Base Mapping

3.1 General

Base map data was primarily obtained as part of the Central Valley Floodplain Evaluation and Delineation (CVFED) program funded by DWR. A LiDAR survey was previously performed to generate digital topographic data consisting of 2-foot contours and a digital terrain model (DTM). The LiDAR data was collected on March 24, 2008. Digital orthophotos were also previously collected and used in the analysis. The orthophotos were collected on March 16, 2008. The orthophotos and topographic data were used in horizontal projection, NAD 83 UTM Zone 10N System. LiDAR data was collected in vertical datum NAVD 1988.

A supplemental field survey was also conducted to assist in the development of the hydraulic model(s). Field survey data was used to supplement LiDAR data at locations where LiDAR had low confidence due to water in the channel at the time it was collected and/or dense vegetation preventing the bare earth elevations from being captured. Field survey data was also needed to capture channel geometry and hydraulic structure elevations. A field survey was also conducted for hydraulic structures when as-built drawings could not be obtained from the Stanislaus County or City of Modesto. Photographs and hand sketches were also collected at locations where bridge as-built structures are not available. The field survey was conducted in November 2012 using vertical datum NAVD 1988.

In addition, during this flood protection analysis, NorthStar Engineering Group captured elevations at numerous locations throughout the plant and provided them on a previously existing topographic map, using vertical datum NAVD 1988.

4.0 Hydraulic Model Development

The following sections describe the additional modifications applied to the approved FEMA HEC-RAS hydraulic model used in the evaluation of water surface elevation upstream of the Sutter Plant.

4.1 Peak Discharges

Peak river discharges that were used in this analysis are summarized below. The FEMA 1-percent annual chance event and the CVFPB 1-percent annual chance event were run and impacts to the water surface were evaluated. The FEMA 1-percent event hydrograph was available, but not the CVFPB 1-percent event hydrograph. Since the model is run as unsteady, the CVFPB 1-percent event hydrograph was scaled down directly from the FEMA 1-percent event hydrograph. The CVFPB 1-percent event discharge is significantly smaller than the FEMA 1-percent event discharge because it is from the early 1970s and does not reflect updated hydrological information. **Table 1** summarizes the 1-percent annual chance (100-year) peak flows. The Tuolumne River at Modesto gage is located at the confluence of Dry Creek and the Tuolumne River.

Table 1 - Tuolumne River 1-Percent Annual Chance Event Flows

Agency 1% Annual Chance Event	Tuolumne River at Modesto (Gage B04105) (cfs)
FEMA	70,000
CVFPB	44,000

4.2 Cross Section Development

Five additional cross sections were added to the FEMA 1-percent HEC-RAS model at the Sutter Plant using approximately 500-foot intervals to better capture and represent the proposed levee/floodwall alignment. This model is referred to as the Modified FEMA 1-percent HEC-RAS model. The new cross sections were extracted using HEC-GeoRAS utilities in ArcMap 10.2. Bathymetric data for the new cross sections were manually interpolated from known upstream and downstream surveyed bathymetry cross sections to approximate the lowest point in the channel and the overall shape of the channel bottom. The original and additional cross sections are shown in plan view on **Figure 3**.

With the additional cross sections added to the model, the water surface elevation decreased 0.5 feet from the 2014 FEMA HEC-RAS modeling results in the vicinity of the Sutter Plant extending upstream. The decrease in water surface elevation was due to added channel detail as well as refined n-value variation across the floodplain overbanks and channel. The Modified FEMA 1-percent HEC-RAS model was used for comparison purposes when evaluating the impacts of the proposed levee/floodwall alignment.

4.3 Hydraulic Structure Modeling

A vertical floodwall was added to the model along the proposed levee/floodwall alignment. A vertical floodwall was used to represent the entire length of the floodwall and levee system

because it simplifies the hydraulic analysis and would cause slightly less of a rise in water surface than a levee. The vertical floodwall was modeled initially to determine impacts to the water surface elevation. If results showed that a full levee prism could fit within the channel, the levee geometry would have been added directly into the geometry cross section. As noted in Section 2.2, between Clarifier No. 2 and Pump Plant 3 there would not be sufficient room for a levee. The floodwall was modeled in the cross section levee data editor function of HEC-RAS as shown in **Table 2** and **Figure 3**. The cross sectional view at River Station 40776 (near Clarifier No.2) is shown in **Figure 4**.

Table 2 - Modeled Levees

Stream Name	River Station	Levee Station (ft)
Tuolumne River	40361	3032
Tuolumne River	40776	2958
Tuolumne River	41238	3244
Tuolumne River	41811	3350

4.4 Manning's n-Values

The horizontally varying n-values for the new and existing cross sections in the vicinity of the Sutter Plant were modified from the original FEMA model n values to reflect the increased level of detail. The existing n value of 0.09 was decreased to 0.07 for a portion of the right overbank to more appropriately model the roughness at the wastewater treatment plant compared to the dense residential development. N values of 0.05-0.065 were used for vegetated areas, and 0.09 was used for areas with dense residential development obstructing flow.

4.5 Contraction and Expansion Coefficients

Contraction and expansion losses are not generally used in unsteady flow; therefore the default coefficient in HEC-RAS is typically zero. The 2014 FEMA HEC-RAS model used the default coefficient of zero since it properly represented the energy losses of the unsteady flow. For this analysis, the addition of the floodwall introduced a sudden flow contraction, leading to additional energy losses in the unsteady flow. As a result, the default 1-D momentum equation used in HEC-RAS was thought to not adequately represent all of the forces in the encroached area. To account for the additional energy loss and change in water surface elevation near the new floodwall, the unsteady contraction and expansion coefficients were set to 0.3 and 0.5, respectively. By increasing the contraction and expansion coefficients, the water surface elevation only increased minimally less than 0.1 foot. Additional information regarding increased unsteady flow coefficient can be found in the HEC-RAS Users Manual on page 6-123.

4.6 Ineffective Flow Areas

Ineffective flow areas were used to limit portions of the effective channel cross section upstream and downstream of leveed constriction. The 2014 FEMA model used ineffective flow areas on the left bank (looking downstream) near the Sutter Plant. With the addition of a floodwall to the model, ineffective areas on the left bank of the cross sections containing a floodwall were removed because it was expected that flow would be directed to the left side of the channel,

making this area effective. Further, since the floodwall protects the right bank, ineffective flow areas behind the floodwall were redundant and were removed from the model.

To model the transition of flow through the constriction caused by the new floodwall, ineffective flow areas were added on the right bank of the cross section directly upstream and the cross section directly downstream of the floodwall.

4.7 Bank Cutting

If the new floodwall were to cause a rise in water surface elevation, further analysis would be conducted to determine whether bank cutting or excavation (steepening the slope of the bank between the floodwall and the river) would create enough additional streamflow capacity to eliminate the rise. The excavation would be limited to the area between the floodwall and the riparian trees (to avoid significant environmental impacts). Construction of a floodwall between Clarifier No. 2 and the riparian growth (which reportedly includes elderberry bushes) could trigger the need for environmental permits. Bank cutting would increase this likelihood. Some federal and state laws that could apply include (but are not limited to):

- Clean Water Act Sections 404, 402, and 401
- Fish and Game Code Section 1601
- Federal Endangered Species Act.

If the bank cutting described above is insufficient to eliminate a rise in water surface elevation, additional deep bank cutting to create a secondary channel through the sludge drying beds would be evaluated. This is further discussed in Section 5.

5.0 Hydraulic Modeling Results

5.1 General

The results from the unsteady model of the proposed levee/floodwall at the Sutter Plant were compared to the Modified FEMA 1-percent HEC-RAS model. Overall, the unsteady model of the proposed Sutter Plant floodwall produces higher water surface elevations than the Modified FEMA 1-percent HEC-RAS model. Water surfaces increased upstream of the levee/floodwall to a maximum rise of 0.55 feet measured at River Station 42542 compared to the Modified FEMA 1-percent HEC-RAS model. The increase in water surface elevation extended past Highway 99, 7th Street, and 9th Street Bridges to the end of the modeled Tuolumne River reaches, and extended up to El Vista Avenue on the Dry Creek reach.

A comparison of flow depth and durations measured near Clarifier No. 2 (River Station 40776) for the FEMA 1-percent (100-year) flow and the DWR 0.5-percent (200-year) flow are provided in **Table 3** below. Overall, the duration of flooding at elevations 60 feet and 65 feet is not anticipated to change if the floodwall is constructed compared to the existing condition. The depth of flooding at Clarifier No. 2 only slightly increased with the floodwall. This occurred because the channel constriction increased flow velocity, limiting the rise in water surface elevation through the narrowest portion of the channel.

Table 3 - Flow Depths and Durations near Clarifier No. 2

Measured Parameter	Existing (100-year)	Proposed (100-year)	Existing (200-year)*
Depth near Clarifier 2 (feet)	11.64	11.66	14.93
Duration above El. 60 (hr)	182	182	192
Duration above El. 65 (hr)	90	90	160

*Existing DWR 200-year floodplain provided for informational uses only. A model of the 200-year flows with the proposed levee/floodwall was not created since only the 100-year flows were selected for analysis.

Unsteady model results using the CVFPB 1-percent peak flow were also compared and a rise of 0.27 feet was produced. Water surface profiles for both the CVFPB 1-percent flow and the FEMA 1-percent flow are included in **Figure 5** and **Figure 6**, respectively.

5.2 Bank Cutting

An unsteady model run was performed with bank cutting between the floodwall and the trees in the area near Clarifier No. 2. The bank was cut at a 5H:1V slope (which may be flat enough to avoid the need for revetment), with a setback of 30 feet from the floodwall (to avoid impacting its stability), ending at the tree canopy (to avoid environmental impacts). The resulting cut was approximately 90 feet wide. A cross sectional view of the bank cut is shown in **Figure 7** and an aerial view of the bank cut extents is shown in **Figure 7C**.

The bank cutting decreased the 0.55-foot rise in water surface by 0.08 feet. The water surface profile with the bank cut (compared to without the bank cut) is shown in **Figure 8**.

To check whether more aggressive bank cutting that would likely require revetment could offset the rise in water surface, a bank cut at 3:1 slope with a setback of 20 feet from the floodwall was also modeled. This bank cutting decreased the 0.55-foot rise in water surface by 0.11 feet.

Therefore, for the given floodwall alignment, bank cutting near Clarifier No. 2 would not fully offset the rise in water surface.

5.3 Secondary Channel

In addition to the bank cutting evaluated above, HDR evaluated whether a deep bank cut to create a secondary channel through the sludge drying beds would offset the rise in water surface. This cut was connected directly to the 3H:1V bank cut near Clarifier No. 2. Such a cut through the sludge drying beds could potentially have environmental benefits if properly vegetated and graded to return the flows to the main channel and prevent fish stranding. Cross-sectional view of the cut are shown in **Figure 7B** and an aerial view of the bank cut extents is shown in **Figure 7C**. **Figure 8** shows an aerial view of the extent of the bank cuts.

A new channel with 5:1 side slopes and a flat bottom at the elevation of the thalweg of the main channel of the Tuolumne River was cut through the sludge drying beds. The cut was set back 100 feet from the drying beds exterior berm and underground pipelines. This new channel was assumed to be moderately vegetated with riparian forest (Manning's roughness of 0.07) with a connection to the main channel of the Tuolumne River at its downstream end. This connection would prevent fish stranding and allow the new channel to fill and drain gradually along with the rise and fall of the Tuolumne River. Under these conditions, 5:1 cut slopes would likely be flat enough to be stable and not subject to significant erosion. The cut was set back 100 feet from the exterior berm and cut depth was limited to the main channel thalweg elevation based on the CVFPB's regulations in Title 23 of the California Water Code. Although the connection to the main channel would be an important feature of the secondary channel, it could not be modeled accurately with the one-dimensional HEC-RAS model since the direction of the connection would be transverse to the main channel and secondary channel.

By cutting through the sludge drying beds to create this secondary channel, the 0.55 foot rise was reduced to a 0.11 foot rise. This amount of rise is considered to be within the uncertainty of the one-dimensional HEC-RAS model.

The presence of the floodwall would also increase flow velocities in the main channel and right overbank area. Both the main channel and right overbank area would experience a significant increase in average flow velocity in the vicinity of Clarifier No. 2. For the main channel, this would likely aggravate a pre-existing erosive velocity by increasing the velocity of 5.8 feet per second (fps) to 7.5 fps. For the right overbank area, the average velocity would increase from about 2.3 fps to 4.1 fps, likely triggering a need for revetment. A two-dimensional model would be needed for determining whether the rise can be eliminated and identifying localized increases in flow velocities associated with the floodwall and bank cutting with a secondary channel.

Therefore, with the one-dimensional HEC-RAS model and the given floodwall alignment, it is not possible to determine whether bank cutting combined with the creation of a secondary channel through the sludge drying beds would fully offset the rise in water surface. In addition, the required grading to connect the secondary channel to the main channel of the Tuolumne River may trigger the need for project approvals from the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration Fisheries, California

Department of Fish and Wildlife, the Regional Water Quality Control Board, State Historic Preservation Office, and the State Lands Commission (in addition to FEMA and the CVFPB).

6.0 Seepage Evaluation Criteria

The predominantly sandy soils at the Sutter Plant raise concerns about seepage under a new floodwall or levee that may be constructed at the Sutter Plant. Stability, levee through-seepage, and settlement were not evaluated due to lack of information about levee fill materials. Nevertheless, these are not likely to be of concern if proper controls are used in selecting and placing new levee fill during construction. The evaluation criteria used for seepage under the proposed floodwall and levee is summarized in **Table 4**.

Table 4 - Summary of Design Criteria

Analysis	Point of Evaluation	Maximum Seepage Gradient or Minimum Factor of Safety
Seepage Analysis 1-Percent	Exit Gradient at Toe of Levee	$i_{ave} \leq 0.5$ Factor of Safety (FS) > 1.6 for surface soils less than 112 pcf

7.0 Modeling and Analyses

7.1 Cross Section Selection

Two cross sections were chosen for the analysis: one section through the proposed floodwall (near Clarifier No. 2) and one section though the proposed levee (west of Clarifier No. 2). The floodwall cross section, Cross Section 1, is located at the southern end of the plant and transverses south to north. This cross section is near the river channel and would include a floodwall approximately 15 feet tall. There is no standard cross section for floodwalls; each floodwall has to be designed specifically for the anticipated loads. For the seepage analysis, the structural dimensions of the wall are assumed to be 22 feet tall (15 feet projecting above ground) with a base 17 feet wide and 2 feet thick. Cross Section 2, the levee cross section, is located west of Cross Section 1, and transverses from south-west to north-east through the plant. The levee is assumed to be a typical levee section consisting of 3H:1V side slopes with a 20 foot wide crown.

The subsurface stratigraphy was developed using historic boring logs provided by the City of Modesto. Twelve historic borings are located within the plant; their depths ranged from 15 feet below ground surface (bgs) to 51½ feet bgs. Eight borings were used to develop the stratigraphy from Cross Section 1 (DH-101 (1981), DH-102 (1981), DH-103 (1981), DH-9 (1983), DH-11 (1983), B-2 (2011), B-3 (2011), B-4 (2011)) and five borings were used to develop the stratigraphy for Cross Section 2 (DH-102 (1981), DH-103 (1981), DH-104 (1981), DH-10 (1983), DH-11 (1983)). The deepest boring provided by the City went to 81 feet, but it was not used due to its great distance from the levee. A plan view of the borings and the alignments of the two cross sections are shown in **Figure 9**. The stratigraphy for each cross section is shown in **Figures 10 and 11**.

The existing ground elevation of some of the historic borings were not provided, therefore the elevation was estimated from existing ground contours. If current ground elevations at the plant are significantly different than when the borings were made, this could be a source of error in the modeled stratigraphy.

7.2 Material Properties

Limited laboratory data were available for the historic borings provided and used in developing the cross sections. Therefore, the hydraulic conductivity values used for the seepage analysis were obtained primarily from typical values recommended by California Department of Water Resources (DWR) and Natomas Levee Improvement Program (NLIP) Board of Senior Consultants (BOSC) for soils in the California Central Valley. The selected hydraulic conductivities are shown in **Table 5**.

Table 5 - Material Properties

Soil Layer	k_h (cm/sec)	k_h (ft/day)	k_v/k_h
Silty Sand (SM)	$3x10^{-4}$	0.85	0.25
Silt (ML)	$1x10^{-5}$	0.028	0.25
Poorly Graded Sand (SP)	$3x10^{-3}$	8.5	0.25
Well Graded Sand (SW)	$1x10^{-2}$	28.3	0.25
Flood Wall	$1x10^{-7}$	$2.83x10^{-4}$	0.25
Levee Fill	$1x10^{-5}$	0.028	0.25

8.0 Seepage Analysis

8.1 Model Development

The finite element computer program SEEP/W, part of the GeoStudio Version 8.13 software package, was used to model floodwall and levee underseepage. The models were developed for each cross section and were extended landward 2,000 feet from the approximate centerline of the levee/floodwall to reduce landside model boundary effects. If topographic information was not available to this 2,000-foot limit, the model was extended horizontally using the lowest ground surface on the landside toe of the levee/floodwall. On the waterside, the models were extended to the approximate middle of the river channel at the location of the cross section being analyzed.

The boundary conditions for the SEEP/W models were as follows:

- Nodes along the waterside levee slope and river bottom and waterside vertical edge were set to the FEMA 1-Percent water surface elevation fixed-head boundary condition (elevation 70.5).
- Nodes along the bottom of the model and landside vertical edge were set to have a no flow boundary condition.
- Nodes on the landside levee slope and the landside ground surface were modeled as potential seepage surfaces.

8.2 Underseepage Analyses and Results

For each underseepage analysis, the average vertical exit gradient (i_{ave}) was calculated across the composite blanket at the levee/floodwall toe. The i_{ave} was calculated as the total head drop in the vertical direction across the levee's landside blanket divided by the blanket thickness. The underseepage results are shown in **Figures 12 and 13** and presented in **Table 6**.

Table 6 - Summary of Underseepage Results

Cross Section	1-Percent WSE i_{ave} at Levee Toe/38ft. Landside of Floodwall Toe
Cross Section 1	0.41
Cross Section 2	0.31

Based on the preliminary analysis using historic geotechnical information, the proposed levee meets underseepage criteria. The proposed floodwall, however, does not meet underseepage criteria unless additional fill material is placed on the landside. One foot of fill material was modeled on the landside of the floodwall and tapered down to existing ground approximately 125 feet landward of the floodwall. Fill volume was estimated using topography in GIS. To fill the area behind the floodwall to Elevation 59 approximately 1000 cubic yards of fill material will be needed. Approximately 350 feet of the proposed floodwall has landside ground elevation

lower than Elevation 59, by approximately 0.5 feet on average. Other commonly used approaches for addressing levee/floodwall underseepage include cutoff walls to a subsurface impervious layer, seepage berms, and relief wells. It appears that a modest amount of fill would address underseepage far more cost effectively than these other approaches. However, because the underseepage would be controlled but not eliminated, wastewater treatment facilities embedded below ground surface would need to be evaluated for seepage uplift forces and surface runoff drainage pumping capacity for the plant would need to account for the seepage.

An assumed footing and drains were included in the floodwall model. Results presented for cross section 1 in **Table 6** include the one foot of fill, footing, and drains.

If further design of a levee/floodwall system is desired, additional geotechnical information would be required to refine and improve the underseepage models. In addition, the floodwall modeling does not include a potential cutoff associated with the installation of the floodwall. Typical USACE floodwall design would include a shallow sheet pile to prevent seepage along the base of the floodwall. This could be included in a refined model.

9.0 Conclusions

From a geotechnical perspective, it appears feasible to construct a levee/floodwall system that, with minor remediation, would meet design criteria for underseepage. However, such a system would require costly relocation and modification of numerous plant pipelines and Pump Plant 3.

From a hydraulic perspective, it does not appear feasible to protect the identified portions of the Sutter Plant shown on **Figure 2** and satisfy the “no-rise” criterion of FEMA with a bank cut near Clarifier No. 2. Cutting a deep secondary channel through the sludge drying beds would eliminate most of the rise; the remaining rise of 0.11 foot should be considered to be within the uncertainty of the one-dimensional HEC-RAS model. The proposed alignment would also lead to increases in flow velocity which would require bank protection.

Deep bank cutting to create a secondary channel through the sludge drying beds would further reduce the water surface elevation upstream of the plant, nearly to an acceptable level. If this option is to be pursued, a more detailed evaluation using a two dimensional modeling tool would be needed to more confidently predict stages and velocities in the area. The HEC-RAS model is not sophisticated enough to accurately model the complex geometry of the secondary channel. Many regulatory agencies including FEMA, CVFPB, USACE, USFWS, NOAA Fisheries, DFW, RWQCB, SHPO, and SLC would also need to be consulted to address project design and environmental concerns associated with the secondary channel and connection to the main channel.

Other risks associated with the levee/floodwall that are unlikely to be fatal for the project, but could add costs include:

- Uplift forces from seepage under the levee/floodwall that could damage wastewater treatment facilities embedded below ground surface, unless mitigated.
- Erosion near the levee/floodwall that could require revetment.
- Erosion along the main channel of the Tuolumne River that may be aggravated by the levee/floodwall.
- Liquefaction of foundation soils that could damage the levee or floodwall.
- Impacts on the environment or listed species that could require mitigation.

10.0 References

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11.0 Hydraulic Model Files

See **Table 7** for the list of files and descriptions for the HEC-RAS model files.

Table 7 - List of Model Files and Descriptions

Type of File	File Description	File Name
HEC-RAS Project File	DWRTO105_TuolumneRvr_DryCrk_FIS	.prj
1-Percent Annual Chance (FEMA 100-Year) Model		
Plan	TLR_DRC_100YR	.p01
Geometry File	TLR_DRC_100yr_200yr_Calib_Geometry	.g03
Unsteady Flow File	100YR_Event	.u01
Refined 1-Percent Annual Chance (FEMA 100-Year) Model with Floodwall at WWTP		
Plan	WWTP_100_inline	.p17
Geometry File	TLR_DRC_100yrCalib_Geo_WWTP_Inline	.g15
Unsteady Flow File	100YR_Event	.u01
Refined 1-Percent Annual Chance (FEMA 100-Year) Model without Floodwall		
Plan	FEMA_addxs	.p04
Geometry File	TLR_DRC_100yr_200yr_Calib_Geometry_xs	.g01
Unsteady Flow File	100YR_Event	.u01
Refined 1-Percent Annual Chance (Board 100-Year) Model with Floodwall at WWTP		
Plan	WWTP_100_inline_44000	.p02
Geometry File	TLR_DRC_100yrCalib_Geo_WWTP_Inline	.g15
Unsteady Flow File	100YR_Event_44000	.u02
Refined 1-Percent Annual Chance (Board 100-Year) Model without Floodwall		
Plan	44000_addxs	.p05
Geometry File	TLR_DRC_100yr_200yr_Calib_Geometry_xs	.g01
Unsteady Flow File	100YR_Event_44000	.u02
Refined 1-Percent Annual Chance (FEMA 100-Year) Model With Floodwall and Secondary Channel		
Plan	Sludgedrying_cut	.p12
Geometry File	Sludgedrying_Cut	.g11
Unsteady Flow File	100YR_Event	.u01
Refined 1-Percent Annual Chance (FEMA 100-Year) Model With Floodwall and Bank Cut		
Plan	Bankshaving	.p08
Geometry File	Bankshaving	.g06
Unsteady Flow File	100YR_Event	.u01
Refined 0.5-Percent Annual Chance (DWR 200-Year) Model Existing Condition		
Plan	FEMA_200_addxs	.p14
Geometry File	TLR_DRC_100yr_200yr_Calib_Geometry_xs	.g01
Unsteady Flow File	200YR_Event	.u03

Figures

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FDR

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

N
W E
S

0 500 feet

1 inch = 500 feet

Sutter Primary Treatment Facility Flood Protection Analysis

Location Map

Figure 1

Date: 8/4/2014

Vernon Avenue
Marlow Street
Hammond Street
Sutter Avenue
Garden Avenue
Robertson Road
John Street
Bellenita Park
Clarifier #1
Clarifier #2
Sludge Drying Beds
Tuolumne River
W Hatch Road
San Ramos Way
Dezzani Lane

F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F2_Study_Area_Map.mxd

HDR

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

- Proposed Floodwall Alignment
- Proposed Levee Alignment
- 1971 Central Valley Flood Protection Board Designated Floodway
- FEMA 100-year Floodplain
- DWR 200-year Floodplain

N
W E
S

0 500 feet

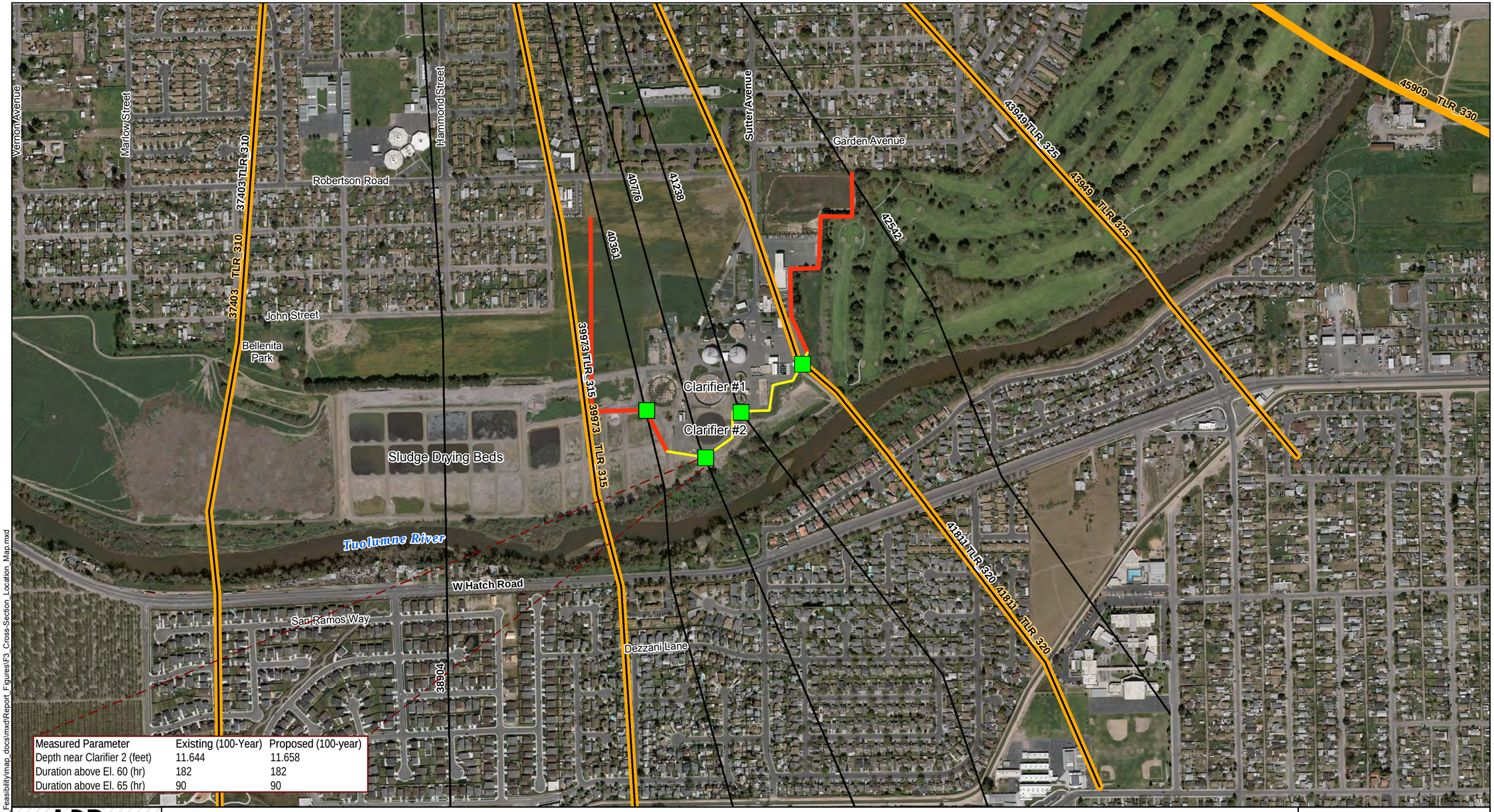
1 inch = 500 feet

Sutter Primary Treatment Facility Flood Protection Analysis

Study Area Map with Flood Control Measures

Figure 2

Date: 11/5/2014



Measured Parameter	Existing (100-Year)	Proposed (100-year)
Depth near Clarifier 2 (feet)	11.644	11.658
Duration above El. 60 (hr)	182	182
Duration above El. 65 (hr)	90	90

HDR

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

- HEC_RAS_Levee_Location
- Existing TO105 Cross-Section
- Sutter Primary Treatment Facility Cross-Section
- Proposed Floodwall Alignment
- Proposed Levee Alignment

N
W E
S

0 600 feet

1 inch = 600 feet

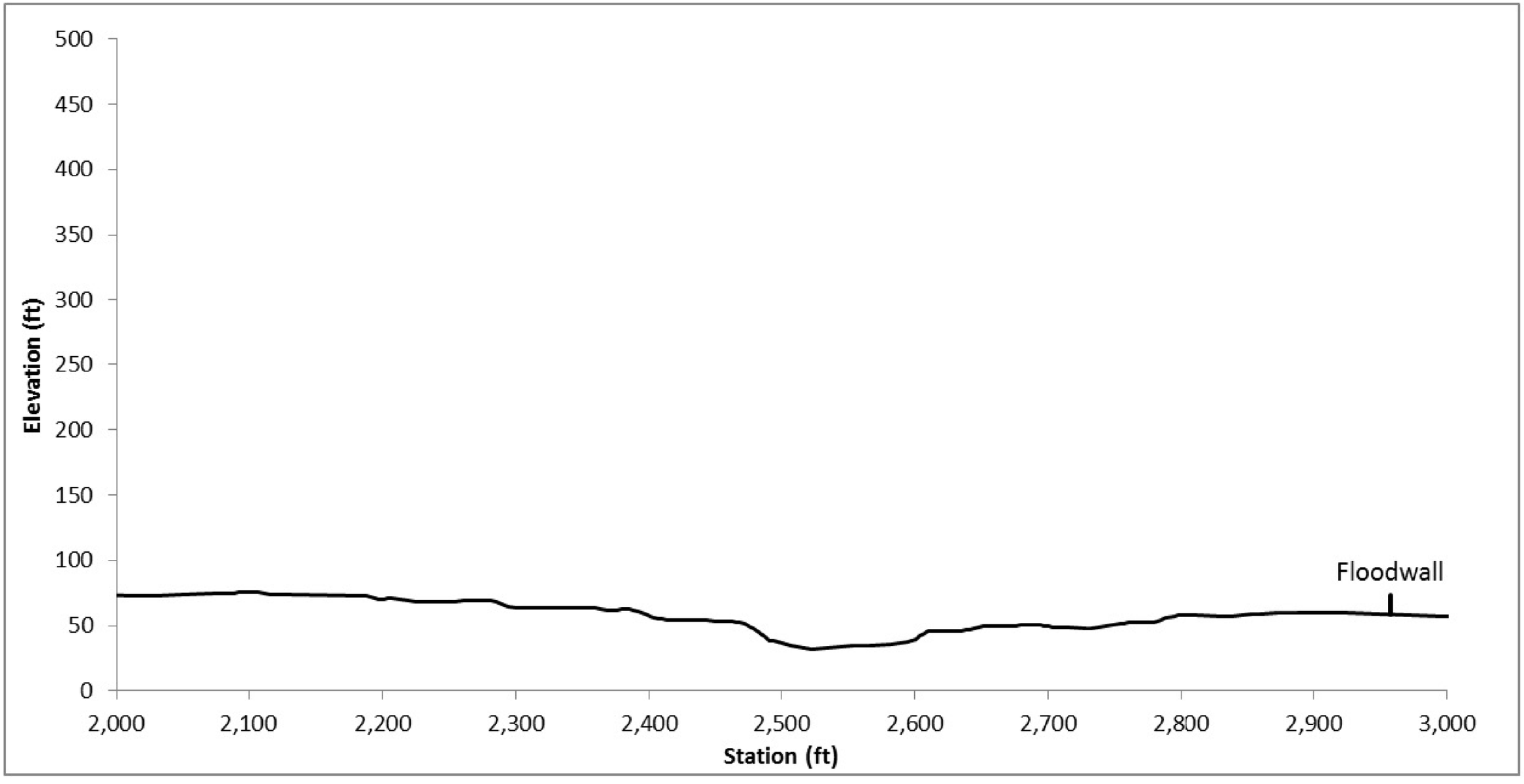
Sutter Primary Treatment Facility Flood Protection Analysis

Cross-Section Comparison

Figure 3

Date: 8/6/2014

F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F3_Cross-Section_Location_Map.mxd



F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F4_Cross-SectionCross-Sectional_View_of_River_Station_40776.mxd

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

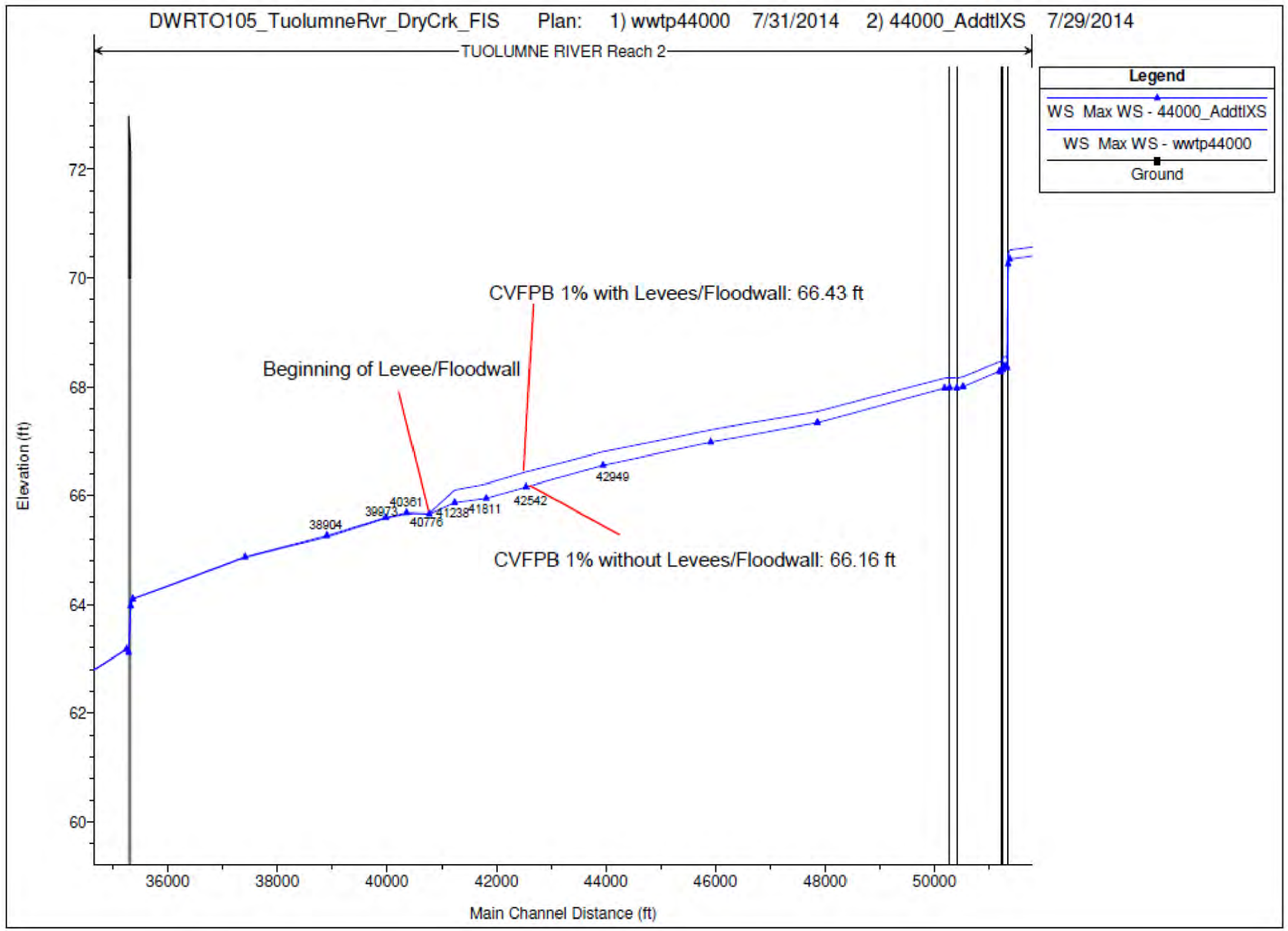
Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

Sutter Primary
Treatment Facility
Flood Protection Analysis

Cross-Sectional View of River Station 40776

Figure 4

Date: 8/7/2014



F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F5_Water_Surface_Profiles_for_CVFPB_1%_Flow.mxd

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

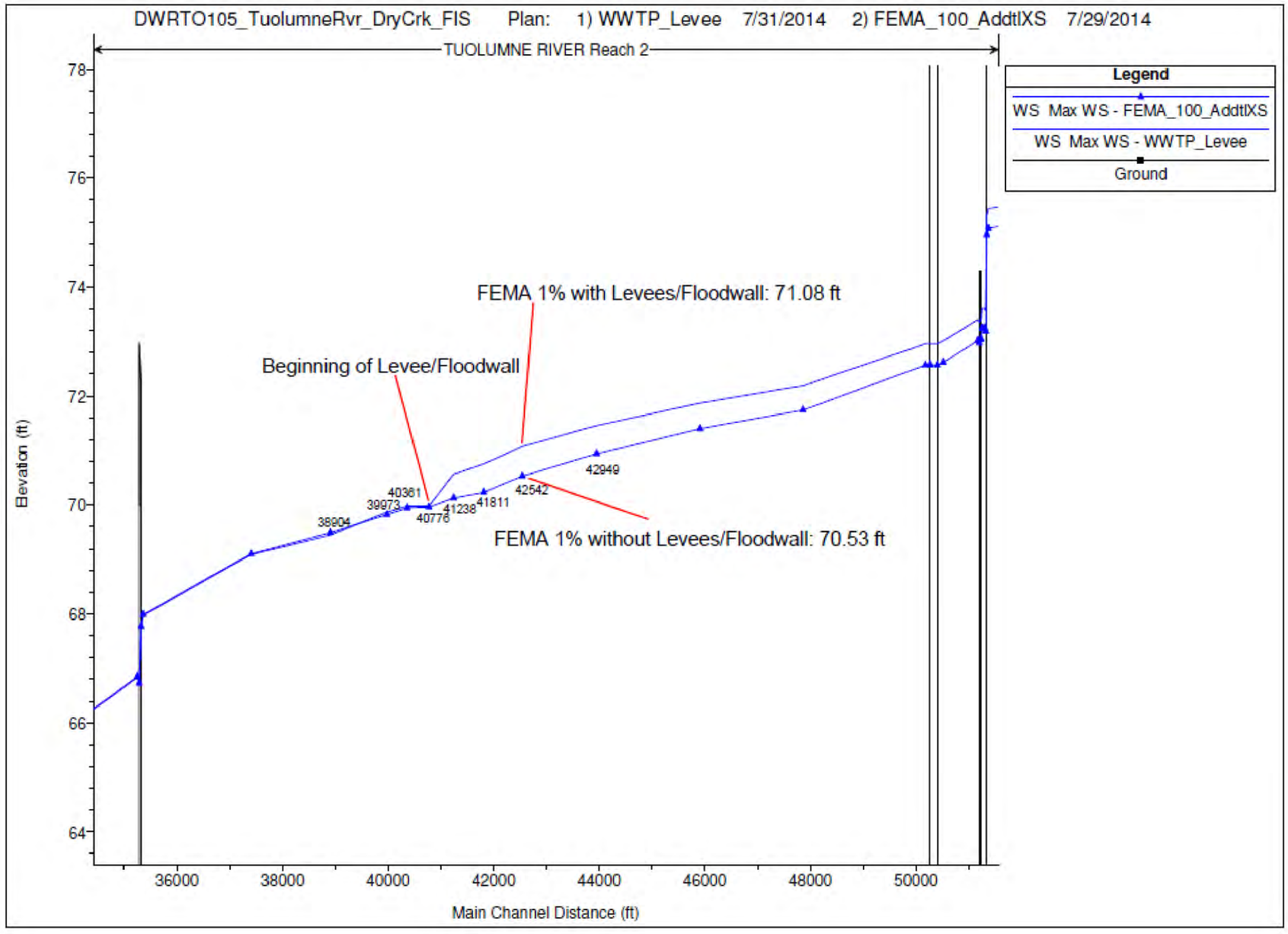
Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

Sutter Primary Treatment Facility Flood Protection Analysis

Water Surface Profiles for CVFPB 1% Flow

Figure 5

Date: 11/7/2014



F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F6_Water_Surface_Profiles_for_FEMA_1%_Flow.mxd

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

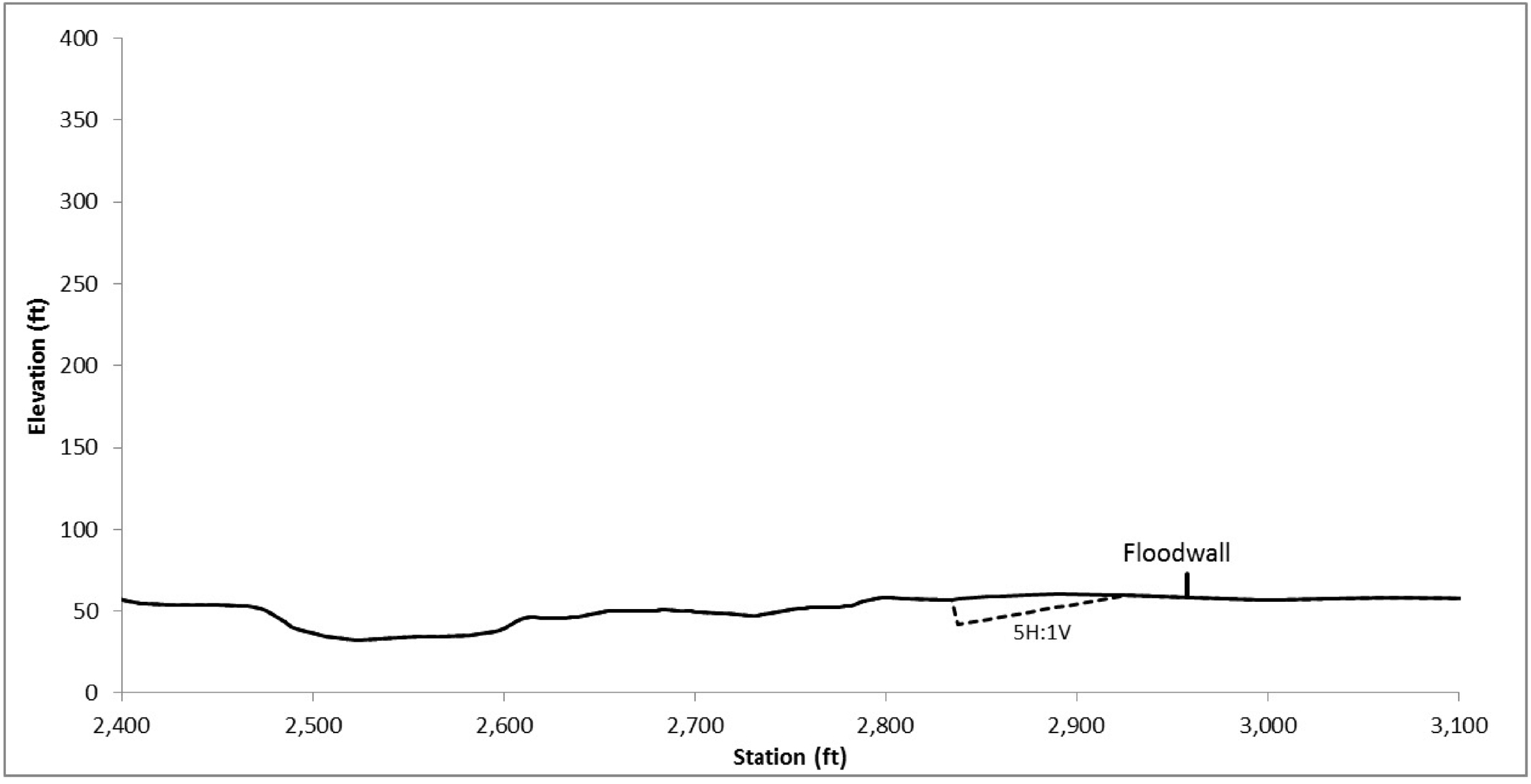
Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

Sutter Primary Treatment Facility Flood Protection Analysis

Water Surface Profiles for FEMA 1% Flow

Figure 6

Date: 11/7/2014



Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

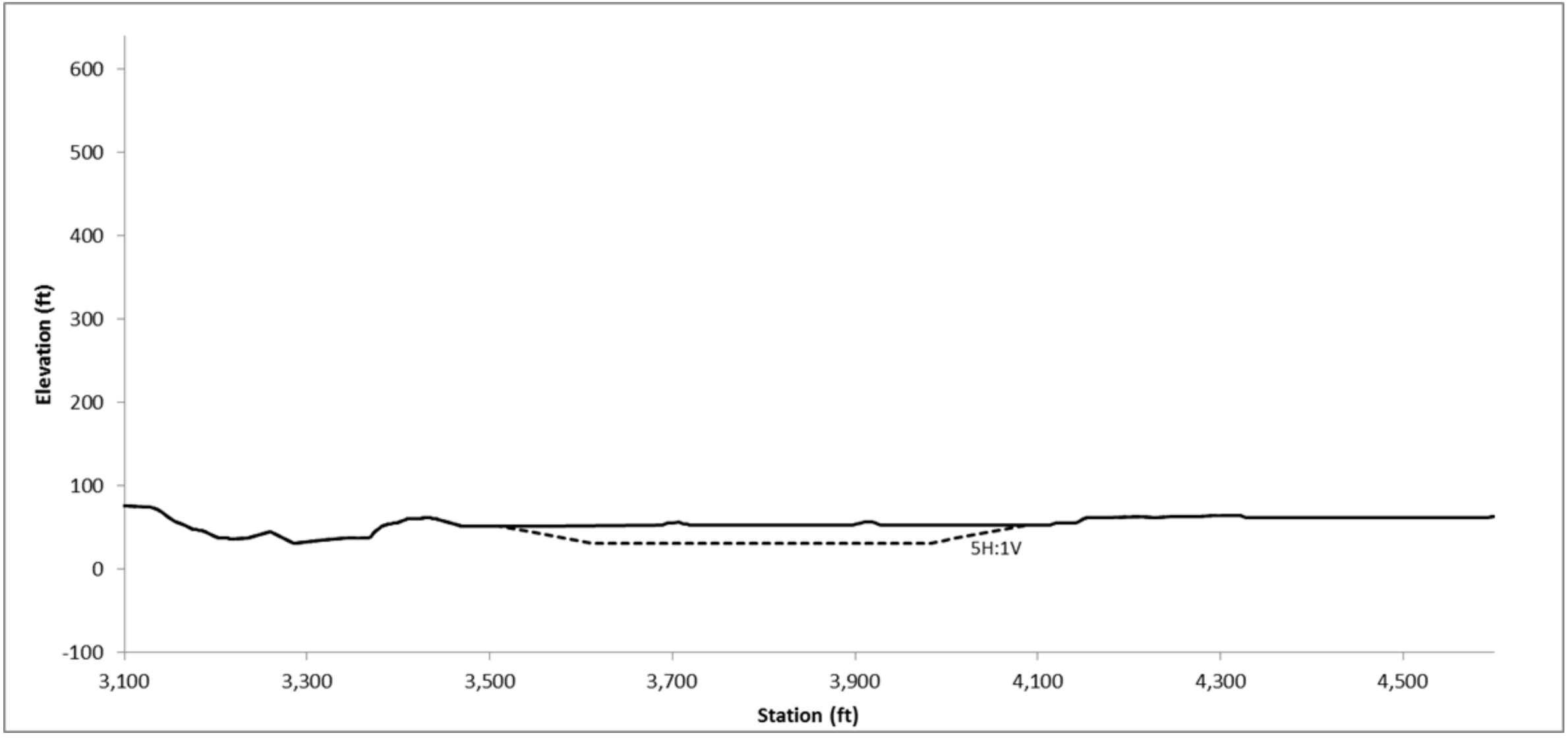
Sutter Primary
Treatment Facility
Flood Protection Analysis

Cross-Sectional View of Bank Cut

Figure 7

Date: 8/7/2014

F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F7_Cross-Sectional_View_ofBank_Cut.mxd



F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F7B_Cross_Sectional_View_of_Secondary_Channel.mxd

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

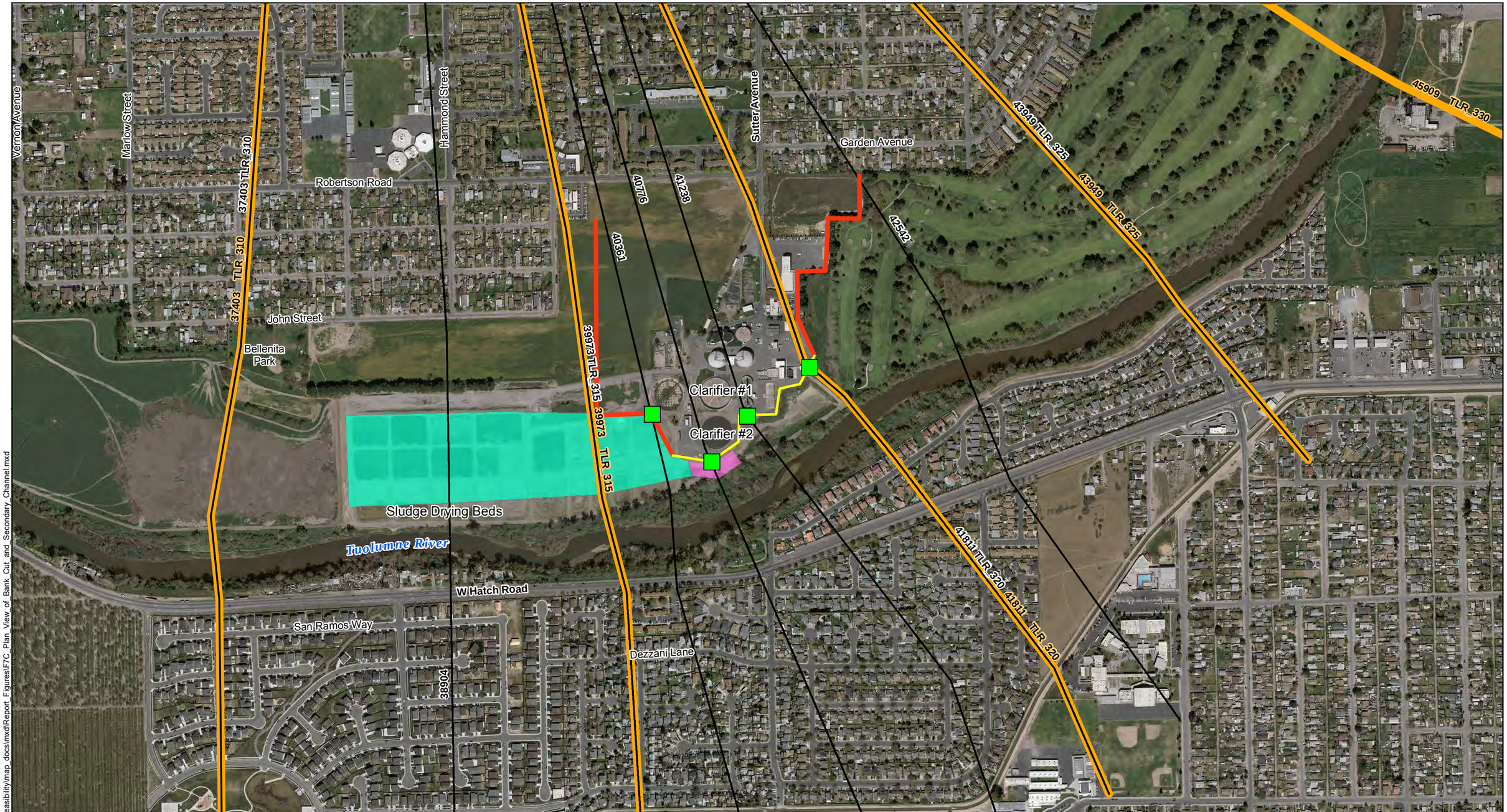
Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

Sutter Primary
Treatment Facility
Flood Protection Analysis

Cross-Sectional View of Secondary Channel

Figure 7B

Date: 11/5/2014



F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F7C_Plan_View_of_Bank_Cut_and_Secondary_Channel.mxd

FDR

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

- HEC_RAS_Levee_Location
- Existing TO105 Cross-Section
- Sutter Primary Treatment Facility Cross-Section
- Proposed Floodwall Alignment
- Proposed Levee Alignment
- Bank Cut
- Secondary Channel

N W E S

0 600 feet

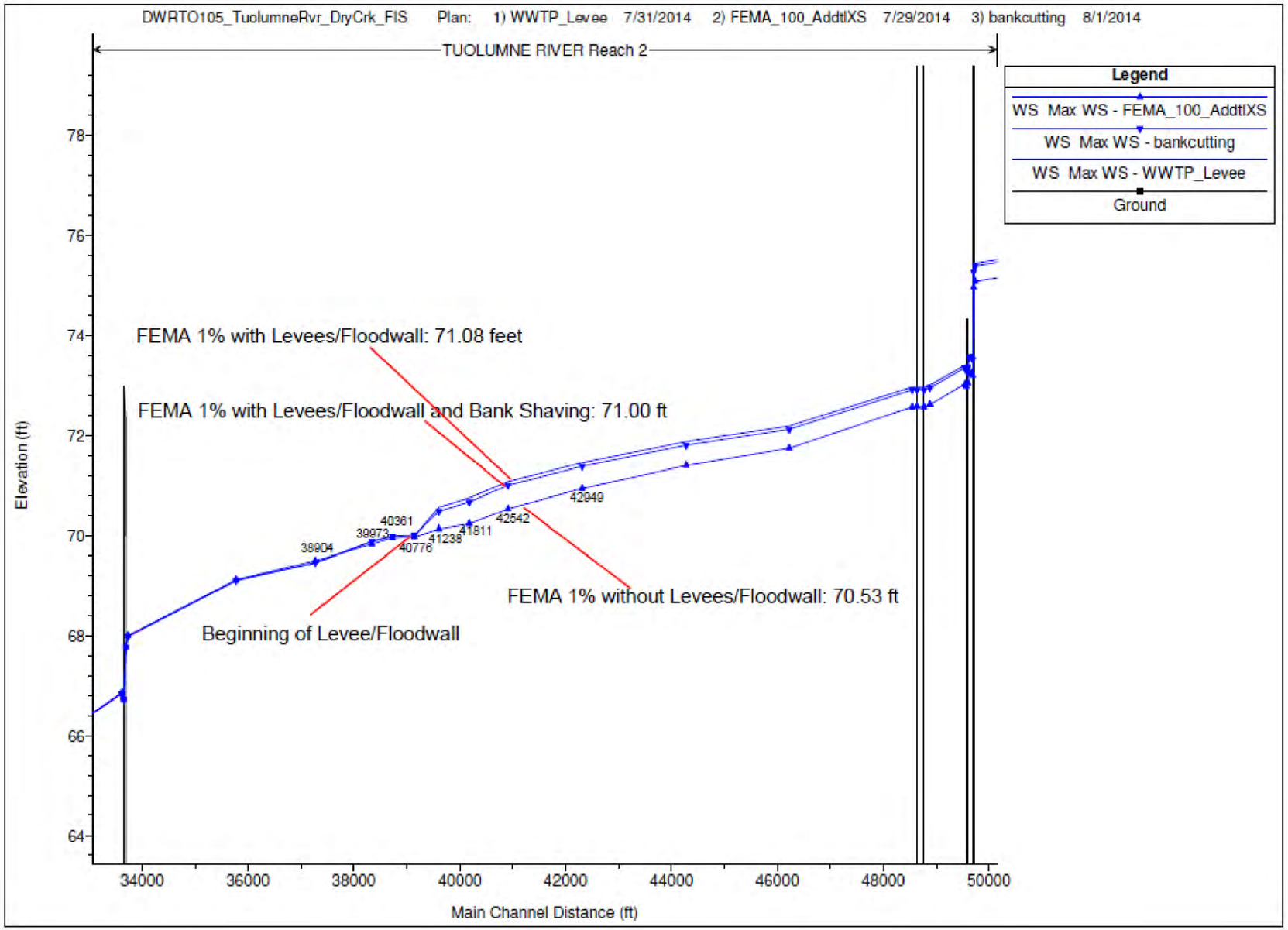
1 inch = 600 feet

Sutter Primary Treatment Facility Flood Protection Analysis

Plan View of Bank Cut and Secondary Channel

Figure 7C

Date: 11/5/2014



Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

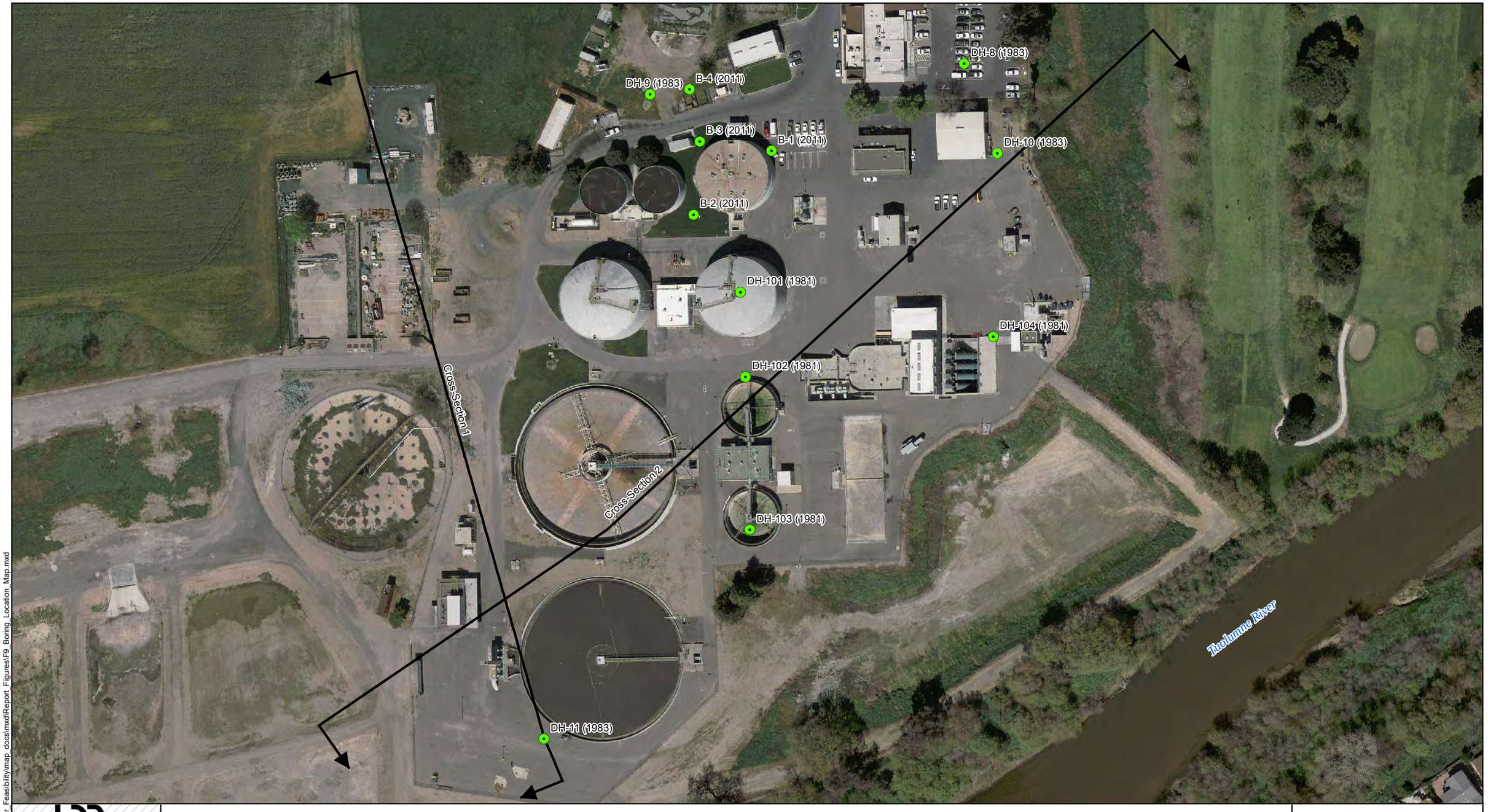
Sutter Primary
Treatment Facility
Flood Protection Analysis

Water Surface Profiles with Bank Shaving

Figure 8

Date: 11/7/2014

F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F8_Water_Surface_Profiles_with_Bank_Shaving.mxd



F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F9_Boring_Location_Map.mxd

FDR

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

- Historic Boring Location
- Geotechnical Cross-Section

N
W E
S

0 120 feet

1 inch = 120 feet

Sutter Primary Treatment Facility Flood Protection Analysis

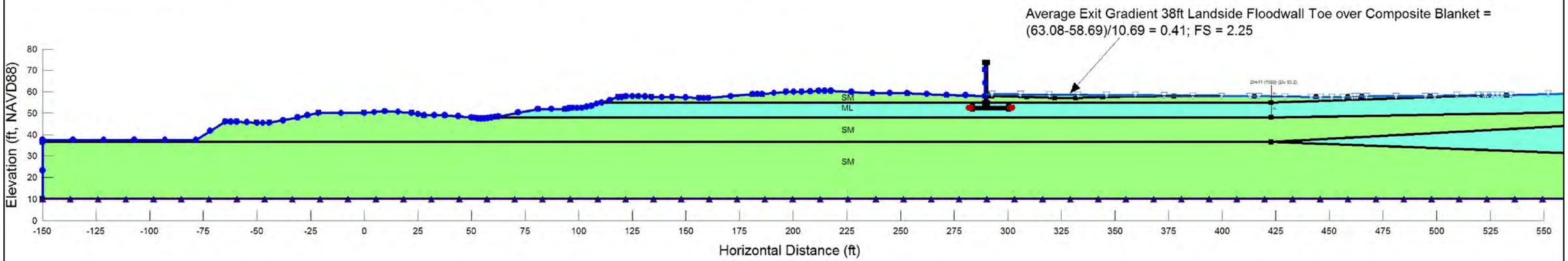
Geotechnical Boring Locations

Figure 9

Date: 10/16/2014

City of Modesto
100-Year WSE = 70.5 ft.
2014.07.14_City of Modesto_CS1_A.gsz
8/7/2014
Analyzed By: Brett Bourgeois, P.E.
QC Reviewed By: Josh Zupan, P.E.

Name: 1: SM K-Sat: 0.85 ft/days Ky'/Kx' Ratio: 0.25
Name: 2: ML K-Sat: 0.0283 ft/days Ky'/Kx' Ratio: 0.25
Name: 4: SP K-Sat: 8.5 ft/days Ky'/Kx' Ratio: 0.25
Name: Flood Wall K-Sat: 0.000283 ft/days Ky'/Kx' Ratio: 1



F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F10_CS_1_Model.mxd

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

Sutter Primary
Treatment Facility
Flood Protection Analysis

Geotechnical
Cross-Section 1
Model Stratigraphy

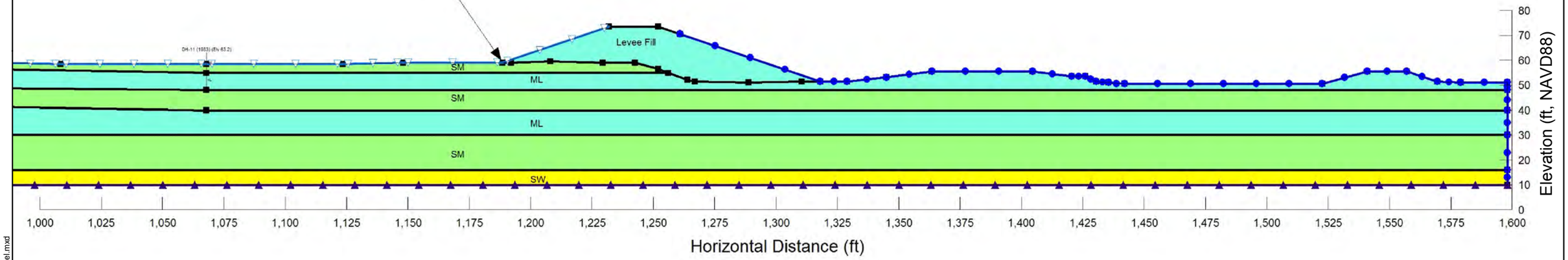
Figure 10

Date: 8/7/2014

City of Modesto
100-Year WSE = 70.5 ft.
2014.07.14_City of Modesto_CS2_A.gsz
8/7/2014
Analyzed By: Brett Bourgeois, P.E.
QC Reviewed By: Josh Zupan, P.E.

Name: 1: SM K-Sat: 0.85 ft/days Ky'/Kx' Ratio: 0.25
Name: 2: ML K-Sat: 0.0283 ft/days Ky'/Kx' Ratio: 0.25
Name: 4: SW K-Sat: 28.35 ft/days Ky'/Kx' Ratio: 0.25
Name: Levee Fill K-Sat: 0.0283 ft/days Ky'/Kx' Ratio: 0.25

Average Exit Gradient at Floodwall Toe over Composite Blanket =
(62.37-59.00)/11.00 = 0.31; FS = 2.98



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Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

Sutter Primary Treatment Facility Flood Protection Analysis

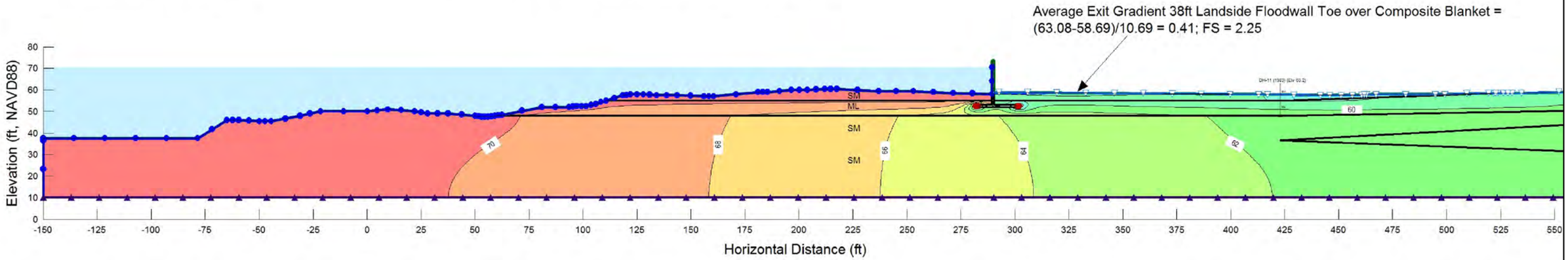
Geotechnical Cross-Section 2 Model Statigraphy

Figure 11

Date: 8/7/2014

City of Modesto
100-Year WSE = 70.5 ft.
2014.07.14_City of Modesto_CS1_A.gsz
8/7/2014
Analyzed By: Brett Bourgeois, P.E.
QC Reviewed By: Josh Zupan, P.E.

Name: 1: SM K-Sat: 0.85 ft/days Ky'/Kx' Ratio: 0.25
Name: 2: ML K-Sat: 0.0283 ft/days Ky'/Kx' Ratio: 0.25
Name: 4: SP K-Sat: 8.5 ft/days Ky'/Kx' Ratio: 0.25
Name: Flood Wall K-Sat: 0.000283 ft/days Ky'/Kx' Ratio: 1



Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

Sutter Primary
Treatment Facility
Flood Protection Analysis

Geotechnical Cross-Section 1 Results

Figure 12

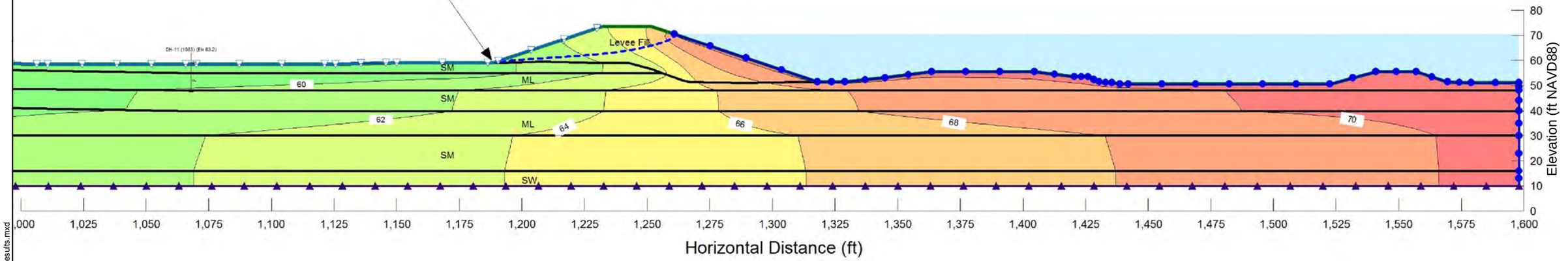
Date: 8/7/2014

F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F12_CS_1_Results.mxd

City of Modesto
100-Year WSE = 70.5 ft.
2014.07.14_City of Modesto_CS2_A.gsz
8/7/2014
Analyzed By: Brett Bourgeois, P.E.
QC Reviewed By: Josh Zupan, P.E.

Name: 1: SM K-Sat: 0.85 ft/days Ky'/Kx' Ratio: 0.25
Name: 2: ML K-Sat: 0.0283 ft/days Ky'/Kx' Ratio: 0.25
Name: 4: SW K-Sat: 28.35 ft/days Ky'/Kx' Ratio: 0.25
Name: Levee Fill K-Sat: 0.0283 ft/days Ky'/Kx' Ratio: 0.25

Average Exit Gradient at Floodwall Toe over Composite Blanket =
(62.37-59.00)/11.00 = 0.31; FS = 2.98



F:\Projects\028_234298_Modesto_Sutter_Feasibility\map_docs\mxd\Report_Figures\F13_CS_2_Results.mxd

Data Sources:FEMA DFIRM 2012, USACE 2008, ESRI

Data Projection: California State Plane Zone 3
Map Projection: California State Plane Zone 3
Horizontal Datum: NAD 83
Vertical Datum: NAVD 88
Units: US Feet

Sutter Primary Treatment Facility Flood Protection Analysis

Geotechnical Cross-Section 2 Results

Figure 13

Date: 8/7/2014

Appendix A

2365 Iron Point Road, Suite 300, Folsom, CA
P 916-817-4700
hdrinc.com

From: Miguel Alvarez <malvarez@modestogov.com>
Sent: Tuesday, July 22, 2014 11:57 AM
To: Mayer, Rodney
Cc: Kathryn Gies; Mike Britten; Andrew Wiesner; Rick Chan; Mesbah, Elizabeth K.; Jim Alves; Jack Bond; William Wong; Laura Anhalt; Dustin Valiquette; Jesse Franco
Subject: RE: Sutter Plant Pros for 200-Year and for 100-Year flood protection
Attachments: RE: Primary Facilities Feasibility Study; Telecommunications Facility .pdf

Good morning Rod, thank you for the attached TM outlining the pros and cons for selecting either the 100-year or 200-year flood protection for the Sutter Treatment Plant site. For the purposes of this study it makes sense to use the 100-year flood protection as originally scoped. However, like you state in your email, the City could modify this feasibility criteria once subsequent planning and design phases are underway.

Regarding the flood protection limits as discussed in the attached email, we suggest that the southern boundary include Clarifier No. 2 within the protected area (see my attached July 3rd response to Mike's July 2nd email). The attached "Flood Analysis Map" shows our recommended flood protection boundary in light blue, which includes Clarifier No. 2. If the group (i.e., those cc'd on this email) have compelling reasons why Clarifier No. 2 should not be included in the protected area, please respond accordingly and we could follow up with a meeting. Otherwise we suggest moving forward with this recommendation.

On another topic, attached is a Geotech Report for the AT&T Tower that was recently built at the Sutter Plant.

Rod I also wanted to confirm if you received the LIDAR data tiles from DWR you needed. I have not received them. I also wanted to see if you have received the Northstar Survey data that was done on 7/8/14.

Miguel Alvarez
Associate Engineer
City of Modesto
Utilities Department
Ph: (209) 577-5348
Fax (209) 522-1780

From: Mayer, Rodney [mailto:Rodney.Mayer@hdrinc.com]
Sent: Tuesday, July 01, 2014 7:59 AM
To: Miguel Alvarez
Cc: Kathryn Gies; Mike Britten; Andrew Wiesner; Rick Chan; Mesbah, Elizabeth K.
Subject: Sutter Plant Pros for 200-Year and for 100-Year flood protection

Hi Miguel – to help the City in deciding what level of flood protection to provide at the Sutter Plant, HDR has developed a list of reasons (pros) for providing 200-year flood protection and for providing 100-year flood protection. The decision to select a level of flood protection is only needed for this feasibility study at this time. The City can change the selection during subsequent planning and design.

Let me know if you have any questions or would like to discuss this further.

Rod

Rodney G. Mayer, PE, GE
D 916.817.4841 M 916.813.7094

TECHNICAL MEMORANDUM

PROS FOR 200-YEAR FLOOD PROTECTION AND FOR 100-YEAR FLOOD PROTECTION AT SUTTER PLANT

Sutter Primary Treatment Facility Rehabilitation Feasibility Study

August 1, 2014

Reviewed By: Libby Mesbah, P.E.

Prepared By: Rod Mayer, P.E., G.E.

The following is a revised version of a June 30, 2014 memorandum. The sections below summarize the pros for selecting 200-year level of flood protection and for selecting a 100-year level of flood protection.

Pros for selecting 200-year level of protection:

- The Sutter Plant lies within an urban area of the Sacramento-San Joaquin Valley as defined in the Government Code. Government Code 65962 will be effective no later than July 2, 2016. It applies to construction of facilities at the Sutter Plant *if the City issues discretionary permits* for construction of facilities at the Sutter Plant.* If it applies, it requires the City to make a finding before approving each discretionary permit. Otherwise, the work could not legally proceed (unless the City changes its discretionary permitting procedure). The finding must be one of the following:
  - 200-year flood protection is being provided for the facilities to be constructed (by a flood protection system, or by nonstructural means such as elevating), or
  - adequate progress is being made on construction of a flood protection system that will provide 200-year flood protection for the facilities.
- 200-year protection would be consistent with the City's ordinance, with flood protection requirements for construction in the neighborhood near the Sutter Plant and in the rest of the Modesto urban area, and would set a good example by the City complying with the flood protection requirements that it places on others.
- 200-year protection would cut in half the chance of plant operations and facilities being impacted by a flood (there is a 1-in-4 chance of experiencing a flood larger than a 100-year flood during the next 30 years).
- The Central Valley Flood Protection Board may be more inclined to issue encroachment permits for work in the designated floodway if 200-year flood protection is being provided.

- The incremental cost may not be excessive, since the plant would already be subject to deep flooding in the 100-year FEMA flood and the water surface for the 200-year FEMA flood is only about 3.5 feet higher than for the 100-year FEMA flood.

Pros for selecting 100-year level of protection:

- If the City does not issue discretionary permits for construction at the Sutter Plant, then 200-year protection is not required by law.
- 100-year flood protection would cost less than 200-year flood protection.
- A levee providing 100-year flood protection would be smaller than a levee providing 200-year flood protection, likely causing slightly less hydraulic impact, making it less difficult/expensive to offset the hydraulic impact.
- The United States Army Corps of Engineers is still developing the Tuolumne River 200-year flood information, consistent with Department of Water Resources' criteria (under the law, DWR establishes criteria for 200-year flood protection). Until that work is done by USACE this fall, only the FEMA 200-year flood is available – but it may not meet DWR's criteria.

Next Steps:

- The City to verify permitting practices for construction of facilities at the Sutter Plant.
- The City to select 100-year or 200-year level of protection for the feasibility evaluation.

*Cities typically issue ministerial and discretionary permits for construction of facilities, depending on the facility and the individual city's practice. Examples of discretionary permits would typically include structures such as a cellphone tower, vehicle parking facility, and a waste storage facility. The City's practice for construction of facilities at the Sutter Plant may be to not issue a permit, to issue a ministerial permit, or to issue a discretionary permit.

Appendix B

2365 Iron Point Road, Suite 300, Folsom, CA
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LEGEND

TRRP Property

City of Modesto Property

FEMA Floodway

Central Valley Flood Protection Board Designated Floodway 1971 (Northern Boundary)

Appendix C

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P 916-817-4700
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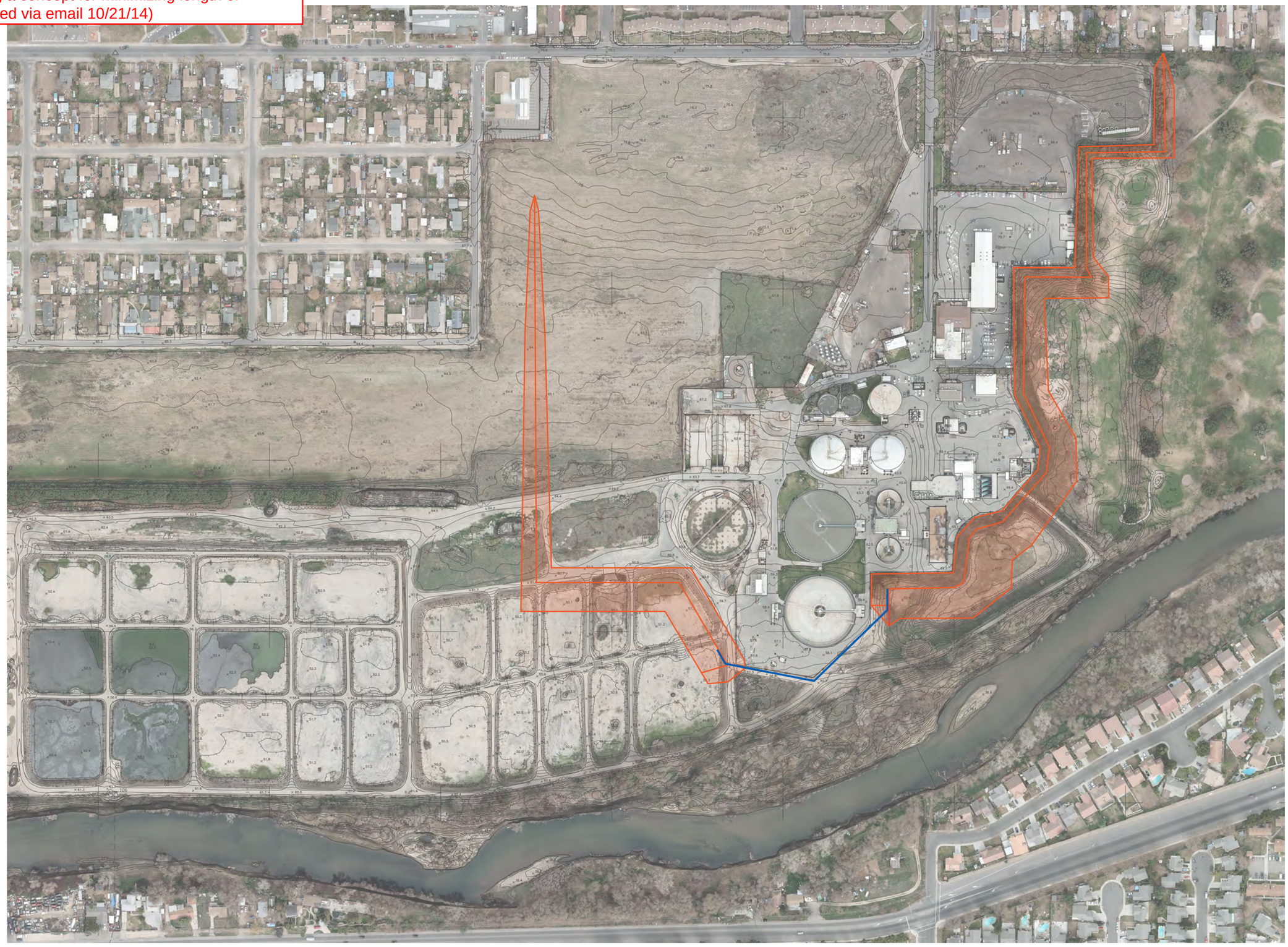
APPENDIX C: Figure provided by Mike Britten at Carollo Engineers showing a concept for minimizing length of floodwall. (submitted via email 10/21/14)



mo1014fi-9601.ai

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P 916-817-4700
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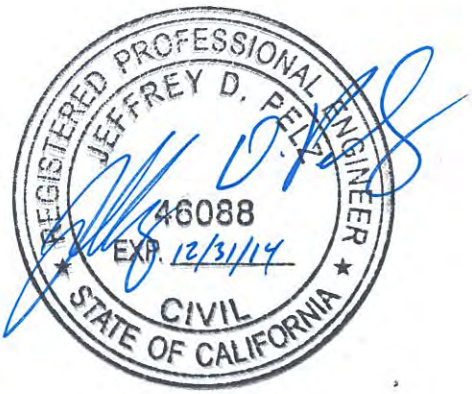
APPENDIX C – WEST YOST ASSOCIATED ENVIRONMENTAL SCREENING MATRIX

WEST YOST ASSOCIATES
Consulting Engineers



MEMORANDUM

DATE: October 1, 2014 Project No.: 125-06-14-08.005

TO: Miguel Alvarez, City of Modesto

CC: Rick Chan, Carollo Engineers
Mike Britten, Carollo Engineers

FROM: Jeff Pelz, P.E., R.C.E. #46088

REVIEWED BY: Kathryn Gies, P.E., R.C.E. #65022

SUBJECT: Environmental Screening Analysis—Sutter Plant Rehabilitation

West Yost Associates has prepared a matrix listing anticipated environmental and permitting issues associated with maintaining primary treatment operations at the City of Modesto's (City) Sutter Avenue Wastewater Treatment Plant (Sutter Plant). The purpose of this screening analysis is to identify potentially costly issues and/or potential "deal breaker" issues that must be considered in deciding whether or not treatment operations should continue at the Sutter Plant. Additional environmental review will be required based on the selected option for continuing City activities at the Sutter Avenue site.

For the purposes of this screening analysis it is assumed that a combination of a floodwall and levee must be constructed to protect all existing operations other than the existing sludge drying beds. In addition, it is assumed likely that dewatered sludge will be hauled to the City's Jennings Road plant, requiring approximately 8 to 11 truck trips per day (at 2030 flow and load conditions).

The following reference documents were reviewed in developing the matrix:

1. City of Modesto Wastewater Master Plan Update Environmental Impact Report, Draft and Final (December 21, 2006 and February 5, 2007).
2. Thomas Law Group blog posting regarding May 8, 2012 California Attorney General's office report (http://www.thomaslaw.com/blog/attorney-general-releases-report-interpreting-ceqa-to-require-consideration-of-environmental-justice-issues-at-the-local-and-regional-levels/) downloaded 8/8/2014.
3. Sutter Primary Treatment Facility Flood Protection Analysis; DRAFT, August 2014. HDR Engineering.
4. Tuolumne River Regional Park Master Plan; for the City of Modesto, City of Ceres, and Stanislaus County JPA. December 2001. EDAW, Inc.

The draft matrix is presented as Table 1. Items that have the potential to result in major costs are identified, as well as issues that have the potential to be either socially or politically unacceptable. The latter items are identified as “potential fatal flaws” in the right hand column of the table.

Table 1. Initial Environmental Screening Analysis of Sutter Plant Retention Alternative

Category	Potential Environmental Constraints	Explanation	Potential Design, Documentation or Permitting Requirements	Potential Cost Impact	Potential Fatal Flaw?
Water Quality and Hydrology	Base Flood Elevation Increase	Construction of a floodwall, levee or fill within the floodplain has the potential to increase the based flood elevation upstream or downstream of the Sutter Avenue Plant. The Federal Emergency Management Agency (FEMA) prohibits changes in the floodplain that would increase flood levels. The Central Valley Flood Protection Board (CVFPB) would also require an encroachment permit that considers any flood level increase as well as any concerns of the public (e.g., adjacent land owners).	An initial flood protection analysis study is being prepared. A more detailed analysis would eventually be required. The draft study indicates a flood protection wall and levee would increase flood elevations, violating FEMA's prohibition. Therefore, either additional channel modifications in the Tuolumne River would be needed to offset the effects of the floodwall and levee or the footprint of the treatment facilities would need to be further consolidated (such as relocating Primary Clarifier #2). It is not clear whether acceptable and adequate modifications to the river channel and riparian areas could be identified or that the treatment plant footprint could be adequately decreased. U.S. Army Corps of Engineers (USACE) and California Department of Fish and Game (CDFG) permits and a Streambed Alteration Agreement may be required. Design approval or concurrence required from FEMA, CVFPB, and possibly others.	Major	Yes
	Stormwater Runoff Quality	Impacts during and post-construction must be avoided.	State stormwater permit coverage will require a construction-period Stormwater Pollution Prevention Plan (SWPPP) with appropriate best management practices. Design of new road and site will need to incorporate runoff water quality protection features. Unless provisions are made to keep all stormwater onsite post construction, coverage under the state's Industrial Stormwater Permit will be required.	Minor	No
	Water Quality Impacts During Construction	Instream excavation and construction activities have the potential to degrade river water quality.	Permits required from USACE and CDFG, which will specify water quality protection measures, such as limiting construction to low-flow periods. Design of permanent features must minimize potential to disrupt flow or promote scour.	Moderate	No
	Microtunneling Collapse or Drilling Mud Release; Other Related Construction Impacts	Certain trenchless technologies may be considered for crossing waterways or wetland areas. These technologies carry certain construction risks associated with tunneling or drilling, as well as construction access.	Design must minimize risks. Appropriate response planning will be required to control impacts in the event of a construction failure. This constraint is applicable regardless of whether treatment operations continue at the Sutter Avenue Plant site.	Minor	No
			Access for tunneling or drilling operations may impact riparian areas, requiring special considerations for construction of an access road.	Minor	No
Biological / Sensitive Species and Habitat	Valley Elderberry Longhorn Beetle and its Elderberry Host Species Plant	Roadway construction, flood protection wall and levee, river channel modifications or construction of relocated facilities on previously undeveloped lands could impact sensitive species or their habitat. The species listed were identified in reference documents. The potential presence or absence of each species, including species that may not be identified in this document, must be determined through additional research conducted initially once a project description has been developed, and possibly through additional pre-construction surveys. Reference documents identify the following species potentially present but conclude that impacts would be less than significant: Western Pond Turtle, Loggerhead Shrikes, Short-eared Owls, Northern Harriers, Tricolored Blackbirds, and Sacramento Splittail (in the Tuolumne River).	Preconstruction surveys required. Avoidance or transplantation of significant host species specimens would be required. A review by the USACE would be triggered by disturbance of riparian areas. Early consultation with USACE and USFWS is recommended. A wetland delineation is likely required.	Minor	No
	Burrowing Owl		Preconstruction surveys required. Avoidance would be a typical mitigation measure (250 ft buffer, February 1 through August 31). Approval from CDFG to evict may be an option from September 1 through January 31. If owls cannot be avoided, a mitigation agreement with CDFG would be required, including compensation equivalent to 6.5 acres of land per individual or pair.	Minor	No
	Nesting Raptors		Preconstruction surveys required. Avoidance would be the typical mitigation measure. Restriction on construction activities may be necessary.	Minor	No
	Swainson's Hawk		Offsite Habitat Management land acquisition or easements may be required to mitigate impacts on potential foraging habitat.	Minor	No
	Various fish species, including fall-run chinook salmon		Modifications within the Tuolumne River channel or adjacent areas must be designed and constructed to protect sensitive fisheries. The types of modifications potentially necessary to eliminate flood elevation increases associated with construction of a flood wall and levee could potentially be major, and therefore would require robust and well-planned protections in design and construction. USACE and CDFG permits and a Streambed Alteration Agreement would be required.	Moderate	No
	Other Species		Site-specific field surveys and research would be needed to confirm other sensitive species or their habitats are not present.	Minor	No

Table 1. Initial Environmental Screening Analysis of Sutter Plant Retention Alternative, cont.

Category	Potential Environmental Constraints	Explanation	Potential Influence on Sutter Plant Retention Alternative	Potential Cost Impact of Concern	Potential Fatal Flaw?
Wetlands and Riparian Disturbance	Streambed Alteration and Impacts to Wetlands	Both open cut and trenchless construction techniques crossing or adjacent to waterways must be reviewed by and coordinated with the CDFG and USACE.	USACE permits and a Streambed Alteration Agreement from CDFG may be required for crossing the Tuolumne River or modifying the channel to offset flood protection impacts. Early consultation with the USACE and CDFG is recommended. Preconstruction surveys will be required.	Minor	No
Transportation	Traffic Impacts from Increased Truck Traffic	Traffic impacts associated with increased biosolids hauling truck traffic would need to be evaluated. Potentially impacted streets near the City would include Sutter Avenue (minor to no impact), Robertson Road, and South Carpenter Road. A new haul road could be constructed over the existing access road for the Tuolumne River Regional Park (TRRP), thus entering South Carpenter Road at the existing access driveway. Only South Carpenter Road would have traffic-related impacts if a new haul road is constructed along this route. Impacts associated with temporary traffic delays during construction were found to be less than significant in reference documents.	Approval by TRRP would be necessary to use the existing access road for plant truck traffic. Mitigation measures may include a visual barrier and/or fencing between the haul road and the park area. In addition, TRRP has identified this access road as the access for the new public park facilities. Thus, coordination on a possible dual use, or working with TRRP to identify an access route for the park facilities elsewhere would be required.	Major	No
Air Quality	Construction Period Dust and Construction Vehicle Exhaust	Construction activities create dust and short-term increases in vehicle and equipment exhaust generation.	Many prescribed mitigation measures must be included in the construction contracts	Minor	No
	Exhaust from Increased Truck Traffic	Off-hauling of dewatered biosolids (prior to drying) by any route would produce increased truck traffic.	An analysis of potential impacts must be performed. Potentially an unavoidable impact.	Minor	No
	Odors During Operations	Constructing new biosolids dewatering facilities near residences increases the possibility that objectionable odors will be perceived outside the boundary of the treatment plant.	Odors from new biosolids mechanical dewatering operations would likely require odor control. Improvements may also need to include odor control for existing facilities, such as the primary clarifiers, to mitigate odors outside the boundary of the treatment plant.	Major	Yes
Noise	Construction Noise	Proximity to residential areas will trigger a need for noise mitigation.	Noise control measures will be included in the construction contract.	Minor	No
	Increased Truck Traffic Noise	It is possible that traffic along a new haul route will be found to impact adjacent residences. New odor control equipment (e.g. blowers) would also be a potential source of noise.	Traffic noise mitigation measures may be identified, or it is possible this impact could be found unavoidable.	Minor	No
	New Operational Noise Sources	Odor control equipment could include blowers, which are a potential source of noise. New or replacement standby generators are also a potential noise source.	Design will likely need to include noise attenuation features.	Minor	No
Geology, Soils, and Seismicity	Stability of Flood Protection, Roads, and Other Structures	New structures must be designed for stability, taking into consideration site-specific information regarding the geology, soils, and seismicity.	Standard design practices would be employed to mitigate these issues.	Minor	No
		Staff reports that an abandoned (and closed) landfill is located under a portion of the existing Sutter Treatment Plant Site.	Depending on the location of the abandoned landfill, construction of the levee/floodwall may require removal of historic landfill materials and importation of soil suitable for levee construction.	Major	No
		The existing access road identified as a possible haul road currently serves as the access road for the closed Carpenter Road Landfill. This landfill was operated by the City of Modesto between 1956 and 1968, and consists of two unlined cells located on both the west and east sides of Carpenter Road, in between Kenneth and Robertson Roads and the Tuolumne River.	It is unknown whether the existing access road falls outside the actual area of the landfill cells. If it is determined that this is not the case, it may not be feasible to construct an access road for the plant along this route, or special construction could be required.	Major	No

Table 1. Initial Environmental Screening Analysis of Sutter Plant Retention Alternative, cont.

Category	Potential Environmental Constraints	Explanation	Potential Influence on Sutter Plant Retention Alternative	Potential Cost Impact of Concern	Potential Fatal Flaw?
Public Health and Safety	Contaminated Soils and Demolition	Lands abandoned by the City that currently house unlined biosolids drying beds will need to be carefully investigated for hazardous materials or other public health/groundwater contamination risks if there is a transfer of ownership or major change in land use.	Depending on identified long-term use of the drying bed area, the City may need to initiate a closure process for this facility. This would require investigation of underlying soils and/or possibly groundwater to identify the extent of any impacts. Soil and groundwater clean-up operations could also be triggered if degradation has been identified.	Moderate	No
		TRRP lands to be acquired by the City for a new haul road would require an environmental assessment to ensure that any hazardous materials or contaminated soils are identified and addressed prior to acquisition. A portion of the existing TRRP property that has been identified for the new access road to the treatment plant is a closed landfill site. It will be necessary to complete a closure plan in compliance with California state law (Postclosure Land Use, CCR Title 27, Section 21190) before this area can be developed.	It is recognized in the TRRP Master Plan (EDAW, December 2001) that a closure plan must be prepared before this area can be developed as a park. Therefore, it is assumed that costs associated with closure of the Carpenter Road Landfill would be incurred by TRRP.	Moderate (Potentially Covered by TRRP Costs)	No
	Hazardous Materials Storage, Use, Transport	Hazardous materials may be used during construction or during ongoing operations.	The quantity and nature of hazardous materials to be stored and transported would need to be disclosed. Design, construction and operational practices would need to comply with laws and regulations protecting employees and the general public.	Minor	No
Environmental Justice	Disproportionate Impacts on Sensitive Population or Disadvantaged Community	To the extent that facilities are relocated closer to low-income residences, or that increased traffic, especially truck traffic, is generated through residential streets with a disadvantaged population, a disproportionate impact could be created. Increased truck traffic would result from eliminating the onsite biosolids drying operation. The most likely impacts would be in the form of operational and traffic noise, odors, air quality impacts associated with traffic, and possibly traffic safety. Environmental justice review is required where federal funds are used (e.g., State Revolving Fund loans). However, the City has discretion to include this review even if federal funds are not used.	Environmental justice impacts would potentially be associated with noise, traffic, and air quality. Whether or not federal funds are used, a City policy decision regarding disproportionate impacts on disadvantaged populations may guide decision making. For offsite biosolids drying, increased frequent truck traffic through the local residential neighborhood would likely need to be avoided by constructing a separate haul road to South Carpenter Road. For onsite biosolids drying operations, relocated drying operations closer to residences will require additional odor control measures. Noise control would also need to be incorporated in the design. Some unavoidable impacts could remain and must be plainly described in the City's statement of overriding considerations.	Major	Yes
Climate Change	Greenhouse Gasses	Greenhouse gasses would be generated by increased traffic (employees and haul trucks) and increased energy use associated with new facilities such as odor control or mechanical dewatering. Both short term and long term impacts are to be considered.	Greenhouse gasses would need to be evaluated for significance.	Minor	No
	Future Increases in Flood Elevations	Recent legal decisions call into question whether or not the impacts of changing flood elevations due to climate change must be considered in a CEQA review. Nevertheless, the City may choose to set higher flood protection elevations, regardless of CEQA requirements.	A City policy decision regarding protection from future flood elevation increases associated with climate change should guide the selection of a final flood protection level for the project.	Major	No
Visual Aesthetics	Light and Glare	New or modified lighting could result in increased light or glare impacts to adjacent residences.	Design would need to consider the type and location of new outdoor lighting fixtures. Construction impacts could require mitigation.	Minor	No
	Effect on Views of the Tuolumne River Area	The view of the Tuolumne River and adjacent areas could potentially be disrupted by relocated treatment facilities and buildings.	Design would need to consider the impact on views of the river area from nearby residences, as well as the potential future public access areas associated with the Tuolumne River Regional Park plans.	Minor	No
Cultural Resources	Native American Historical Site Disturbance	Wherever excavation occurs, particularly in areas adjacent to water sources, there is potential for discovery of historically significant artifacts or burial sites.	If federal funds are used, consultation with the State Historic Preservation Office would be required. A pre-construction survey would be conducted and standard mitigation procedures for protection and preservation would be included in the construction contract.	Minor	No

APPENDIX D – COST ESTIMATES FOR THE SUTTER OPTION AND JENNINGS OPTION

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PROJECT : Modesto Sutter Treatment Facility Feasibility Study
Sutter Option

COST ESTIMATE PREPARATION DATE : 11/11/2014
JOB # : 9601A.00 **BY :** KTL
ELEMENT # 0
ELEMENT : SUMMARY OF CONSTRUCTION COSTS

Estimating Contingency:	30%
Sales Tax:	7.625%
General Conditions:	10%
Contractor Overhead and Profit:	15%

ELEMENT #	DESCRIPTION	COST
1	Demolition of Sutter Treatment Facilities	$10,979,000
2	Floodplain Improvements at Sutter Plant	$52,119,000
3	Primary Treatment Facilities at Sutter Plant	$4,633,000
4	New Anaerobic Digesters at Sutter Plant	$20,169,000
5	Sludge Dewatering at Sutter Plant	$12,202,000
6	Sludge Cake Drying Beds at Jennings Plant	$6,021,000
7	Sludge Haul Road at Sutter Plant	$1,007,000
	Total Estimated Construction Cost =	**$107,130,000**
	Engineering, Legal, Administrative Fees, Permitting, and Construction Management 20% of Construction Cost	$21,426,000
	Total Estimated Project Cost =	**$128,556,000**

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COST ESTIMATE

PROJECT : Modesto Sutter Treatment Facility Feasibility Study
Sutter Option
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 1
ELEMENT : Demolition of Sutter Treatment Facilities to 4' Below Grade and Backfill to Grade

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Digesters No. 1 and 2 (104' Diameter Concrete Tank and 32' SWD)	2	EA	$111,000	1.00	$222,000	
Digester No. 3 (90' Diameter Steel Tankand 30' SWD)	1	EA	$434,000	1.00	$434,000	
Digesters No. 4 (60' Diameter Concrete Tank and 21.7' SWD)	1	EA	$117,000	1.00	$117,000	
Digesters No. 5 (60' Diameter Concrete Tank and 19.5' SWD)	1	EA	$106,000	1.00	$106,000	
Digester Building	1	EA	$109,000	1.00	$109,000	
Sludge Thickeners No. 1 and 2	2	EA	$110,000	1.00	$220,000	
Thickener Process Building	1	EA	$141,000	1.00	$141,000	
Spiro-Vortex Basin	1	EA	$991,000	1.00	$991,000	
Demo Concrete Slab and Mechanism						
Backfill with Imported Material to Match Grade						
Sludge Drying Beds	1	LS	$4,336,000	1.00	$4,336,000	
Disposal of Top 2' Feet of Soil and Backfill with 2' of Imported Material						
SUBTOTAL						**$6,676,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$6,676,000**
Estimating Contingency	30	%				$2,003,000
SUBTOTAL						**$8,679,000**
Sales Tax on 50% of Subtotal Above	0	%				$0
SUBTOTAL						**$8,679,000**
General Conditions	10	%				$868,000
SUBTOTAL						**$9,547,000**
General Contractor Overhead and Profit	15	%				$1,432,000
ELEMENT CONSTRUCTION COST						**$10,979,000**

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COST ESTIMATE

PROJECT : Modesto Sutter Treatment Facility Feasibility Study
Sutter Option
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 2
ELEMENT : Floodplain Improvements at Sutter Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Levee/Floodwall Construction						
Clearing and Grubbing	17	AC	$384	1.07	$7,000	
Imported Fill for Levees (import, place, compact)	140,000	CY	$42	1.07	$6,291,600	
Levee Armoring (riprap)	15,670	Tons	$28	1.07	$469,500	
Excavation and Backfill for Wall	61,300	CY	$20	1.07	$1,300,100	
Footing for Floodwall	890	CY	$510	1.07	$486,100	
Concrete Wall	900	CY	$772	1.07	$743,500	
Sheet Pile for Underflow Cutoff	3,900	SF	$25	1.07	$104,500	
Stormwater Pump Station	1	LS	$840,000	1.00	$840,000	
Flood Proofing Incoming Utilities						
Excavation and Backfill	1,600	CY	$370	1.07	$633,400	
Hand Excavation and Backfill	6,300	CY	$20	1.07	$134,800	
Concrete Encasement for Pipes	1,800	CY	$510	1.07	$982,300	
60" RCP	430	LF	$164	1.07	$75,500	
Sheet Piling	65,500	SF	$30	1.07	$2,102,600	
Manhole Replacement	8	EA	$150,000	1.07	$1,284,000	
Environmental Mitigation for Bank Cutting	1	LS	$500,000	1.00	$500,000	
Bank Cutting						
Excavation	813,120	CY	$5.20	1.07	$4,524,200	
Hauling and Disposal Fees at Hazardous Waste Facility (assume 10%)	81,320	CY	$15	1.07	$1,305,200	
Hauling and Disposal at regular landfill	731,800	CY	$10	1.07	$7,830,300	
Bank Restoration	28	AC	$20,000	1.07	$599,200	
Bank Armoring (riprap)	10,530	Tons	$28	1.07	$315,500	
SUBTOTAL						**$30,529,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$30,529,000**
Estimating Contingency	30	%				$9,159,000
SUBTOTAL						**$39,688,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$1,513,000
SUBTOTAL						**$41,201,000**
General Conditions	10	%				$4,120,000
SUBTOTAL						**$45,321,000**
General Contractor Overhead and Profit	15	%				$6,798,000
ELEMENT CONSTRUCTION COST						**$52,119,000**

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COST ESTIMATE

PROJECT : Modesto Sutter Treatment Facility Feasibility Study
Sutter Option
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 3
ELEMENT : Primary Treatment Improvements at Sutter Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Renovate Primary Clarifier (Two 200' Diameter and 10' SWD)						
Demo (Sludge Clarifier Mechanism, Basin Bottom Grout, and Misc Demo)	2	EA	$236,000	1.00	$472,000	
Concrete Wall Coating	2	EA	$148,000	1.00	$296,000	
Primary Clarifier Improvements	2	EA	$184,000	1.00	$368,000	
200' Dia Sludge Collector Mechanism	2	EA	$563,000	1.00	$1,126,000	
SUBTOTAL						**$2,262,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	10	%				$226,000
Plant Electrical and Instrumentation (% of Subtotal)	10	%				$226,000
SUBTOTAL						**$2,714,000**
Estimating Contingency	30	%				$814,000
SUBTOTAL						**$3,528,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$135,000
SUBTOTAL						**$3,663,000**
General Conditions	10	%				$366,000
SUBTOTAL						**$4,029,000**
General Contractor Overhead and Profit	15	%				$604,000
ELEMENT CONSTRUCTION COST						**$4,633,000**

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COST ESTIMATE

PROJECT : Modesto Sutter Treatment Facility Feasibility Study
Sutter Option
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 4
ELEMENT : New Anaerobic Digesters at Sutter Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Anaerobic Digesters	2	LS	$4,800,000	1.07	$10,272,000	
105' Diameter and 29' SWD						
Digester Control Building with Digester Support Facilities						
SUBTOTAL						**$10,272,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	5	%				$514,000
Mechanical and Piping (% of Subtotal)	5	%				$514,000
Plant Electrical and Instrumentation (% of Subtotal)	5	%				$514,000
SUBTOTAL						**$11,814,000**
Estimating Contingency	30	%				$3,544,000
SUBTOTAL						**$15,358,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$586,000
SUBTOTAL						**$15,944,000**
General Conditions	10	%				$1,594,000
SUBTOTAL						**$17,538,000**
General Contractor Overhead and Profit	15	%				$2,631,000
ELEMENT CONSTRUCTION COST						**$20,169,000**

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COST ESTIMATE

PROJECT : Modesto Sutter Treatment Facility Feasibility Study
Sutter Option
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 5
ELEMENT : Sludge Dewatering at Sutter Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Sludge Dewatering Contained in a Building	6,130	SF	$800	1.07	$5,247,300	
Sludge Hauling Trucks and Trailers	1	LS	$250,000	1.00	$250,000	
SUBTOTAL						**$5,497,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	5	%				$275,000
Mechanical and Piping (% of Subtotal)	10	%				$550,000
Plant Electrical and Instrumentation (% of Subtotal)	15	%				$825,000
SUBTOTAL						**$7,147,000**
Estimating Contingency	30	%				$2,144,000
SUBTOTAL						**$9,291,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$354,000
SUBTOTAL						**$9,645,000**
General Conditions	10	%				$965,000
SUBTOTAL						**$10,610,000**
General Contractor Overhead and Profit	15	%				$1,592,000
ELEMENT CONSTRUCTION COST						**$12,202,000**

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COST ESTIMATE

PROJECT : Modesto Sutter Treatment Facility Feasibility Study
Sutter Option
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 6
ELEMENT : Sludge Drying Beds at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Sludge Drying Beds						
Concrete pad (8")	4,280	CY	$400	1.07	$1,831,800	
Base Layer (12")	173,200	SF	$3	1.07	$518,900	
SUBTOTAL						**$2,351,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	50	%				$1,176,000
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$3,527,000**
Estimating Contingency	30	%				$1,058,000
SUBTOTAL						**$4,585,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$175,000
SUBTOTAL						**$4,760,000**
General Conditions	10	%				$476,000
SUBTOTAL						**$5,236,000**
General Contractor Overhead and Profit	15	%				$785,000
ELEMENT CONSTRUCTION COST						**$6,021,000**

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COST ESTIMATE

PROJECT : Modesto Sutter Treatment Facility Feasibility Study
Sutter Option
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 7
ELEMENT : Sludge Haul Road at Sutter Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
AC Paving 4" over 12" ABC	110,000	SF	$4.64	1.07	$546,100	
Grading	4,074	CY	$10	1.07	$43,600	
SUBTOTAL						**$590,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$590,000**
Estimating Contingency	30	%				$177,000
SUBTOTAL						**$767,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$29,000
SUBTOTAL						**$796,000**
General Conditions	10	%				$80,000
SUBTOTAL						**$876,000**
General Contractor Overhead and Profit	15	%				$131,000
ELEMENT CONSTRUCTION COST						**$1,007,000**

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PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative A

COST ESTIMATE PREPARATION DATE : 11/11/2014
JOB # : 9601A.00 **BY :** KTL
ELEMENT # 0
ELEMENT : SUMMARY OF CONSTRUCTION COSTS

Rate of Annual Inflation:	3%
Estimating Contingency:	30%
Sales Tax:	7.625%
General Conditions:	10%
Contractor Overhead and Profit:	15%

ELEMENT #	DESCRIPTION	COST
1	Demolition of Sutter Treatment Facilities	$12,180,000
2	Site Improvements at Jennings Plant	$2,681,000
3	New Primary Treatment Facilities at Jennings Plant	$30,039,000
4	New Anaerobic Digesters at Jennings Plant	$30,247,000
5	Sludge Dewatering at Jennings Plant	$11,645,000
6	WAS Thickening at Jennings Plant	$3,678,000
7	Sludge Cake Drying Beds at Jennings Plant	$6,021,000
	Total Estimated Construction Cost =	**$96,491,000**
	Engineering, Legal, Administrative Fees, Permitting, and Construction Management 20% of Construction Cost	$19,298,000
	Total Estimated Project Cost =	**$115,789,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative A
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 1
ELEMENT : Demolition of Sutter Treatment Facilities to 4' Below Grade and Backfill to Grade

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Primary Clarifiers	2	EA	$365,000	1.00	$730,000	
Digesters No. 1 and 2 (104' Diameter and 32' SWD)	2	EA	$111,000	1.00	$222,000	
Digester No. 3 (90' Diameter and 30' SWD)	1	EA	$434,000	1.00	$434,000	
Digesters No. 4 (60' Diameter Concrete Tank and 21.7' SWD)	1	EA	$117,000	1.00	$117,000	
Digesters No. 5 (60' Diameter Concrete Tank and 19.5' SWD)	1	EA	$106,000	1.00	$106,000	
Digester Building	1	EA	$109,000	1.00	$109,000	
Sludge Thickeners No. 1 and 2	2	EA	$110,000	1.00	$220,000	
Thickener Process Building	1	EA	$141,000	1.00	$141,000	
Spiro-Vortex Basin	1	EA	$991,000	1.00	$991,000	
Demo Concrete Slab and Mechanism						
Backfill with Imported Material to Match Grade						
Sludge Drying Beds	1	LS	$4,336,000	1.00	$4,336,000	
Disposal of Top 2' Feet of Soil and Backfill with 2' of Imported Material						
SUBTOTAL						**$7,406,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$7,406,000**
Estimating Contingency	30	%				$2,222,000
SUBTOTAL						**$9,628,000**
Sales Tax on 50% of Subtotal Above	0	%				$0
SUBTOTAL						**$9,628,000**
General Conditions	10	%				$963,000
SUBTOTAL						**$10,591,000**
General Contractor Overhead and Profit	15	%				$1,589,000
ELEMENT CONSTRUCTION COST						**$12,180,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative A
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 2
ELEMENT : Site Improvements at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Expansion of Administration Building at Jennings Plant	1	LS	$1,570,000	1.00	$1,570,000	
SUBTOTAL						**$1,570,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$1,570,000**
Estimating Contingency	30	%				$471,000
SUBTOTAL						**$2,041,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$78,000
SUBTOTAL						**$2,119,000**
General Conditions	10	%				$212,000
SUBTOTAL						**$2,331,000**
General Contractor Overhead and Profit	15	%				$350,000
ELEMENT CONSTRUCTION COST						**$2,681,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative A
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 3
ELEMENT : New Primary Treatment Facilities at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Primary Clarifiers - Three 105' Diameter						
Shoring	23,840	SF	$37	1.07	$950,700	
Excavation	17,720	CY	$4	1.07	$75,800	
Backfill - ABC	1,130	CY	$44	1.07	$53,200	
Backfill - Native	2,660	CY	$18	1.07	$51,200	
Offhaul	16,570	CY	$20	1.07	$354,600	
Concrete Slab on Grade	1,635	CY	$560	1.07	$979,700	
Concrete Walls	695	CY	$1,035	1.07	$769,700	
Metals	1	LS	$163,000	1.00	$163,000	
FRP Weir, 0.25" thick	990	LF	$15	1.07	$15,900	
FRP Scum Baffle, 0.25" thick	990	LF	$52	1.07	$55,100	
Clarifier Mechanism, 105' diameter	3	EA	$382,000	1.07	$1,226,200	
Primary Sludge Pump Station	1,790	SF	$450	1.07	$861,900	
Flow Splitting Structures	830	SF	$775	1.07	$688,300	
Imported Fill (import, place, and compact) for Corner of Storage Pond	140,700	CY	$42	1.07	$6,323,100	
SUBTOTAL						**$12,568,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	15	%				$1,885,000
Mechanical and Piping (% of Subtotal)	5	%				$628,000
Plant Electrical and Instrumentation (% of Subtotal)	20	%				$2,514,000
SUBTOTAL						**$17,595,000**
Estimating Contingency	30	%				$5,279,000
SUBTOTAL						**$22,874,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$872,000
SUBTOTAL						**$23,746,000**
General Conditions	10	%				$2,375,000
SUBTOTAL						**$26,121,000**
General Contractor Overhead and Profit	15	%				$3,918,000
ELEMENT CONSTRUCTION COST						**$30,039,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative A
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 4
ELEMENT : Anaerobic Digesters at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Anaerobic Digesters	3	LS	$4,800,000	1.07	$15,408,000	
105' Diameter and 29' SWD						
Digester Control Building with Digester Support Facilities						
SUBTOTAL						**$15,408,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	5	%				$770,000
Mechanical and Piping (% of Subtotal)	5	%				$770,000
Plant Electrical and Instrumentation (% of Subtotal)	5	%				$770,000
SUBTOTAL						**$17,718,000**
Estimating Contingency	30	%				$5,315,000
SUBTOTAL						**$23,033,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$878,000
SUBTOTAL						**$23,911,000**
General Conditions	10	%				$2,391,000
SUBTOTAL						**$26,302,000**
General Contractor Overhead and Profit	15	%				$3,945,000
ELEMENT CONSTRUCTION COST						**$30,247,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative A
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 5
ELEMENT : Sludge Dewatering at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Sludge Dewatering Contained in a Building	6,130	SF	$800	1.07	$5,247,300	
SUBTOTAL						**$5,247,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	5	%				$262,000
Mechanical and Piping (% of Subtotal)	10	%				$525,000
Plant Electrical and Instrumentation (% of Subtotal)	15	%				$787,000
SUBTOTAL						**$6,821,000**
Estimating Contingency	30	%				$2,046,000
SUBTOTAL						**$8,867,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$338,000
SUBTOTAL						**$9,205,000**
General Conditions	10	%				$921,000
SUBTOTAL						**$10,126,000**
General Contractor Overhead and Profit	15	%				$1,519,000
ELEMENT CONSTRUCTION COST						**$11,645,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative A
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 6
ELEMENT : WAS Thickening at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Relocation of GBT from Sutter Plant	1	LS	$100,000	1.00	$100,000	
New Sludge Thickening Building	1,200	SF	$1,600	1.07	$2,054,400	
SUBTOTAL						**$2,154,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$2,154,000**
Estimating Contingency	30	%				$646,000
SUBTOTAL						**$2,800,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$107,000
SUBTOTAL						**$2,907,000**
General Conditions	10	%				$291,000
SUBTOTAL						**$3,198,000**
General Contractor Overhead and Profit	15	%				$480,000
ELEMENT CONSTRUCTION COST						**$3,678,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative A
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 7
ELEMENT : Sludge Drying Beds at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Sludge Drying Beds						
Concrete pad (8")	4,280	CY	$400	1.07	$1,831,800	
Base Layer (12")	173,200	SF	$3	1.07	$518,900	
SUBTOTAL						**$2,351,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	50	%				$1,176,000
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$3,527,000**
Estimating Contingency	30	%				$1,058,000
SUBTOTAL						**$4,585,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$175,000
SUBTOTAL						**$4,760,000**
General Conditions	10	%				$476,000
SUBTOTAL						**$5,236,000**
General Contractor Overhead and Profit	15	%				$785,000
ELEMENT CONSTRUCTION COST						**$6,021,000**

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PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative B

COST ESTIMATE PREPARATION DATE : 11/11/2014
JOB # : 9601A.00 **BY :** KTL
ELEMENT # 0
ELEMENT : SUMMARY OF CONSTRUCTION COSTS

Rate of Annual Inflation:	3%
Estimating Contingency:	30%
Sales Tax:	7.625%
General Conditions:	10%
Contractor Overhead and Profit:	15%

ELEMENT #	DESCRIPTION	COST
1	Demolition of Sutter Treatment Facilities	$12,180,000
2	Site Improvements at Jennings Plant	$2,681,000
3	New Primary Treatment Facilities at Jennings Plant	$16,598,000
4	New Anaerobic Digesters at Jennings Plant	$30,247,000
5	Sludge Dewatering at Jennings Plant	$11,645,000
6	WAS Thickening at Jennings Plant	$3,678,000
7	Sludge Cake Drying Beds at Jennings Plant	$6,021,000
	Total Estimated Construction Cost =	**$83,050,000**
	Engineering, Legal, Administrative Fees, Permitting, and Construction Management 20% of Construction Cost	$16,610,000
	Total Estimated Project Cost =	**$99,660,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative B
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 1
ELEMENT : Demolition of Sutter Treatment Facilities to 4' Below Grade and Backfill to Grade

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Primary Clarifiers	2	EA	$365,000	1.00	$730,000	
Digesters No. 1 and 2 (104' Diameter and 32' SWD)	2	EA	$111,000	1.00	$222,000	
Digester No. 3 (90' Diameter and 30' SWD)	1	EA	$434,000	1.00	$434,000	
Digesters No. 4 (60' Diameter Concrete Tank and 21.7' SWD)	1	EA	$117,000	1.00	$117,000	
Digesters No. 5 (60' Diameter Concrete Tank and 19.5' SWD)	1	EA	$106,000	1.00	$106,000	
Digester Building	1	EA	$109,000	1.00	$109,000	
Sludge Thickeners No. 1 and 2	2	EA	$110,000	1.00	$220,000	
Thickener Process Building	1	EA	$141,000	1.00	$141,000	
Spiro-Vortex Basin	1	EA	$991,000	1.00	$991,000	
Demo Concrete Slab and Mechanism						
Backfill with Imported Material to Match Grade						
Sludge Drying Beds	1	LS	$4,336,000	1.00	$4,336,000	
Disposal of Top 2' Feet of Soil and Backfill with 2' of Imported Material						
SUBTOTAL						**$7,406,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$7,406,000**
Estimating Contingency	30	%				$2,222,000
SUBTOTAL						**$9,628,000**
Sales Tax on 50% of Subtotal Above	0	%				$0
SUBTOTAL						**$9,628,000**
General Conditions	10	%				$963,000
SUBTOTAL						**$10,591,000**
General Contractor Overhead and Profit	15	%				$1,589,000
ELEMENT CONSTRUCTION COST						**$12,180,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative B
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 2
ELEMENT : Site Improvements at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Expansion of Administration Building at Jennings Plant	1	LS	$1,570,000	1.00	$1,570,000	
SUBTOTAL						**$1,570,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$1,570,000**
Estimating Contingency	30	%				$471,000
SUBTOTAL						**$2,041,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$78,000
SUBTOTAL						**$2,119,000**
General Conditions	10	%				$212,000
SUBTOTAL						**$2,331,000**
General Contractor Overhead and Profit	15	%				$350,000
ELEMENT CONSTRUCTION COST						**$2,681,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative B
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 3
ELEMENT : New Primary Treatment Facilities at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Primary Clarifiers - Three 105' Diameter						
Shoring	23,840	SF	$37	1.07	$950,700	
Excavation	17,720	CY	$4	1.07	$75,800	
Backfill - ABC	1,130	CY	$44	1.07	$53,200	
Backfill - Native	2,660	CY	$18	1.07	$51,200	
Offhaul	16,570	CY	$20	1.07	$354,600	
Concrete Slab on Grade	1,635	CY	$560	1.07	$979,700	
Concrete Walls	695	CY	$1,035	1.07	$769,700	
Metals	1	LS	$163,000	1.00	$163,000	
FRP Weir, 0.25" thick	990	LF	$15	1.07	$15,900	
FRP Scum Baffle, 0.25" thick	990	LF	$52	1.07	$55,100	
Clarifier Mechanism, 105' diameter	3	EA	$382,000	1.07	$1,226,200	
Primary Sludge Pump Station	1,790	SF	$450	1.07	$861,900	
Flow Splitting Structures	830	SF	$775	1.07	$688,300	
Purchase Land in the Field to the North	23	AC	$20,000	1.00	$460,000	
SUBTOTAL						**$6,705,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	20	%				$1,341,000
Mechanical and Piping (% of Subtotal)	5	%				$335,000
Plant Electrical and Instrumentation (% of Subtotal)	20	%				$1,341,000
SUBTOTAL						**$9,722,000**
Estimating Contingency	30	%				$2,917,000
SUBTOTAL						**$12,639,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$482,000
SUBTOTAL						**$13,121,000**
General Conditions	10	%				$1,312,000
SUBTOTAL						**$14,433,000**
General Contractor Overhead and Profit	15	%				$2,165,000
ELEMENT CONSTRUCTION COST						**$16,598,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative B
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 4
ELEMENT : Anaerobic Digesters at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Anaerobic Digesters	3	LS	$4,800,000	1.07	$15,408,000	
105' Diameter and 29' SWD						
Digester Control Building with Digester Support Facilities						
SUBTOTAL						**$15,408,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	5	%				$770,000
Mechanical and Piping (% of Subtotal)	5	%				$770,000
Plant Electrical and Instrumentation (% of Subtotal)	5	%				$770,000
SUBTOTAL						**$17,718,000**
Estimating Contingency	30	%				$5,315,000
SUBTOTAL						**$23,033,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$878,000
SUBTOTAL						**$23,911,000**
General Conditions	10	%				$2,391,000
SUBTOTAL						**$26,302,000**
General Contractor Overhead and Profit	15	%				$3,945,000
ELEMENT CONSTRUCTION COST						**$30,247,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative B
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 5
ELEMENT : Sludge Dewatering at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Sludge Dewatering Contained in a Building	6,130	SF	$800	1.07	$5,247,300	
SUBTOTAL						**$5,247,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	5	%				$262,000
Mechanical and Piping (% of Subtotal)	10	%				$525,000
Plant Electrical and Instrumentation (% of Subtotal)	15	%				$787,000
SUBTOTAL						**$6,821,000**
Estimating Contingency	30	%				$2,046,000
SUBTOTAL						**$8,867,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$338,000
SUBTOTAL						**$9,205,000**
General Conditions	10	%				$921,000
SUBTOTAL						**$10,126,000**
General Contractor Overhead and Profit	15	%				$1,519,000
ELEMENT CONSTRUCTION COST						**$11,645,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative B
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 6
ELEMENT : WAS Thickening at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Relocation of GBT from Sutter Plant	1	LS	$100,000	1.00	$100,000	
New Sludge Thickening Building	1,200	SF	$1,600	1.07	$2,054,400	
SUBTOTAL						**$2,154,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$2,154,000**
Estimating Contingency	30	%				$646,000
SUBTOTAL						**$2,800,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$107,000
SUBTOTAL						**$2,907,000**
General Conditions	10	%				$291,000
SUBTOTAL						**$3,198,000**
General Contractor Overhead and Profit	15	%				$480,000
ELEMENT CONSTRUCTION COST						**$3,678,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative B
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 7
ELEMENT : Sludge Drying Beds at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Sludge Drying Beds						
Concrete pad (8")	4,280	CY	$400	1.07	$1,831,800	
Base Layer (12")	173,200	SF	$3	1.07	$518,900	
SUBTOTAL						**$2,351,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	50	%				$1,176,000
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$3,527,000**
Estimating Contingency	30	%				$1,058,000
SUBTOTAL						**$4,585,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$175,000
SUBTOTAL						**$4,760,000**
General Conditions	10	%				$476,000
SUBTOTAL						**$5,236,000**
General Contractor Overhead and Profit	15	%				$785,000
ELEMENT CONSTRUCTION COST						**$6,021,000**

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PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative C

COST ESTIMATE PREPARATION DATE : 11/11/2014
JOB # : 9601A.00 **BY :** KTL
ELEMENT # 0
ELEMENT : SUMMARY OF CONSTRUCTION COSTS

Rate of Annual Inflation:	3%
Estimating Contingency:	30%
Sales Tax:	7.625%
General Conditions:	10%
Contractor Overhead and Profit:	15%

ELEMENT #	DESCRIPTION	COST
1	Demolition of Sutter Treatment Facilities	$12,180,000
2	Site Improvements at Jennings Plant	$2,681,000
3	New Primary Treatment Facilities at Jennings Plant	$17,592,000
4	New Anaerobic Digesters at Jennings Plant	$30,247,000
5	Sludge Dewatering at Jennings Plant	$11,645,000
6	WAS Thickening at Jennings Plant	$3,678,000
7	Sludge Cake Drying Beds at Jennings Plant	$6,021,000
	Total Estimated Construction Cost =	**$84,044,000**
	Engineering, Legal, Administrative Fees, Permitting, and Construction Management 20% of Construction Cost	$16,809,000
	Total Estimated Project Cost =	**$100,853,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative C
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 1
ELEMENT : Demolition of Sutter Treatment Facilities to 4' Below Grade and Backfill to Grade

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Primary Clarifiers	2	EA	$365,000	1.00	$730,000	
Digesters No. 1 and 2 (104' Diameter and 32' SWD)	2	EA	$111,000	1.00	$222,000	
Digester No. 3 (90' Diameter and 30' SWD)	1	EA	$434,000	1.00	$434,000	
Digesters No. 4 (60' Diameter Concrete Tank and 21.7' SWD)	1	EA	$117,000	1.00	$117,000	
Digesters No. 5 (60' Diameter Concrete Tank and 19.5' SWD)	1	EA	$106,000	1.00	$106,000	
Digester Building	1	EA	$109,000	1.00	$109,000	
Sludge Thickeners No. 1 and 2	2	EA	$110,000	1.00	$220,000	
Thickener Process Building	1	EA	$141,000	1.00	$141,000	
Spiro-Vortex Basin	1	EA	$991,000	1.00	$991,000	
Demo Concrete Slab and Mechanism						
Backfill with Imported Material to Match Grade						
Sludge Drying Beds	1	LS	$4,336,000	1.00	$4,336,000	
Disposal of Top 2' Feet of Soil and Backfill with 2' of Imported Material						
SUBTOTAL						**$7,406,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$7,406,000**
Estimating Contingency	30	%				$2,222,000
SUBTOTAL						**$9,628,000**
Sales Tax on 50% of Subtotal Above	0	%				$0
SUBTOTAL						**$9,628,000**
General Conditions	10	%				$963,000
SUBTOTAL						**$10,591,000**
General Contractor Overhead and Profit	15	%				$1,589,000
ELEMENT CONSTRUCTION COST						**$12,180,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative C
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 2
ELEMENT : Site Improvements at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Expansion of Administration Building at Jennings Plant	1	LS	$1,570,000	1.00	$1,570,000	
SUBTOTAL						**$1,570,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$1,570,000**
Estimating Contingency	30	%				$471,000
SUBTOTAL						**$2,041,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$78,000
SUBTOTAL						**$2,119,000**
General Conditions	10	%				$212,000
SUBTOTAL						**$2,331,000**
General Contractor Overhead and Profit	15	%				$350,000
ELEMENT CONSTRUCTION COST						**$2,681,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative C
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 3
ELEMENT : New Primary Treatment Facilities at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Primary Clarifiers - Three 105' Diameter						
Shoring	23,840	SF	$37	1.07	$950,700	
Excavation	17,720	CY	$4	1.07	$75,800	
Backfill - ABC	1,130	CY	$44	1.07	$53,200	
Backfill - Native	2,660	CY	$18	1.07	$51,200	
Offhaul	16,570	CY	$20	1.07	$354,600	
Concrete Slab on Grade	1,635	CY	$560	1.07	$979,700	
Concrete Walls	695	CY	$1,035	1.07	$769,700	
Metals	1	LS	$163,000	1.00	$163,000	
FRP Weir, 0.25" thick	990	LF	$15	1.07	$15,900	
FRP Scum Baffle, 0.25" thick	990	LF	$52	1.07	$55,100	
Clarifier Mechanism, 105' diameter	3	EA	$382,000	1.07	$1,226,200	
Primary Sludge Pump Station	1,790	SF	$450	1.07	$861,900	
Flow Splitting Structures	830	SF	$775	1.07	$688,300	
SUBTOTAL						**$6,245,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	40	%				$2,498,000
Mechanical and Piping (% of Subtotal)	5	%				$312,000
Plant Electrical and Instrumentation (% of Subtotal)	20	%				$1,249,000
SUBTOTAL						**$10,304,000**
Estimating Contingency	30	%				$3,091,000
SUBTOTAL						**$13,395,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$511,000
SUBTOTAL						**$13,906,000**
General Conditions	10	%				$1,391,000
SUBTOTAL						**$15,297,000**
General Contractor Overhead and Profit	15	%				$2,295,000
ELEMENT CONSTRUCTION COST						**$17,592,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative C
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 4
ELEMENT : Anaerobic Digesters at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Anaerobic Digesters	3	LS	$4,800,000	1.07	$15,408,000	
105' Diameter and 29' SWD						
Digester Control Building with Digester Support Facilities						
SUBTOTAL						**$15,408,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	5	%				$770,000
Mechanical and Piping (% of Subtotal)	5	%				$770,000
Plant Electrical and Instrumentation (% of Subtotal)	5	%				$770,000
SUBTOTAL						**$17,718,000**
Estimating Contingency	30	%				$5,315,000
SUBTOTAL						**$23,033,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$878,000
SUBTOTAL						**$23,911,000**
General Conditions	10	%				$2,391,000
SUBTOTAL						**$26,302,000**
General Contractor Overhead and Profit	15	%				$3,945,000
ELEMENT CONSTRUCTION COST						**$30,247,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative C
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 5
ELEMENT : Sludge Dewatering at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Sludge Dewatering Contained in a Building	6,130	SF	$800	1.07	$5,247,300	
SUBTOTAL						**$5,247,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	5	%				$262,000
Mechanical and Piping (% of Subtotal)	10	%				$525,000
Plant Electrical and Instrumentation (% of Subtotal)	15	%				$787,000
SUBTOTAL						**$6,821,000**
Estimating Contingency	30	%				$2,046,000
SUBTOTAL						**$8,867,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$338,000
SUBTOTAL						**$9,205,000**
General Conditions	10	%				$921,000
SUBTOTAL						**$10,126,000**
General Contractor Overhead and Profit	15	%				$1,519,000
ELEMENT CONSTRUCTION COST						**$11,645,000**

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COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative C
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 6
ELEMENT : WAS Thickening at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Relocation of GBT from Sutter Plant	1	LS	$100,000	1.00	$100,000	
New Sludge Thickening Building	1,200	SF	$1,600	1.07	$2,054,400	
SUBTOTAL						**$2,154,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	0	%				$0
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$2,154,000**
Estimating Contingency	30	%				$646,000
SUBTOTAL						**$2,800,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$107,000
SUBTOTAL						**$2,907,000**
General Conditions	10	%				$291,000
SUBTOTAL						**$3,198,000**
General Contractor Overhead and Profit	15	%				$480,000
ELEMENT CONSTRUCTION COST						**$3,678,000**

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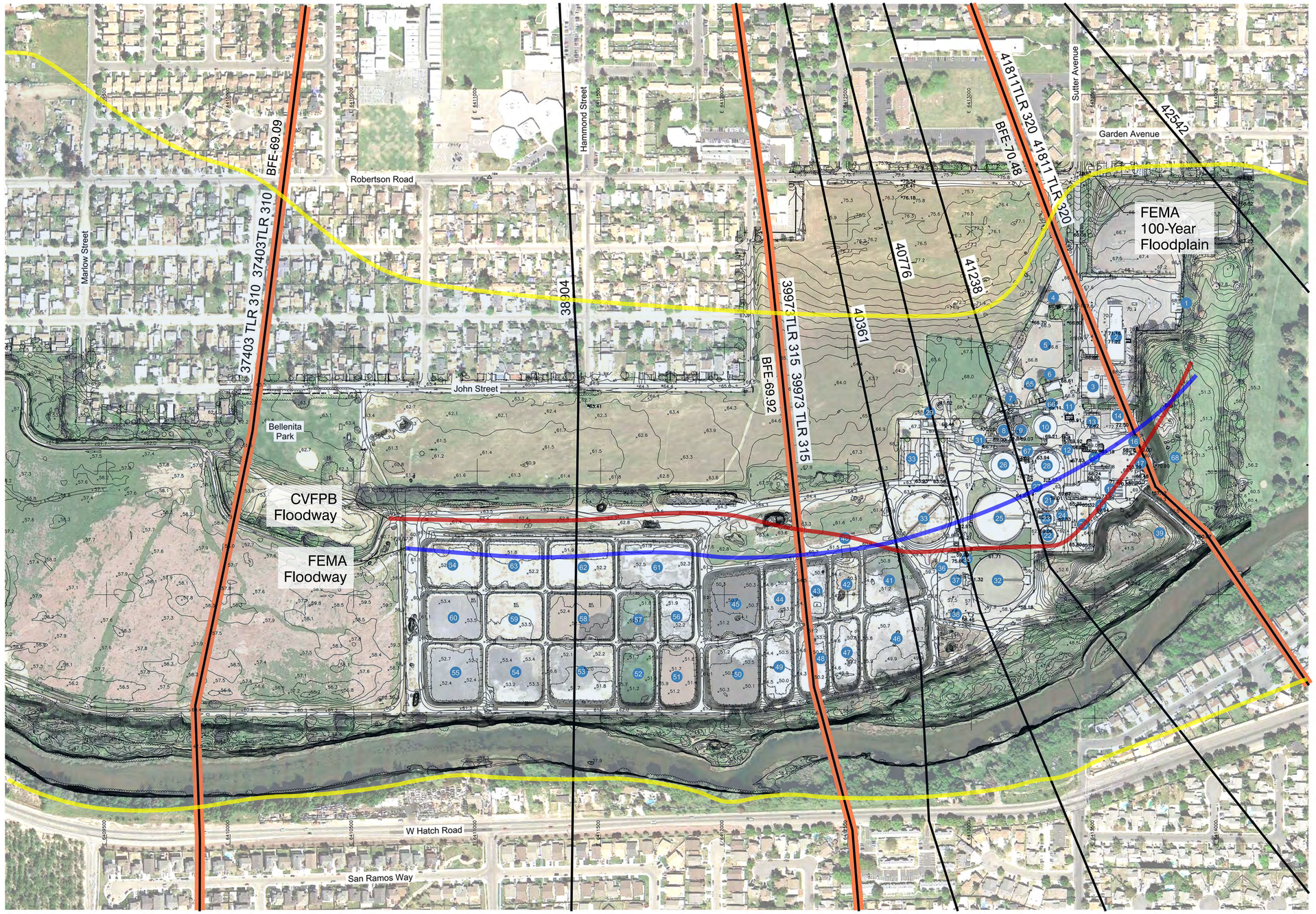
COST ESTIMATE

PROJECT : Modesto - Sutter Treatment Facility Feasibility Study
Jennings Option - Alternative C
JOB # : 9601A.00
LOCATION : MODESTO, CA
ELEMENT # : 7
ELEMENT : Sludge Drying Beds at Jennings Plant

LOCATION FACTOR : 1.07
COST ESTIMATE PREPARATION DATE : 11/11/2014
BY : KTL
REVIEWED BY:

DESCRIPTION	QUAN	UNIT	UNIT COST	LOCATION FACTOR	SUBTOTAL	TOTAL
Sludge Drying Beds						
Concrete pad (8")	4,280	CY	$400	1.07	$1,831,800	
Base Layer (12")	173,200	SF	$3	1.07	$518,900	
SUBTOTAL						**$2,351,000**
Plant Paving and Grading and Yard Piping (% of Subtotal)	50	%				$1,176,000
Mechanical and Piping (% of Subtotal)	0	%				$0
Plant Electrical and Instrumentation (% of Subtotal)	0	%				$0
SUBTOTAL						**$3,527,000**
Estimating Contingency	30	%				$1,058,000
SUBTOTAL						**$4,585,000**
Sales Tax on 50% of Subtotal Above	7.625	%				$175,000
SUBTOTAL						**$4,760,000**
General Conditions	10	%				$476,000
SUBTOTAL						**$5,236,000**
General Contractor Overhead and Profit	15	%				$785,000
ELEMENT CONSTRUCTION COST						**$6,021,000**

APPENDIX E – TOPOGRAPHIC MAP OF SUTTER PLANT



0 100' 200' 400'

LEGEND

1. Collection Storage Yard
2. Collection and Electrical
3. Admin and Lab
4. Water Well 15A
5. Overflow Parking
6. Crane Storage Building
7. Septic Receiving Station
8. Digester #5
9. Digester #4
10. Digester #3
11. Electrical Sub-Station 1
12. FeCL2 Station
13. Maintenance (Staff Building)
14. Maintenance (Shop Building)
15. Emergency Generator #1
16. Electrical Sub-Station 2
17. Cannery Seg Pump Station
18. Headworks
19. Air Handling Building
20. Odor Control Bio-Filter
21. Sludge Thickener No. 1 (Abandoned)
22. Sludge Thickener No. 2 (Abandoned)
23. G.B.T. Building
24. Polymer Mixing
25. Clarifier #1
26. Digester #1
27. Sludge Handling Building
28. Digester #2
29. Collection Storage Yard
30. Vac Con Dump Site
31. Water Well 15B
32. Clarifier #2
33. Aeration Building/Holding Basin
34. Emergency Generator #2
35. Outfall Control Building
36. Solid Waste Storage
37. Outfall Pumping Storage
38. Outfall Control Valves
39. Emergency Holding Basin
40. Vactor Dump Station
41.-64. Sludge Drying Beds
65. Fuel Station
66. Digester Control Building
67. Old Laboratory
68. Dryden Box

Spot Elevations

X - Survey from 2015 Feasibility Study

X - Survey from 2013 Facility Layout Plan

TOPOGRAPHIC MAP OF SUTTER PLANT

FIGURE E1

CITY OF MODESTO
SUTTER PLANT
SUTTER TREATMENT FACILITY FEASIBILITY STUDY

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