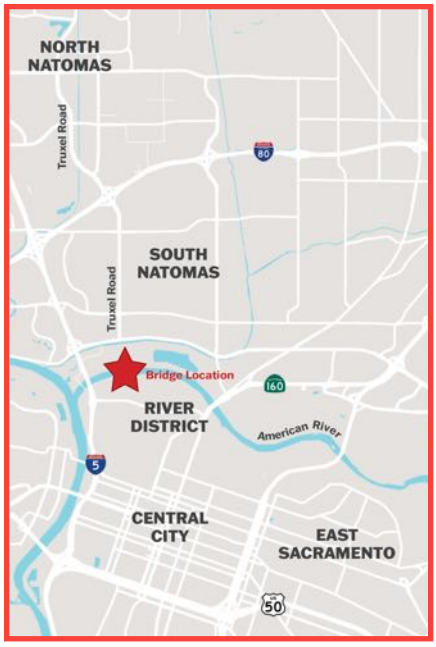
Truxel Bridge
Concept and Feasibility Study

City of SACRAMENTO

We want your feedback on Truxel Bridge!

Take the Online Community Questionnaire now until February 26



Visit **bit.ly/TruxelBridgeQuestionnaire** or scan the QR code.

The City of Sacramento is planning for a new bridge across the Lower American River that will create a better connection for those traveling between north Sacramento communities and downtown Sacramento. The City's goals of providing better access between communities will improve air quality, enhance job opportunities and economic development, and improve emergency response.

For more information, visit the project website at **bit.ly/TruxelBridge** or contact Fedolia "Sparky" Harris at **fharris@cityofsacramento.org**

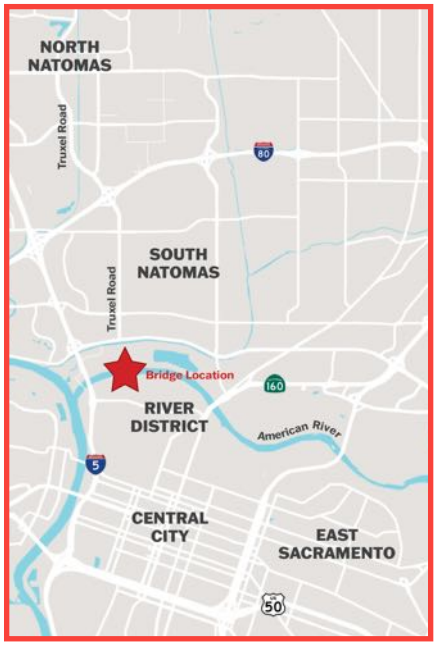


Truxel Bridge
Concepto y estudio de viabilidad

City of SACRAMENTO

¡Queremos conocer su opinión sobre el Puente Truxel!

Responda al Cuestionario comunitario en línea ahora y hasta el 26 de febrero



Ingrese en **bit.ly/TruxelBridgeQuestionnaire** o escanee el código QR

La ciudad de Sacramento planea construir un nuevo puente sobre el American River que creará una mejor conexión para quienes viajen entre las comunidades del norte de Sacramento y el centro de la ciudad. Los objetivos de la ciudad de proporcionar un mejor acceso entre las comunidades mejorarán la calidad del aire, aumentarán las oportunidades de trabajo y el desarrollo económico, y mejorarán la capacidad de respuesta ante emergencias.

Para más información, ingrese en el sitio web del proyecto **bit.ly/TruxelBridge** o póngase en contacto con Fedolia "Sparky" Harris enviando un correo electrónico a **fharris@cityofsacramento.org**.



Stakeholder Meeting Summary
April 9th, 2024 | 3:00- 4:30
Stanford Settlement Neighborhood Center

Introduction

On Tuesday, April 9, 2024 from 3:00 – 4:30 p.m., the City of Sacramento hosted a Stakeholder Focus Group Meeting as part of the Truxel Bridge Concept and Feasibility Study's public outreach and engagement process. The meeting was held at the Stanford Settlement Neighborhood Center located at 450 West El Camino Avenue.



Pamela Dalcin-Walling, Dokken Engineering, (back right), presents to attendees about Truxel Bridge

Prior to the stakeholder meeting, the City hosted an introductory community meeting in January 2024 and launched a follow-up online questionnaire in February 2024, which garnered 1,019 responses from the community about various project elements like the proposed bridge alignment and cross sections. The purpose of the April meeting was to present modified options for the bridge cross sections and mix of uses and gather additional feedback from stakeholder representatives.

10 Representatives from the following organizations attended the meeting:

- 350 Sacramento
- Sacramento Area Council of Governments (SACOG)
- North Natomas Jibe
- The River District
- Environmental Council of Sacramento (ECOS)
- Save the American River Association (SARA)
- Gardenland-Northgate Neighborhood Association
- The Sandford Settlement Center
- Sacramento Area Bike Advocates (SABA)
- Sacramento Transit Advocates and Riders (STAR)

Project Background

In 2013, the City completed the American River Crossings Alternatives Study, and the City Council adopted the vision for a new multi-modal crossing at Truxel Road as the recommended alignment. The Truxel Bridge alignment was recommended and adopted based on its ability to address limited connectivity across the lower American River, creating a barrier to downtown Sacramento for communities north of the river. The City's plan for Truxel Bridge will create a more direct connection for those walking, biking, taking transit, or driving between northern Sacramento communities and Sacramento's urban core. It will also provide better



Proposed location for Truxel Bridge

access, improve air quality, increase job opportunities, enhance economic development, and reduce emergency response times.



Gladys Cornell (center) begins the presentation

Presentation

The meeting began with a welcome from Gladys Cornell, Outreach Manager with AIM Consulting, who reviewed the meeting agenda, introduced the project team, and provided a recap of the public outreach activities completed so far as well as the feedback received. Below are some of the key benefits and concerns that the team has heard from the community:

Key Benefits:

- Encourages alternative modes of travel
- Provides better emergency access
- Offers direct, faster access to downtown
- Avoids I-5 congestion

Key Concerns:

- Cut through traffic on Truxel Road
- Safe facilities for bikes/peds on bridge
- Environmental impacts to the Lower American River
- Cost of bridge

Next, Fedolia "Sparky" Harris, Principal Planner and the City's Project Manager, provided an overview of the feasibility study, its purpose and background, and some frequently asked questions from the community. Below are the FAQs and their acknowledged answers.



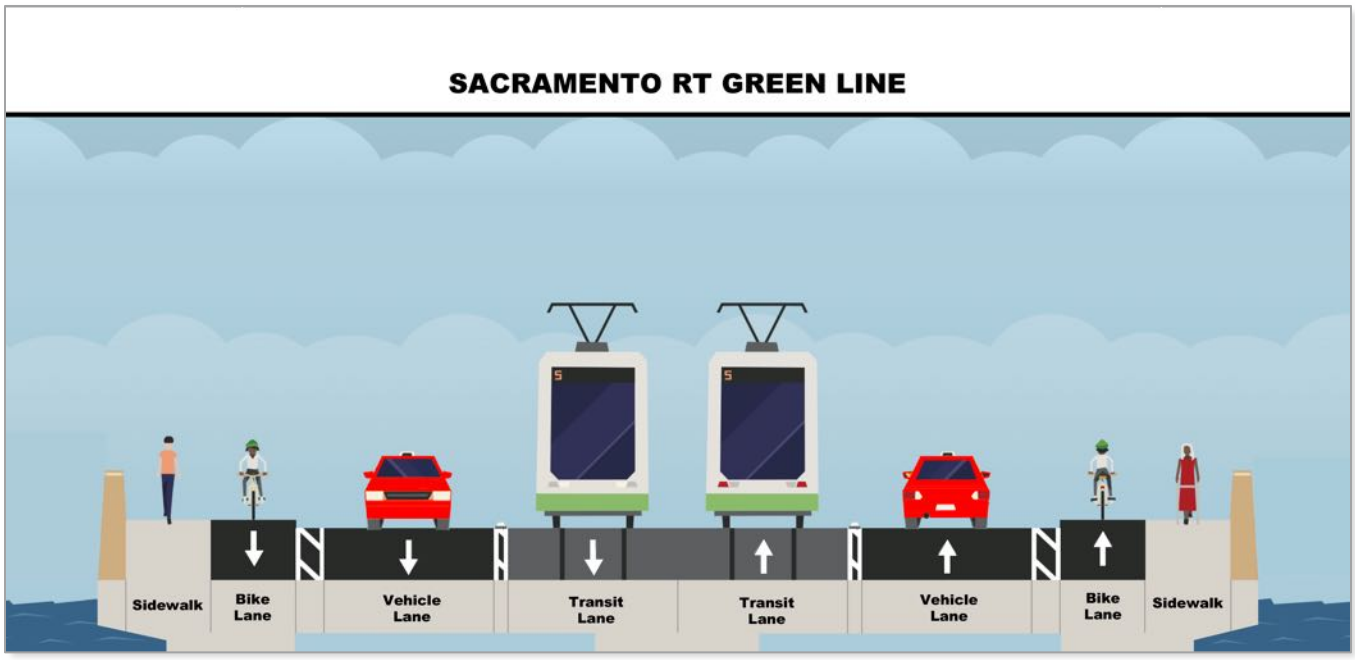
Sparky Harris (center) provides a project overview

- **Can the project be built if environmental impacts are identified?**
  - Yes, most projects have some level of environmental impact. These impacts must be identified, disclosed to the public, and minimized.
- **Can a different bridge location be considered as one of the alternatives?**
  - After the need for an American River bridge crossing was identified, the City of Sacramento completed the American River Crossing Alternatives Study, which identified Truxel Road as the preferred location. The City Council would have to approve revisiting other bridge locations.

- Will the environmental document require consideration of multiple alternatives?
  - At this time, it is anticipated that the project's CEQA document will be an Environmental Impact Report. The City will be responsible for selecting feasible project alternatives that accomplish the project's objectives and that also may avoid or substantially lessen significant environmental effects.
- Can a bridge without cars be considered as one of the alternatives?
  - At this time, the project addresses the need for a local jurisdiction multi-modal crossing of the lower American River that includes vehicle lanes. This has been established in the Sacramento General Plan and recognized in the Metropolitan Transportation Plan/Sustainable Communities Strategy 2035, Sacramento Area Council of Governments, 2012.

Following Sparky's introduction, Pamela Dalcin-Walling, Project Manager with Dokken Engineering, reviewed the Truxel Bridge horizontal alignment design and proposed cross-section options. Below are the proposed cross sections presented to the community earlier in 2024, and then the modified cross sections with community feedback incorporated.

Cross Sections: Option C



Benefits:

- All modes and directions are separated
- Jed Smith connection for the west side
- Reduced shoulder control speeds

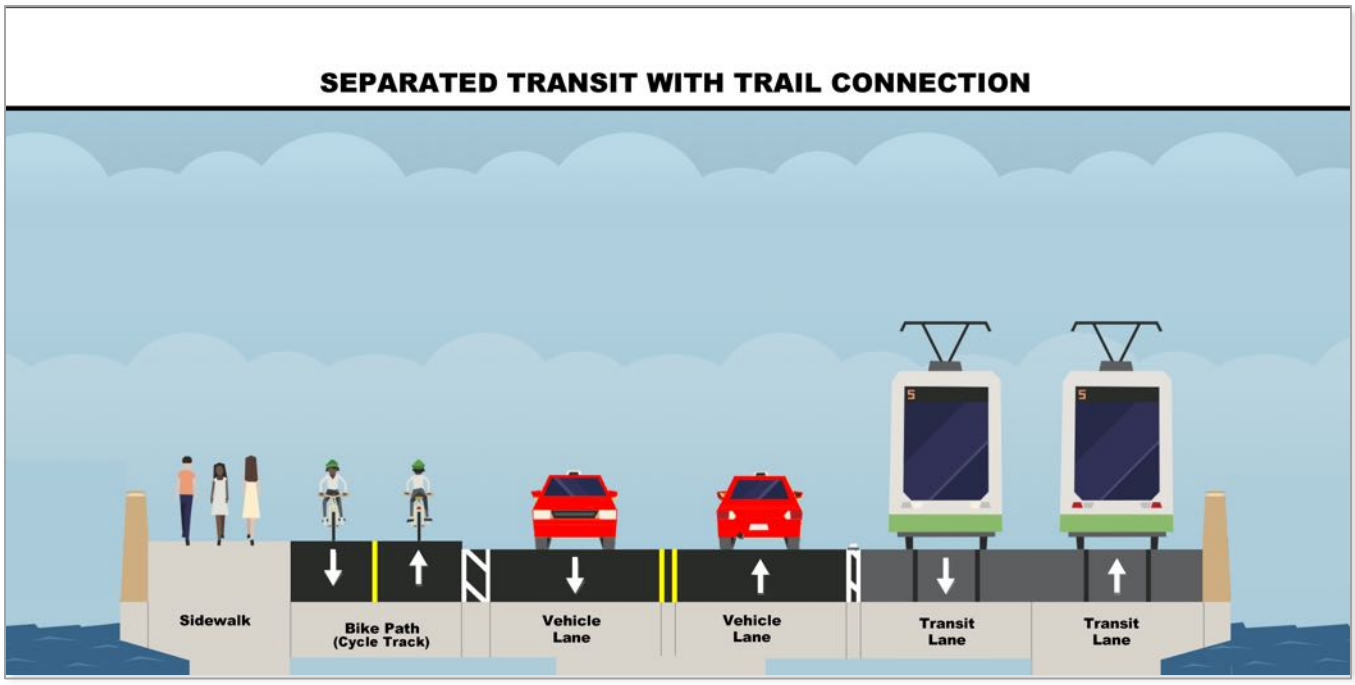
Likes:

- Separated transit lanes
- Placement of transit in the middle
- Bike lanes/sidewalks on both sides
- Directional consistency of all modes

Dislikes:

- No barrier between cars and bikes
- Wider bridge
- Partial trail connectivity

Cross Sections: Option B



Benefits:

- All modes are separated
- Jed Smith connection
- Reduced shoulder control speeds

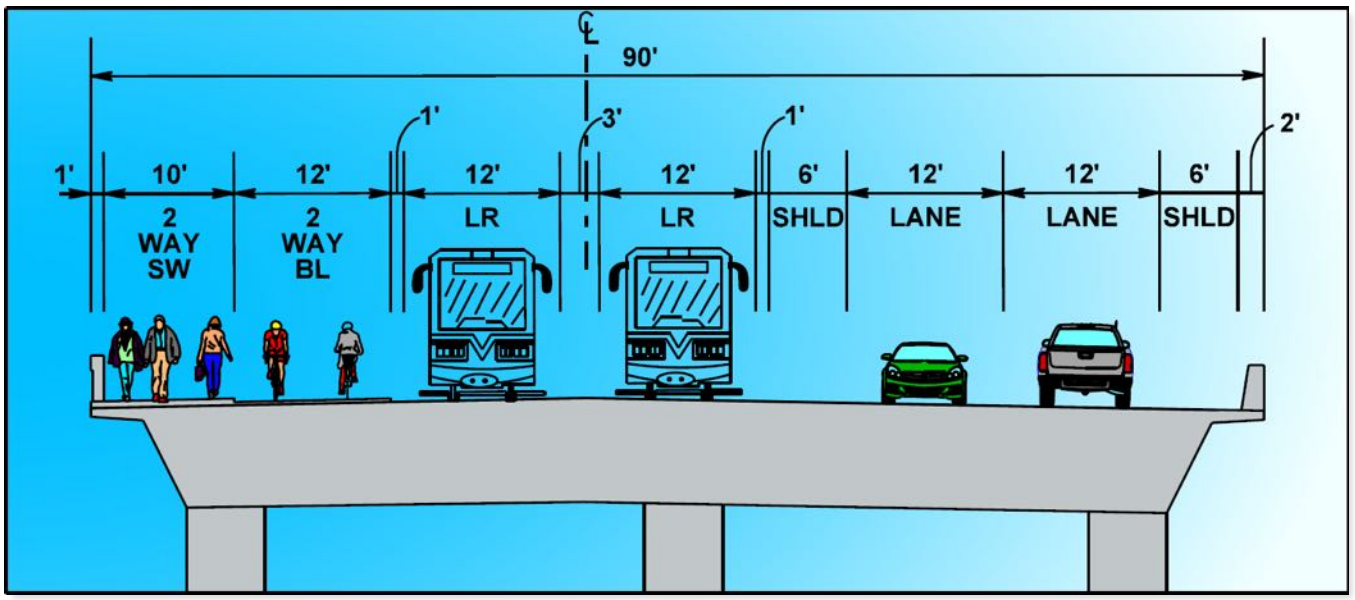
Likes:

- Separation of bikes, peds, vehicles, and transit
- A narrower shoulder discourages speeding

Dislikes:

- No barrier between cars and bikes
- No dedicated emergency lane
- Greater environmental impact

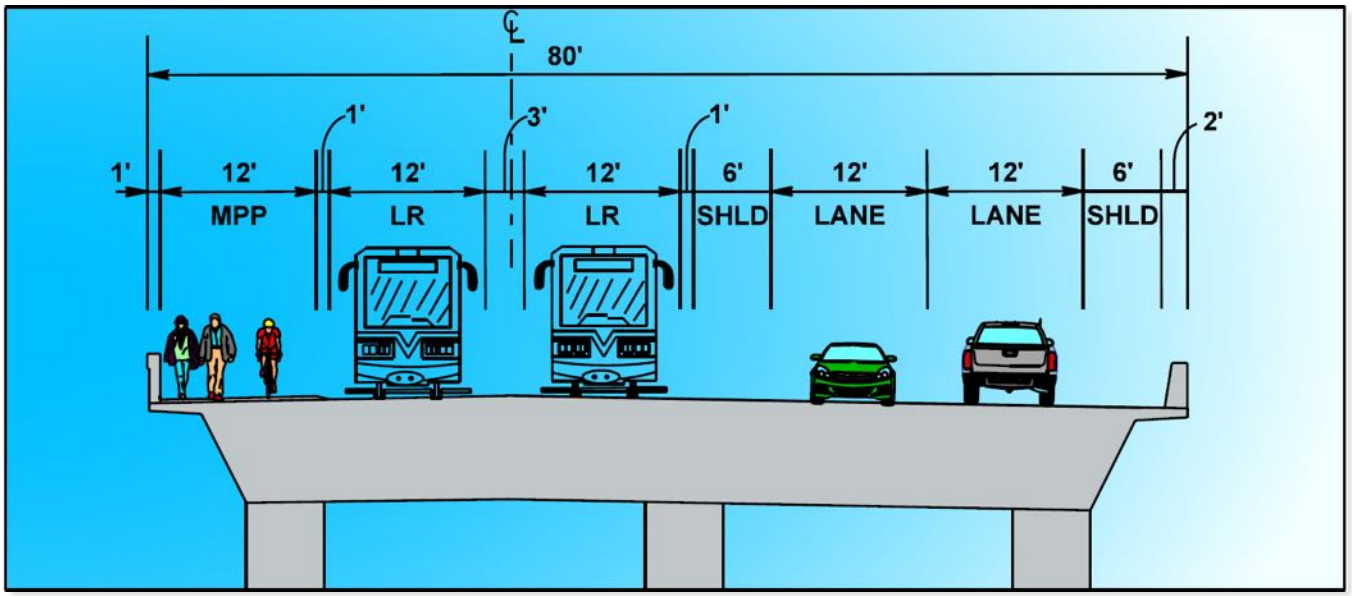
Cross Sections: Option B1



Variation:

Swap transit and cars to provide separation from bikes/peds.

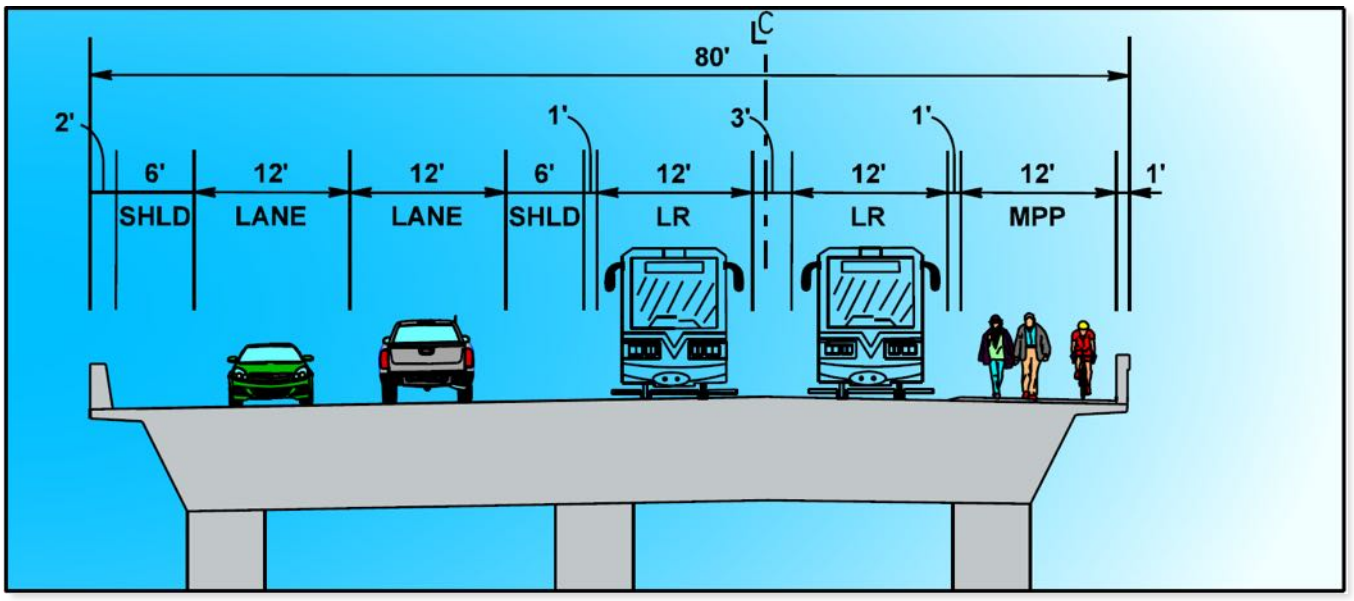
Cross Sections: Option B2



Variation:

Swap transit and cars to provide separation from bikes/peds.
Combine bikes/peds for the Multipurpose Path on the west.

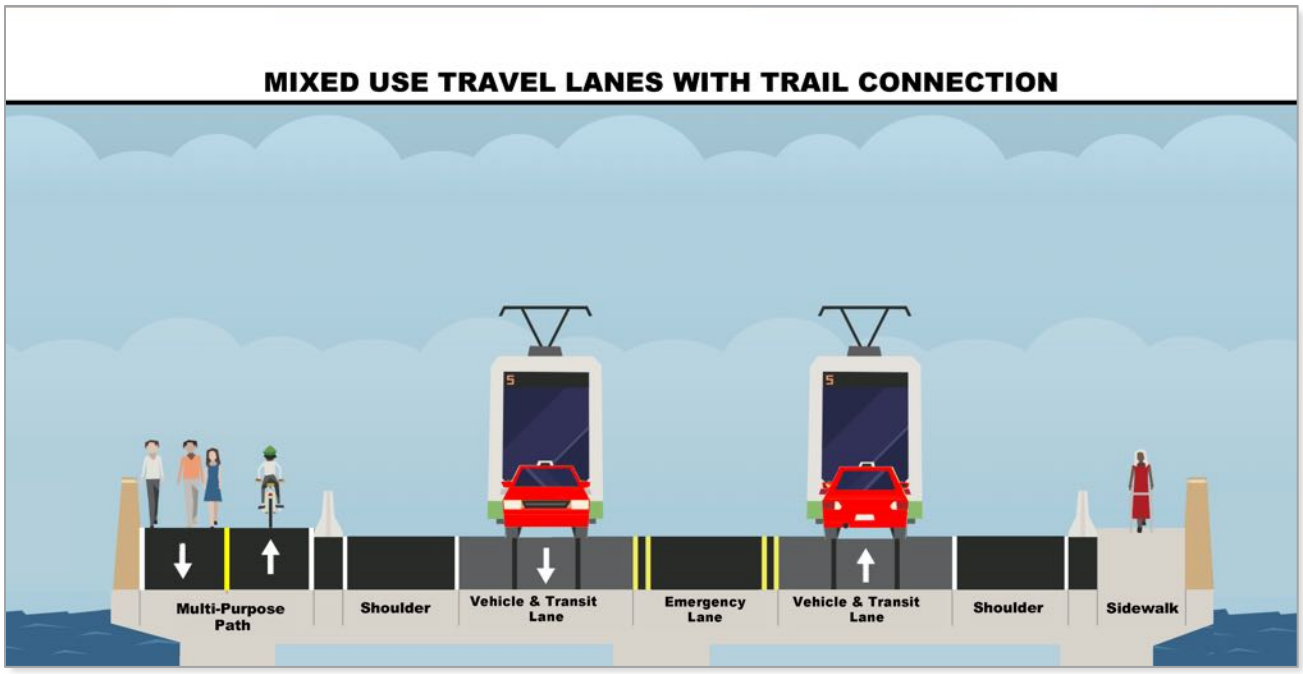
Cross Sections: Option B3



Variation:

Swap transit and cars to provide separation from bikes/peds.
Combine bikes/peds for Multipurpose Path on the east.

Cross Sections: Option A



Benefits:

- Narrowest
- Least environmental impacts
- Lowest cost
- Emergency lane
- Shoulders
- Multi-purpose path
- Jed Smith connection
- Physical barrier between vehicles/ bikes & peds
- Combined vehicles and transit in same lanes controls speeds

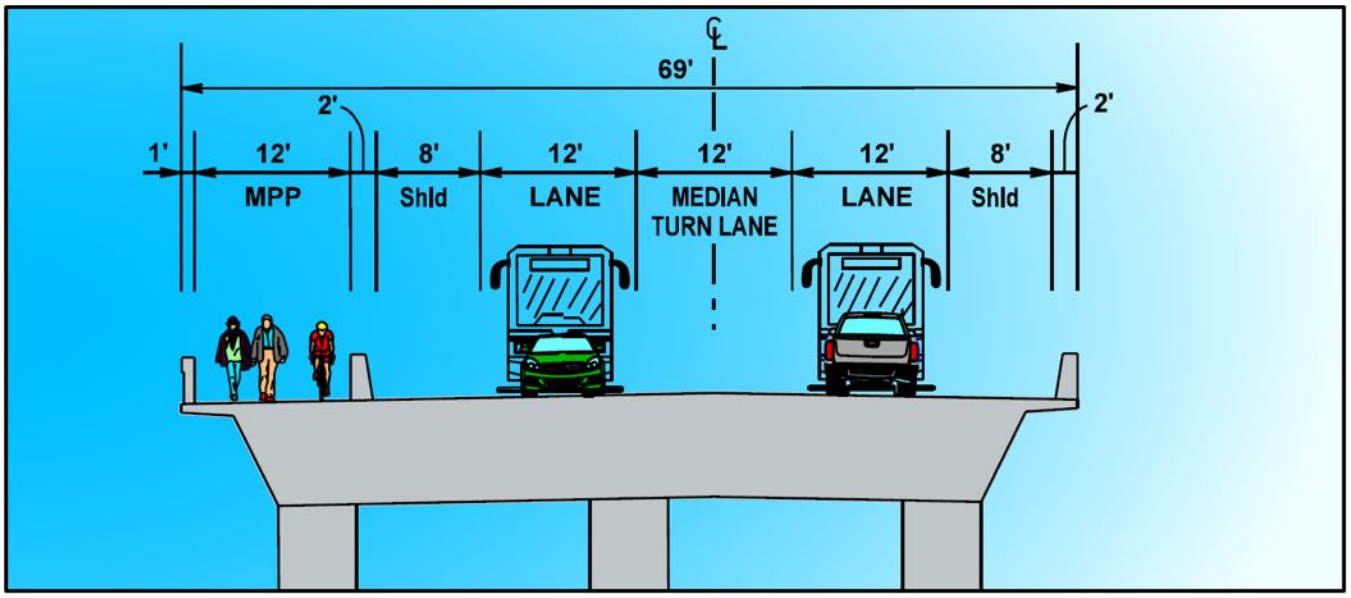
Likes:

- Separation of bikes/peds
- Placement of various modes
- Low costs
- Shoulders & Emergency Lane

Dislikes:

- Shared vehicle/transit lanes
- Not enough bike/ped separation

Cross Sections: Option A1



Variation:
Reduces width by removing sidewalk

Stakeholder Feedback
All community feedback from the discussion is below, with the project team members' responses in bold below.


Stakeholder discusses cross section options

- How long is the span of the bridge?
  - Close to 3,000 feet
- Good, I think sharing tracks with Light Rail for a short amount of time is not that bad.
- All options only have two lanes (one in each direction) for vehicles?
  - Yes.
- As a resident, I appreciate that you're considering transit-only lanes. I don't want to own a car anymore. I think they're unsafe and I do want to bike more. I think the lack of car-free options is unfair to the lowest-income residents. There may be a bias in the feedback you're getting from the community. If we continue with car-inclusive infrastructure, that will not help to mitigate VMT, and climate goals of the City.

- We hear you, and to address those, we try to lower the barriers by making the questionnaire as accessible as possible. We work with local stakeholder organizations to reach priority populations. We also raise awareness by holding pop-up workshops in the community where the community already gathers.
- In terms of the VMT calculations, we are working on analyses that are anticipated to show that making the route to downtown more direct actually lowers VMT (VMT per capita).



Attendees discuss the cross sections

- It sounds like you would be digging twice.
  - We don't anticipate digging again when RT is installed, we build the bridge so that transit accommodations can be added easily.
- Is there a cost difference based on what type of transit is included on the bridge?
  - We don't currently have any cost estimates.
- I heard someone say that this is not consistent with the American Parkway Plan, is that true?
  - The American River Parkway plan shows a transit/pedestrian/bike-only bridge. We can't build anything until we update that plan to reflect the kind of bridge we want to build. We anticipate working with the County to amend the Parkway Plan during the environmental phase.
- E-bikes are becoming more popular. Regular bikes and e-bikes creates a deterrent for mixing. The speed differences in an area with pedestrians may be concerning. I do like the idea of having a barrier between bicyclists and pedestrians.
- If there is a rounded lip (elevated bike lane), would it encourage people to drive onto it if they were frustrated? But having a sharp corner could also be dangerous for bicyclists if they fall off.
  - Do you have a preference for a specific cross section?
  - I think that bikes should be separate from pedestrians. So, an option that has bikes on one side to connect to trail. But is separate.
- Could you eliminate one shoulder on Option A, and make it narrower? For Option A1 – Make it with four-foot shoulders, then the middle lane would be for breakdowns and emergency vehicles.
- Upcoming bikeway guidelines are going to say 8-foot minimum either direction for cycletracks. For anywhere, and it's because of the different types of bikes now. The City is obligated to consider it.
- New vehicle/transit lanes are unacceptable. They are pinch points in the transit system and incur unnecessary slowdowns. In turn, there will be lots of money spent to eventually fix it. That would be true whether it ends up being LRT or BRT/bus. That's my organization's view.


Attendees discuss the cross sections

- When looking at the different options, I would prefer to have transit and vehicles, because they have 15-minute headways. I would think sharing that space is more efficient. I don't think it's acceptable to have walking and biking mixed. People feel more comfortable when there is a physical barrier protecting them. I feel like it may be better to consolidate space.
- The shoulders on Option A seem like it's almost begging for people to drive up onto them.
- I don't think I'm on that technical level, but if there were no cars, some people work late into the night, work multiple jobs, and work odd hours. Using public transportation requires time that some people don't have. Most people will have their friends or parents drop them off. I like the idea of public transportation, but the reality is that people may not use it.
- Caltrans is putting in extra lanes on I-5, does that mean this bridge is not needed?
    - **The short answer is no. They have looked at Truxel bridge as potential mitigation, but not a replacement for any of the traffic. This bridge has the potential to reduce VMT. The goal is to not increase VMT. They're supportive.**
    - Caltrans has said they would put in auxiliary lanes to the airport. My question is if there are cars on this bridge, would they not have to add lanes on I-5?
    - **The Truxel Bridge is intended to serve people coming from North/South Natomas. Those improvements on I-5 are intended to serve the whole I-5 corridor. Right now, Truxel Bridge would divert some of the local traffic off I-5.**
- Because of how transit currently works, it currently gets stuck behind cars most of the time. In reality, if we started to eliminate that with new development, some people might take public transit from point A to point B. I get that this is difficult and has been years in the making, but eliminating anything to discourage people from driving will help to improve our world for the future.
- If we do have cars and transit sharing, there needs to be strong public education to make sure people know how it will help the community. I used to take the bus downtown, but it's a different use of your time. I like Option A the best.
- As we're looking at the American River Parkway and the two rivers on southern side. You'll want to make sure there are the smoothest connections. I think people walking may also be interested as well. Yes, the difficulty in people looking to travel in a way besides transit is pretty bleak. It's going to be many years. With any luck, there will be more transformation in the mobility network. We need to make sure there is efficient transit travel.

- As a transportation advocate, my priorities are walking, biking and transit, so I do support the bridge.
- Because there's ambiguity about what kind of transit, let's not overbuild it. I do like the mixed lanes, it creates more flexibility as the options evolve.
- This project has been going on for over 10 years. We've become more climate oriented. By the time this thing gets built, it could be another 10 years. Part of me wants to see whether or not we should go back to Council with the future in mind. We know what's going on with the climate. Is there a mechanism to revisit that with council, or have some future focus? We're talking about the present, but this bridge will get built in 10 years time.
    - We have to base our plans on future plans (like General Plan), that already take future projections into account. The best they can do is plan for the future based on land use planning, etc.
- We're thinking about future recommendations, and things are being built right now that are using older planning documents or old criteria. I just want to make sure we are considering that.
- Right now all the plans exclude car-free conversations. The plans are not being funded right now. We would be funding it in the future.
- If we are giving RT dedicated right of way, that would be easier to sell. As soon as you start mixing uses, RT would lose some of that control.
    - RT doesn't want anything in the middle between transit lanes/space (shoulders/extra lanes). Not saying no emergency access, but just not between.
- Could RT communicate with LRT vehicles to keep them off the bridge in case of emergencies?
    - Yes, but if they are already on the bridge, they would have to stop if there is a car broken down on the shoulder.

Next Steps

Finally, the project team reviewed next steps with the stakeholders. The project team will be taking the stakeholders input and making further versions of the cross sections for the next community meeting in Fall 2024.

SACRAMENTO REGIONAL TRANSIT
EST. 1973

To Fedolia “Sparky” Harris,

SacRT has been an active partner in the Truxel Bridge conceptual design process guided by Dokken Engineering and the City of Sacramento. The Truxel Bridge project is in the early stages of development requiring more refinement and direction from City Council.

SacRT staff held an internal meeting on August 27th, 2024, to discuss numerous bridge design alternatives and provide comments for the future refinement of those alternatives. Below are highlighted comments, suggestions, clarifications and guidance to the City of Sacramento (originally provided September 6th, 2024) for the Truxel Bridge project:

Alignments:

- An alignment where trains are next to bikes/peds is potentially problematic without a barrier.
- SacRT is concerned about the potential crossover designs as it can increase the risk of train vs car collisions, as well as motorists possibly entering the exclusive railway and being impossible or very difficult to remove.
- Consider modifying the pedestrian crossing design of the future intersection at garden highway to ensure pedestrians only cross on three legs. This would allow the bridge/roadway connection to have less conflicts with light rail turning movements.
- The alternatives display long intersections on the bridge, which may have a traffic delay.

CPUC:

- Speeds will be slow through these segments due to curves and may lead to possible train/car collisions concerns.
- CPUC could conceivably raise the same concerns and should be contacted sooner than later in this project development process.

Traffic Study:

- A traffic study has been done to estimate vehicle volumes, but did not include the analysis of intersection delays at the crossovers. The City has confirmed the next phase of project development will conduct more traffic analysis (i.e. the environmental section will examine delay plus the internal circulation of the buildings).
- The clarification of the City traffic division’s involvement in the development of this project would be appreciated.

Safety:

- There was some uncertainty if vertical barriers would exist between transit and bike/ped, in the scenario where the two features are next to one another. Please clarify in the final report.

- There is consensus that if trains are next to bikes/peds, there should be a vertical barrier between them, to prevent bikes/peds from accidentally straying in front of a train. The barrier type and height can be determined in the next phase of review if agreed upon in practice now.

- Please consider determining if there are any documents or studies that can be added to the final product that state center vs side running transit is safer on a shared bridge.

Bus vs Rail Awareness:

- SacRT internally discussed the consequences of rail and overhead not being constructed at the same time as the bridge. Tracks on bridges require electrical isolation and the use of track plinths for fixing the future track elements.

- Track plinths must be incorporated into the deck of the bridge at the time of bridge construction, (i.e. cannot be retrofitted later).

- SacRT asks this Truxel Bridge project team to examine if other bridges in the Country have exposed plinths, but a temporary roadway placed over the plinths for an operable bus service. Currently, a bus running on future or planned rail tracks is not possible without an engineering solution. At a bare minimum, SacRT can assume increased bridge costs due to this information.

- Lastly, footings for future OCS will also require 13-foot-deep footings, and that curved track will require even more footings. Consultant profiles do show a 3-foot width between tracks, presumably for OCS poles, and presumably their design and cost estimates would include those OCS pole footings, because the bridge cannot be retrofitted later. SacRT requests verification with the City and consultant on this aspect of the design.

Kevin Schroder

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Senior Planner
Sacramento Regional Transit District
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Attachment N. Geotechnical Memo

PRELIMINARY FOUNDATION REPORT



PREPARED FOR:

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PREPARED BY:

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GEOCON

GEOCON PROJECT NO. S2815-05-01

JULY 2024

GEOCON
CONSULTANTS, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. S2815-05-01
July 31, 2024

VIA ELECTRONIC MAIL

Pamela Dalcin-Walling, PE
Dokken Engineering
110 Blue Ravine Road, Suite 200
Folsom, California 95630

Subject: PRELIMINARY FOUNDATION REPORT
TRUXEL ROAD AT AMERICAN RIVER BRIDGE
SACRAMENTO, CALIFORNIA

Ms. Dalcin-Walling:

In accordance with your authorization, we herein submit our *Preliminary Foundation Report* (PFR) for the proposed Truxel Road at American River bridge project located in Sacramento, California.

This report generally evaluates the geotechnical conditions for the proposed bridge based on previous subsurface explorations and geotechnical laboratory test data for the project area and provides preliminary geotechnical recommendations for project planning and preliminary design. Additional site-specific subsurface exploration, geotechnical laboratory testing, and engineering analysis will be required for design-level project recommendations.

Please contact us if you have any questions regarding this PFR or if we may be of further service.

Respectfully submitted,

GEOCON CONSULTANTS, INC.



Ronald E. Loutzenhiser, PE, GE
Senior Engineer

Jeremy J. Zorne, PE, GE
Senior Engineer

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APPENDIX A
PREVIOUS BORING LOGS, LOGS OF TEST BORINGS, AND LABORATORY TESTING BY OTHERS

APPENDIX B
ANALYSES AND CALCULATIONS

PRELIMINARY FOUNDATION REPORT

1.0 INTRODUCTION

This *Preliminary Foundation Report* (PFR) presents our preliminary geotechnical conclusions and recommendations for the proposed Truxel Road at American River bridge project located in Sacramento, California. The approximate site location is depicted on the Vicinity Map, Figure 1. The purpose of this report is to generally evaluate subsurface geologic and geotechnical conditions for the proposed bridge and to provide preliminary geotechnical recommendations for use in bridge concept and feasibility study evaluation. Given the preliminary nature of this study, this report should not be relied upon for final project design.

The preliminary recommendations presented herein are based on our review of the existing subsurface and laboratory test data for the project area, preliminary engineering analyses, and our experience with similar soil and geologic conditions. No subsurface investigation was performed as part of our study. The logs of borings, laboratory test results, and logs of test boring (LOTB) sheets used in our review are presented in Appendix A. Preliminary engineering analyses and calculations are presented in Appendix B.

2.0 SCOPE OF WORK

Our scope of work included:

- Reviewing published geologic maps, aerial photographs, preliminary project plans, in-house documents, geotechnical information by Geocon and others, and other literature pertaining to the site to aid in evaluating geologic conditions and hazards that may be present. A list of referenced materials is provided in Section 18 of this report.
- Performing a site reconnaissance to review existing site conditions.
- Performing preliminary engineering analyses to develop geotechnical design criteria and evaluate existing site conditions.
- Preparing this PFR in general accordance with Caltrans' *Foundation Reports for Bridges (2021)*.

3.0 PROJECT DESCRIPTION

3.1 Background and Site Description

The American River and adjacent Garden Highway extend east-west near the project location, with Garden Highway located on the north river levee. The south river levee is topped by a paved pedestrian / bicycle path. The north and south river levees are approximately 2,400 feet apart. The American River directly abuts the south levee and Steelhead Creek (also known as the Natomas East Main Drainage Canal / Arcade Creek) abuts the north levee. Discovery Park and undeveloped riparian floodplain area occupy the area in between. Truxel Road is an arterial connector currently extending north from the Garden Highway beyond Interstate 80 and terminating in the North Natomas area of the City of Sacramento. Approximately 1,500 feet south of the river, Richards Boulevard is an east-west aligned arterial connector extending through the "River District", a largely commercial / industrial area of Sacramento. Richards Boulevard connects to Jibboom Street and Interstate 5 (I-5) on the west and State Route 160 (SR-160) on the east. There are no other arterial street connectors that cross the American River between I-5 and SR-160 for vehicular traffic and the only option for pedestrian/bicycle traffic in the area is the Jibboom Street bridge, an old local access vehicular bridge east of I-5, or the Sacramento Northern Bikeway, a converted rail bridge east of SR-160.

Land use in the project area is generally residential north of the American River and commercial/industrial with some residential south of the river. Major bodies of water near the proposed bridge site include the American River, Steelhead Creek, an approximately 50-acre pond within the floodplain area north of the American River, and the Sacramento River approximately 4,000 feet west.

3.2 Proposed Structures

The improvements discussed herein are based on preliminary project plans and design loading information provided by Dokken Engineering. Elevations used in this report are based on the North American Vertical Datum of 1988 (NAVD 88), which is the datum currently used for the project . The proposed bridge structure will be a 20-span, cast-in-place, prestressed concrete box girder and voided slab bridge. Preliminary bridge details are provided in Table 3.2.

TABLE 3.2
PRELIMINARY PROPOSED BRIDGE DETAILS

Bridge Details	
Bridge Station Line	"Truxel" Line
Begin Bridge (BB), Station	112+12.50
End Bridge (EB), Station	140+12.49
Bridge Length, feet	2,800 (20 spans: 4 at 80, 15 at 160, 1 at 80)
Bridge Width, feet	92.0 (based on the widest alternative being considered)
BB Elevation, feet	40.84
EB Elevation, feet	43.15
Abutment 1 Pile Type and Number of Piles	24-inch diameter driven steel pipe piles, 30 piles
Bent Pile Type and Number of Piles (per support)	96" Diameter cast-in-drilled-hole (CIDH) pile, 4 to 6 piles
Abutment 21 Pile Type and Number of Piles	24-inch diameter driven steel pipe piles, 30 piles

Pile cutoff elevations, abutment pile cap elevations, pile layout, and other specific details are not available at this time. Associated retaining walls may be required for this project; however, no design details are currently available. No other structures (sound walls, ground-supported overhead signs, etc.) are currently proposed for this project.

The proposed project configuration and approximate bridge alignment are shown on the Site Plan, Figure 2.

3.3 Pertinent Project Information

A summary list of references used in this study is presented in Section 18. Key project information was obtained from the following:

1. *General Plan, Truxel Bridge Concept and Feasibility Study*, Dokken Engineering, undated.
2. Additional project information and topography provided electronically by Dokken Engineering.

4.0 EXCEPTIONS TO POLICIES AND PROCEDURES

Unless otherwise stated, this PFR was developed and prepared in general conformance with Caltrans' current policies.

5.0 GEOTECHNICAL INVESTIGATION

A site-specific geotechnical investigation has not yet been performed for the project. Existing geotechnical information referenced for this PFR include the following:

- *Intra-Division Correspondence, III-Sac-238-B, Beltline Freeway*, State of California, Department of Public Works, Division of Highways, Materials and Research Department, August 4, 1959. Boring D-1 is assumed to be located near the northwest corner of the intersection of Truxel Road and Garden Highway based on the description on the boring log.

- *Urban Levee Geotechnical Evaluations Program*, Department of Water Resources, June 2008, Boring Nos. WCSBAR_001B and WCSBAR_002M.

- *Geotechnical Investigation, Township 9 – Parcels 8 and 15A, Sacramento, California*, Geocon Consultants, Inc. (Project No. S9498-05-11), December 2014, cone penetration test (CPT) soundings CPT1, CPT2, and CPT5.

- *Geotechnical Investigation, Township 9 – Seven Parcels, North Side of Richards Blvd between 5th and 7th Streets, Sacramento, California*, Geocon Consultants, Inc. (Project No. S9498-05-18), September 16, 2020, CPT soundings CPT2020-1, CPT2020-2.

- *Additional Geotechnical Investigation Summary, Township 9 – Phase A1/A3, 7th Street and Chill Avenue, Sacramento, California*, Geocon Consultants, Inc. (Project No. S9498-05-20), September 26, 2022, Borings B1 and B2.

- *Structure Preliminary Geotechnical Report for [Interstate 5] American River Bridge (Widen)*, Caltrans, File No. 03-Sac-5-PM 24.82, Bridge No. 24-0068, July 10, 2020. This project is located approximately ½ mile west (downstream) of the proposed bridge alignment with a similar bridge length over the same river and the explorations show generally similar soil conditions as expected at the project location. Explorations from this report are provided for reference only and were not used in our preliminary analysis given the distance from the project alignment, age of the data (1960's), and lack of laboratory test results.

No ground surface elevation data was stated for Boring D-1 so we assumed an elevation based on the current ground surface profile has been used. Elevations for the CPT soundings are also unknown and were also assumed in a similar manner. Explorations included in the American River Bridge SPGR reference benchmarks that are not shown within the Sacramento City database; the reference datum and elevation adjustment to NAVD 88 for these explorations are unknown.

6.0 LABORATORY TESTING PROGRAM

No geotechnical laboratory testing was performed as part of our study. Geotechnical laboratory test results provided in the referenced documents listed in Section 5.0 consisted of the following:

- In-Place Dry Density and Moisture Content: ASTM D2937 (CTM 226)
- Grain Size Distribution: ASTM D422
- Atterberg Limits: ASTM D4318
- Unconfined Compression: ASTM D2166
- Consolidation: ASTM D2435

Laboratory test results are provided in Appendix A.

7.0 GEOTECHNICAL CONDITIONS

7.1 Geology

The site is located within the Great Valley Geomorphic Province of California, more commonly referred to as the Sacramento Valley. The Sacramento Valley is a broad depression bounded by the Sierra Nevada mountain range to the east and the Coast Ranges to the west. The Sacramento Valley has been filled with a thick sequence of sediments derived from weathering of the adjacent mountain ranges resulting in a stratigraphic section of Cretaceous, Tertiary and Quaternary deposits.

The site is located near the central portion of the Sacramento Valley, about midway between the Coast Ranges and the Sierra Nevada mountains. The American River extends approximately east-west through the site and joins the north-south aligned Sacramento River approximate 4,000 feet west/downstream of the bridge site. Alluvial sediments at the site have been deposited primarily during flood stages of the American River, as well as those of the Sacramento River and other minor local watercourses. Past development included constructing earthen levees along the north and south river banks and an embankment supporting Truxel Road extending north from the Garden Highway.

7.2 Surface Conditions

The proposed bridge alignment will cross the existing north and south levees, the American River, and the floodplain area (Steelhead Creek and Discovery Park), meeting up with existing roadways beyond the levees. North of the north levee, the ground surface elevation is at approximate elevation 17 feet with Truxel Road on an ascending embankment that climbs to elevation 40 feet at the top of the levee

where the roadway ends at the intersection with the Garden Highway. South of the Garden Highway, the embankment slope descends to elevation 10 feet at Steelhead Creek. South of the creek, the ground surface elevation gradually climbs from approximate elevation 20 feet to approximate elevation 30 feet at the north bank of the American river approximately 1,700 feet to the south. The north bank of the American River has an approximate 20-foot drop into the river channel. At the south bank of the American River, the levee climbs to an elevation of 40 feet and then descends to approximate elevation 28 feet on the land side. Levee embankment slopes adjacent to the proposed bridge location vary from approximately 2.5:1 to 3:1 based on available topographic mapping. Site drainage occurs via sheet flow in undeveloped areas. There are no significant existing cut or fill areas in the immediate project area, other than the levee and roadway approach embankments.

The waterside levee embankments and the Discovery Park area are heavily vegetated with mature trees, brush, blackberry bushes, and other vegetation. Overhead utilities cross Truxel Road immediately north of the intersection with Garden Highway. High voltage transmission lines parallel Garden Highway approximately 300 feet to the south (south of Steelhead Creek); a tower supporting these lines exists due south of the intersection of Truxel Road and Garden Highway.

7.3 Subsurface Conditions

The following descriptions of subsurface conditions are based on the exploration logs presented in Appendix A and our geotechnical experience in the area. The exploration logs in Appendix A are those that are closest to the project alignment and/or extend the deepest below grade. These explorations were used for our preliminary analysis for this project. We note that most of these explorations are at least 500 feet away from the proposed bridge alignment and soil conditions indicated herein may not be fully representative of the subsurface conditions along the project alignment. Also included in Appendix A are the American River Bridge Log of Test Borings No. 1 through No. 5. These logs are from the I-5 bridge approximately ½ mile west of the proposed bridge alignment and have been included for reference but were not used in our preliminary project analysis due to the large distance from the site, lack of geotechnical laboratory test data, and lack of elevation information.

Soils described in the sections below are generally broken out into four major units:

- Unit 1 Levee/embankment fill
- Unit 2 Recent alluvium, channel deposits, and overbank deposits
- Unit 3 Older river channel deposits/alluvium (dense to very dense gravel and sand layer)
- Unit 4 Older alluvium

7.3.1 Levee/Embankment Fill (Unit 1)

The levee/embankment fill (Unit 1) encountered in the 2008 borings by the Department of Water Resources generally consists of dense sand with varied silt content (SP-SM, SM) and stiff to very stiff clay (CL) with varied sand content. This layer extends from the ground surface to approximate elevation 27 feet in Boring WCSBAR_001B and approximate elevation 21 feet in Boring WCSBAR_002M. These borings are located approximately 450 feet east of the proposed bridge alignment.

7.3.2 Alluvium (Units 2 through 4)

Alluvial soils were encountered below the levee embankment fill (Unit 1) in Borings WCSBAR_001B and WCSBAR_002M and from the ground surface (or below minor fill thicknesses associated with roadway or building pad construction) in the remaining explorations. This alluvium can be divided into three units (Units 2 through 4). The borings and CPT soundings used for evaluation are located approximately 450 to 1,800 feet east of the south bridge abutment location with one boring apparently located approximately 200 feet west of the north abutment location (Boring D-1, location assumed based on a somewhat vague description on the boring log).

- **Unit 2 (Recent alluvium, channel deposits, and overbank deposits)**: Unit 2 soils extend from the ground surface or below Unit 1 soils to approximate elevation -26 feet. These soils generally consist of very loose to medium dense poorly-graded sand (SP), poorly-graded sand with silt (SP-SM), silty sand (SM), clayey sand (SC), and low plasticity sandy silt (ML) and soft to stiff silt (ML), elastic silt (MH), and clay (CL). These soils appear to transition from a more granular soil profile to the south to more cohesive soils to the north. These soils, where non-cohesive and below groundwater, are potentially liquefiable during a design level earthquake. These materials are also generally subject to settlement/consolidation under superposed loads.

- **Unit 3 (Older river channel deposits/alluvium)**: Unit 3 soils consist of a layer of dense to very dense gravel (GP) / cobble materials with varying amounts of sand and silt. These soils extend to approximate elevation -60 feet in explorations near the south river levee. The Caltrans boring north of the river (Boring D-1) did not penetrate more than a few feet into this unit and the unit thickness is unknown at this location. These soils are competent for support of foundation loads but the gravel and cobble content can make pile driving or drilling for deep foundation elements difficult to perform.

- **Unit 4 (Older alluvium)**: Unit 4 soils underlie Unit 3 materials to the maximum depth explored of approximately 111.5 feet (elevation -91.5 feet) and generally consist of dense to very dense poorly-graded sand (SP), well-graded sand with silt (SW-SM), and silty sand (SM) and hard silt (ML), clayey silt (CL-ML), and clay (CL). These soils are competent for support of foundation loads.

A similar soil profile was generally indicated in the Caltrans Logs of Test Borings (1960's) included in the SPGR for the I-5 bridge located approximately ½ mile west of the proposed bridge alignment. While included here for general reference, these borings have not been used for preliminary project analysis. These logs indicate that a change in Unit 2 soil conditions occurs across the American River floodplain near the north bank of the American River channel, with sandy soils near the active river channel transitioning to clayey soils to the north. Based on geologic mapping, we expect a more varied transition at the proposed bridge location due to mapped river meanders. Unit 3 gravel/cobbles zones are indicated to be somewhat variable in elevation and thickness along this alignment (indicated elevation of first encounter ranges from -20 feet to -30 feet and bottom of these layers varies from -33 feet to -75 feet [or lower], with interbedded zones of clay, silt, and sand). Similar variation may be encountered along the project alignment. We note that the elevations indicated within this paragraph are based on a currently unknown/possibly local datum and not on the project datum (NAVD 88).

7.4 Pertinent Soil Conditions or Geologic Hazards

The following sections discuss other potential geologic hazards evaluated for the project including landslides, embankment failures, ground subsidence, expansive soils, and collapsible soils.

7.4.1 Landslides

No landslides were observed during our site investigation. Other than bank loss due to scour, landslides or similar slope failures are not a hazard for the site.

7.4.2 Embankment Failures

No embankment failures were observed during our site investigation. The site and vicinity are generally flat and level. Slopes of existing levees/embankments in the project area appear to be performing well without overt indications of significant failures. Other than the existing levees and the Truxel Road approach embankment to Garden Highway, there are no significant embankment slopes on or adjacent to the site.

7.4.3 Ground Subsidence

Ground subsidence is a regional phenomenon that occurs where underlying loose geologic units undergo a densification process. Subsidence can result from the extraction of mineral resources and/or groundwater, as well as the rapid settlement induced by seismic activity. There is potential for ground subsidence in Unit 2 soils due to liquefaction-induced ground settlement, particularly along the southern portion of the project alignment. Given the proximity of the American and Sacramento Rivers, regional ground subsidence due to groundwater withdrawal is not anticipated.

7.4.4 Expansive Soils

Expansive soils possess a high swelling or shrinking potential due to change in moisture content. The common materials associated with high expansion potential are clays. The majority of the near surface onsite soil is silt and sand, with some low-plasticity clays noted within the borings that penetrate the levee embankment. Proposed foundations will be supported below a depth where significant moisture variation is expected. Thus, expansive soils are not a consideration for bridge foundation design or new roadway approach embankments.

7.4.5 Collapsible Soils

Collapsible soils are unsaturated soils that undergo a large volume change upon saturation, even without increase in external loads. Soils that generally display collapsible potential are porous and have a low dry density. No porous or honeycomb structure was noted within the reviewed boring logs. Bridge foundations will penetrate through less competent and potentially liquefiable Unit 2 soils to bear within Unit 3 and possibly Unit 4 soils. Thus, the potential for collapsible soils are not a consideration for foundation design.

8.0 GROUNDWATER

Where recorded, previous explorations encountered groundwater at depths ranging from approximately 13.7 to 35.1 feet (elevation -5.0 to 6.1 feet). Table 8.0 summarizes the groundwater encounters, including the dates encountered, approximate depths, and elevations. Top of exploration elevations are estimated/assumed based on available data for several explorations; actual exploration and groundwater elevations may vary at these locations.

TABLE 8.0
SUMMARY OF ENCOUNTERED GROUNDWATER

Exploration No.	Exploration Date	Exploration Depth (feet)	Surface Elevation (feet)	Groundwater Depth (feet)	Groundwater Elevation (feet)
B2	9/2/2022	86.5	21.0	22.0	-1.0
D-1	8/4/1959	50.0	15.0[1]	20.0	-5.0
WCSBAR_002M	6/19-20/2008	97.0	41.2	35.1	6.1
CPT1	12/15/2014	46.8	21.5[1]	19.4	2.1
CPT2	12/15/2014	50.2	21.5[1]	19.8	1.7
CPT5	12/15/2014	66.1	35.0[1]	33.0	2.0
CPT2020-1	8/19/2020	38.9	20.0[1]	13.7	6.3
CPT2020-2	8/19/2020	48.2	20.0[1]	14.5	5.5
Average					**2.2**

Note: 1. Surface elevation is estimated or assumed based on available data.

Groundwater elevations from the online *SGMA Data Viewer* maintained by the California Department of Water Resources (DWR) shows a groundwater elevation at the project site of approximately -10 feet for Spring 2023, the most recent interval provided. The above DWR elevation is in NAVD 88, which is consistent with the project datum.

Caltrans used a design groundwater elevation of 23 feet in their 2020 SPGR for the proposed I-5 bridge widening approximately ½ mile downstream (west) of the project alignment. This elevation is also in NAVD 88.

Given the above, a design groundwater elevation of 23 feet was used for our preliminary analysis based on the controlling design groundwater elevation recommended by Caltrans near this project location.

Fluctuations of groundwater levels may occur due to variations in precipitation, temperature, and other factors. Depth to groundwater can also vary significantly due to localized pumping, irrigation practices, and seasonal fluctuations. Therefore, it is possible that future groundwater may be higher or lower than the levels observed during the referenced investigations.

9.0 AS-BUILT DATA

There is no existing bridge structure at the proposed project location. The As-Built plans indicate the I-5 bridges to the west are supported by driven 45-ton piles. These piles are indicated to consist of a combination of Alternative "Z" Raymond Step Taper piles (both 12-inch and 15-inch diameters at the top of pile) and 14BP117 steel H-piles. Additional details on the pile types and locations used, installed lengths, and construction difficulties are available in the Caltrans report for this structure (2020).

10.0 SCOUR DATA

The proposed bridge will span the American River and Steelhead Creek. No scour information is available in the I-5 bridge SPGR. A Caltrans Foundation Report (FR, 2022) for the American River Bridge for State Route 51 (Business 80) approximately three miles east (upstream) of the project site indicates that long term scour is to be anticipated only within the active river channel (no depth provided) and local scour between approximately 4 to 18 feet may be expected at all pier support locations.

A preliminary hydraulics memo has been prepared for this project (Dokken Engineering, July 2024). According to the memo, with design peak flow "some bed scour may occur that may not be replenished as the upstream in-channel stored sediments are slowly being depleted." Also, the bridge foundations are anticipated to be designed below scour depths and local scour at support locations/levee embankment slopes will be mitigated by use of rip-rap boulders and armoring.

Preliminary scour estimates for this project provided by Dokken Engineering indicate between 2 and 5 feet of total scour are anticipated at pier locations. The results of a detailed hydraulics analysis will need to be considered and incorporated into the future Foundation Report (FR) for the project.

11.0 CORROSION EVALUATION

No soil corrosivity testing has been performed as part of the existing geotechnical evaluations reviewed near this project site. Soil corrosion potential testing will be performed as part of the geotechnical investigation for final project design and presented in the project FR.

12.0 SEISMIC INFORMATION

12.1 Ground Motion Hazard

The design response spectrum for the Safety Evaluation Earthquake (SEE), as specified in Caltrans *Seismic Design Criteria* with October 2019 interim revisions (v2.0), is the probabilistic response spectrum representing the horizontal ground motion at the site with a 5% probability of exceedance in 50 years (return period of 975 years). The United States Geological Survey (USGS) *2014 National Seismic Hazard Map* is used as the basis to determine the design Acceleration Response Spectrum (ARS). The preliminary ARS for the site was estimated using Caltrans' *ARS Online* web tool (V3.1.0, accessed June 11, 2024). Table 12.1 summarizes the site-specific information used for the analysis and the *ARS Online* results.

TABLE 12.1
ARS ONLINE SUMMARY

Approx. Latitude, °	Approx. Longitude, °	Estimated Shear Wave Velocity (VS30)[1], feet/second	Design Peak Ground Acceleration (PGA)[2], g	Deaggregated Mean Earthquake Moment Magnitude (M)	Mean Site-to-Source Distance (R)[3], miles	Site Soil Class[4]
38.6043	-121.4963	700	0.26	6.68	55.4	S2

Notes:
1. Estimated time-average shear wave velocity for the upper 100 feet of soil at the site.
2. Where "g" represents the acceleration due to gravity.
3. Mean site-to-source distance for 1.0 second period spectral acceleration.
4. Based on the subsurface soil conditions encountered within the foundation's zone of influence and Caltrans *Seismic Design Criteria* Sections 6.1 and 6.2.3. Site Soil Class S1 is considered competent and Site Soil Class S2 is considered non-competent (marginal, poor, soft, potentially liquefiable, and soil susceptible to lateral spreading).

The bridge is not located within a deep sedimentary basin per Caltrans *ARS Online*. Based on the subsurface materials encountered during previous referenced investigations nearby, the site is anticipated to be generally underlain by soft to stiff and loose to very dense alluvial soils, which most

closely reflects a Caltrans Soil Profile Type D. The shear wave velocity, V_{S30}, was calculated using an average of the shear wave correlations obtained from the four Geocon CPTs referenced for project design in which shear wave velocity measurements were obtained (CPT-1, CPT-5, CPT2020-1, and CPT2020-2).

The preliminary recommended design response spectrum for the proposed replacement bridge is presented as Figure 3 (Preliminary Recommended Design Response Spectrum).

12.2 Other Seismic Hazards

12.2.1 Surface Fault Rupture

The site is not located within an Alquist-Priolo Earthquake Fault Zone as established by the State Geologist around known active faults. Local field reconnaissance revealed no indications of an active fault trace at the site. Review of available literature indicates there are no active fault traces within 1,000 feet of the project location. The USGS maps the nearest active fault as the Hunting Creek-Berryessa fault system located over 40 miles west of the project location. Given the above, no fault rupture hazard analysis is required for this project.

12.2.2 Liquefaction and Seismic-Induced Ground Surface Settlements

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary loss of shear strength due to pore pressure buildup under the cyclic shear stresses associated with intense earthquakes. Primary factors that trigger liquefaction are moderate to strong ground shaking (seismic source), the presence of relatively clean, loose granular soils (primarily poorly graded sands and silty sands), and saturated soil conditions (shallow groundwater).

The site is not located in a currently established State of California Seismic Hazard Zone for liquefaction. However, soil and groundwater conditions exist near the site that may be susceptible to seismic-induced liquefaction and the Soil Site Class is designated as S2 per the current Caltrans *Seismic Design Criteria* guidance. We preliminarily evaluated liquefaction potential using both the measured parameters in the referenced CPT soundings and the SPT blow counts measured in the referenced borings. The CPT-based analysis was performed using the CLiq software program (v. 2.2.0.37 by GeoLogismiki) following the Youd, et. al (2001) analysis method. The SPT-based analysis was performed following Youd, et. al (2001) per the Caltrans *Geotechnical Manual, Liquefaction Evaluation* module (Caltrans 2020). A peak ground acceleration (PGA) of 0.26g developed using ARS online (see Section 12.1) was used in liquefaction analysis per Caltrans guidelines. We used a design groundwater elevation of 23 feet.

We estimated post-liquefaction settlement under the PGA ground motions using the CLiq software following the methodology of Zhang, et. al (2002) for the CPT-based analysis and the methodology of Boulanger and Idriss (2008) for the SPT-based analysis. For the borings, we excluded soil layers that had relative densities of "dense" or "very dense" based on N_{60} blow counts (Caltrans *Geotechnical Manual, Liquefaction Evaluation*) or the $(N_1)_{60}$ blow count was greater than 25 (*AASHTO LRFD BDS*).

A summary of our preliminary liquefaction analysis is included in Appendix B. Table 12.2.2 summarizes the results of the analyses.

TABLE 12.2.2
PRELIMINARY LIQUEFACTION ANALYSIS SUMMARY

Exploration	Approximate Exploration Elevation, ft	Approximate Depths of Potentially Liquefiable Zone, ft	Approximate Elevations of Potentially Liquefiable Zone, ft	Approximate Thickness of Potentially Liquefiable Zone, ft	Estimated Vertical Settlement, in.
B1	20.0	0 – 43.0	-23.0 – 20.0	43.0	16.0
B2	21.0	0 – 47.0	-26.0 – 21.0	47.0	16.9
CPT1	21.5	20.0 – 44.3	-22.8 – 1.5	24.3	4.0
CPT2	21.5	13.9 – 49.0	-27.5 – 7.6	35.1	5.3
CPT5	35.0	32.8 – 59.9	-24.9 – 2.2	27.1	2.4
CPT2020-1	20.0	7.6 – 38.2	-18.2 – 12.4	30.6	7.8
CPT2020-2	20.0	13.9 – 49.0	-27.5 – 7.6	35.1	9.4
D-1	No liquefaction				
WCSBAR_001B	No liquefaction				
WCSBAR_002M	No field blow counts or soil laboratory data for liquefaction analysis				

Based on our preliminary evaluation, several soil layers near the southern portion of the bridge alignment between elevation -27.5 to 20 feet are considered potentially liquefiable as a result of the design-level (PGA) earthquake ground motion; however, Boring WCSBAR_001B does not appear to have potentially liquefiable zones. This may be due to previous levee improvements performed in the location of that test boring, natural variation in geologic depositions, differences in sampling equipment/methods, or other reasons. The only nearby exploration we have to reference north of the American River channel is Boring D-1, which indicates that potentially liquefiable soils are not present near the northern end of the bridge alignment. Based on the CPT data, the thickness of these soil layers are variable and up to about 30 feet thick. Our CPT- and SPT-based analyses indicates that post-liquefaction vertical ground settlements of up to approximately 17 inches may occur; however, CPT-based analyses are typically preferred to SPT-based analyses. The average estimated liquefaction-induced settlement from CPT-based analyses is approximately 6 inches. It is typical geotechnical practice to assume that the magnitude of differential liquefaction settlement is approximately one-half of the estimated total liquefaction settlement.

Another secondary effect of liquefaction is the potential for liquefaction-induced sand boils or ground loss. In this case, pore water pressure induced within liquefied strata exerts significant upward forces and results in ejecta of the liquefied soil at the ground surface. Sand boils/ground loss may be resisted by a "capping layer" of non-liquefiable soil. At this site, there is not a sufficiently thick, non-liquefiable soil layer overlying the potentially liquefiable layers within the channel. Therefore, there is a potential for localized ground loss due to sand boils at the site.

Given the above, we anticipate that strong ground shaking due to a seismic event would likely cause liquefaction of some soil layers at/near the proposed bridge location resulting in ground surface settlement (subsidence) and potentially localized ground loss within the channel due to sand boils, particularly along the southern portion of the bridge alignment. We considered these conditions in developing preliminary recommendations for foundation design. Since sand boils may occur, the post-liquefaction vertical settlements at the pier locations presented herein should be considered minimum, lower-bound estimates as sand boils can result in additional, unquantifiable ground loss.

Each bridge support location will be supported on deep foundation elements that extend below the liquefiable soil to bear within Unit 3 and Unit 4 materials. The effects of liquefaction have been considered in the preliminary foundation design. Per Caltrans design guidelines, abutments are not designed for Extreme Limit State axial loading conditions. However, the piles for the abutments should extend through Unit 1 and Unit 2 soils to bear within more competent, underlying materials.

12.2.3 Pile Downdrag

Piles at the pier and abutment locations will extend through any potentially-liquefiable soil layers to bear within competent underlying soils. Per Caltrans design guidelines abutments are not designed for Extreme Limit State loading conditions (including liquefaction).

Based on the existing ground profile data and preliminary pile loading conditions provided by Dokken Engineering, we have performed preliminary liquefaction-induced downdrag analysis for a typical pile at Piers 9-20 using the guidance provided in the Caltrans *Geotechnical Manual, Liquefaction-Induced Downdrag* module (January 2020), which relies on the *AASHTO LRFD Bridge Design Specification* with California Amendments (April 2019), Caltrans *Memo to Designers 3-1, Deep Foundations* (June 2014), and the various modules of the Caltrans *Geotechnical Manual* (latest versions). The piles at these support locations share the highest pile loads and would also likely experience the most downdrag if they are penetrating potentially liquefiable soils. A spreadsheet documenting the preliminary liquefaction-induced downdrag analyses performed for the Extreme Limit State loading conditions following these document guidelines is included in Appendix B. Table 12.2.3 summarizes the results of the analyses.

TABLE 12.2.3
PRELIMINARY LIQUEFACTION-INDUCED DOWNDRAG ANALYSIS SUMMARY

Explorations (Various)	Approximate Elevations of Potentially Liquefiable Zone, ft	Downdrag Zone Bottom Elevation, ft	Estimated Downdrag Load, kips/pile
Piers (96" CIDH)	-27.5 – 20.0	-18	2,357

Note: Downdrag loads were calculated for 96-inch diameter CIDH piles at a typical pier location.

12.2.4 Lateral Spreading Potential

Since there appears to be a potential for seismic-induced liquefaction, the possibility of lateral spreading during a liquefaction event should be considered. Lateral spread potential should be evaluated as part of the analysis for the design FR after a site-specific field investigation is completed and updated topographic and cross-section information is available for the project.

12.2.5 Seismic Slope Stability

Given the limited project information at this time, slope stability modeling has not been performed as part of this preliminary study. Slope stability should be evaluated as part of the analysis for the design FR after a site-specific field investigation is completed and updated project details and topographic/cross-section information is available for the project.

12.2.6 Tsunami Risk

Tsunamis are large sea waves caused by submarine earthquakes, landslides, or volcanic eruptions. Per Caltrans *Memo to Designers 20-13*, a tsunami hazard is significantly reduced for projects located greater than ½ mile from the coast or at elevations greater than 40 feet. The proposed bridge is located approximately 40 miles inland from the nearest large bay (Suisun Bay) connected to the Pacific Ocean. Sacramento County does not have a California Official Tsunami Inundation Map. Based on the above information and per MTD 20-13, a tsunami hazard does not exist at the site.

13.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following preliminary recommendations are for the Truxel Road Bridge as shown on the referenced *General Plan* (undated) by Dokken Engineering. These recommendations are based on select existing subsurface information data in the general project area and are provided solely for the project feasibility study (not for construction).

13.1 Deep Foundations

Based on the anticipated structural loading, reported soft to stiff/very loose to medium dense near-surface soil conditions in the previous investigations near the project location, estimated liquefaction ground settlements, the potential for ground loss due to sand boils, and the anticipated scour conditions at the site, shallow foundations are not considered suitable and the proposed bridge will require deep foundations for support. The deep foundations will penetrate through the relatively soft/liquefiable soil to bear within the underlying hard/dense, non-liquefiable materials.

Based on the subsurface conditions at the proposed bridge location and the design loading requirements, the structure may be supported by large diameter cast-in-drilled-hole (CIDH) concrete piles at the pier locations and Caltrans Class 200 driven piles at Abutments (24-inch diameter steel pipe piles driven open-ended). Given the anticipated thickness of potentially liquefiable soils at the pier foundation locations (approximately 30-foot depth below bottom of pile cap), potential loss of lateral support as the result of a liquefaction event, and limited penetration anticipated during driving into the underlying dense gravel soils, Class 200 driven piles are not considered a feasible foundation option at the pier locations from a geotechnical perspective. Class 200 driven piles are only considered potentially feasible at the abutment locations because Extreme Limit State loading conditions are not considered for abutment design; however, detailed slope stability and lateral pile analysis will be required to confirm their use is acceptable for this project. Although not analyzed as part of this preliminary study, larger diameter cast-in-steel-shell (CISS) piles may also be suitable for the project at both abutment and pier locations.

Due to the presence of the granular soil and groundwater, temporary casing and/or wet construction methods will be required during CIDH concrete pile installation.

According to current Caltrans guidelines, preliminary foundation designs for abutments and bents were analyzed using the latest American Association of State Highway and Transportation Officials (AASHTO) *Load and Resistance Factor Design* (LRFD) *Bridge Design Specifications* (BSD) with Caltrans Amendments methodology. We used the APILE and SHAFT software programs which incorporate the α method for clays and β method for sands per FHWA guidelines. For the piers, the piles are assumed to act individually given the single row of piles at each support location. As abutment piles are anticipated to be tipped into dense to a thick layer of dense to very dense granular materials and the pile capacity is generated predominantly through end-bearing, Caltrans does not require settlement analysis to be performed and settlement of abutment pile foundations was not analyzed for this preliminary study. Preliminary foundation recommendations are provided herein.

Seismic-induced soil liquefaction may cause settlement of the liquefiable and overlying soil layers. For the pile foundations, the movement may influence the axial load distribution in the piles, including negative skin friction/downdrag. Pile design presented herein incorporates the recommendations of the *Liquefaction-Induced Downdrag* module of the Caltrans *Geotechnical Manual*.

Pier pile foundations will penetrate through overlying potentially liquefiable soils to bear within dense to very dense and very stiff to hard alluvial soil. Per Caltrans design guidelines, abutment piles are not designed for Extreme Limit State loading conditions.

Preliminary design pile tip elevations for the piers shown below have been lowered by two feet below the controlling design tip elevation to account for the bottom portion of the pile that cannot be tested using gamma-gamma testing (untested concrete zone) per the recommendations of the Caltrans *Cast-in-Drilled-Hole (CIDH) Pile Foundations* module.

CIDH concrete piles will develop their support from side frictional resistance for the Service and Strength Limit States and from both side frictional resistance and end bearing for the Extreme Limit State. Tables 13.1A through 13.1C summarize the preliminary foundation design loads and recommended tip elevations. Calculations are presented in Appendix B. The pile tip elevations for the piers extend below the limits of the previous geotechnical investigations at the site and we assume similar soil conditions extend to the depths of the proposed pile tips.

TABLE 13.1A
PRELIMINARY PILE FOUNDATION DESIGN DATA TABLE

Support No.	Pile Type	Finished Grade Elevation (feet)	Cut-off Elevation (feet)	Pile Cap Size (feet)		Permissible Settlement under Service Load (inches)	Number of Piles per Support
				B	L		
Abut 1	24” dia. PP	25.0	20.0	14	94	1.0	30
Piers	96” CIDH	-6.0 to 25.0 (varies)	-16.0 to 20.0 (varies)	N/A	N/A	1.0	4 to 6 (varies)
Abut 21	24” dia. PP	25.0	20.0	14	94	1.0	30

Note: N/A = not applicable.

TABLE 13.1B
PRELIMINARY PILE FOUNDATION FACTORED DESIGN LOADS

Support No.	Service-I Limit State (kips)		Strength/Construction Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load Per Support / Column	Permanent Loads Per Support / Column	Compression		Tension		Compression		Tension	
			Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1	3,150	2,700	4,725	210	0	0	N/A	N/A	N/A	N/A
Piers	2,400	1,800	3,600	3,600	0	0	2,700	2,700	0	0
Abut 21	3,150	2,700	4,725	210	0	0	N/A	N/A	N/A	N/A

Note: N/A = not applicable.

TABLE 13.1C
PRELIMINARY FOUNDATION DESIGN RECOMMENDATIONS

Support Location	Pile Type	Cut-off Elevation (feet)	Required Nominal Resistance (kips)				Preliminary Design Tip Elevations (feet)[2,3,5]	Preliminary Tip Elevation (feet)[4,6]
			Strength / Construction		Extreme Event			
			Comp. (ϕ_{qs}=0.7, ϕ_{qp}=0.7)[1]	Tension (ϕ_{qs}=0.7)	Comp. (ϕ_{qs}=1.0, ϕ_{qp}=1.0)	Tension (ϕ_{qs}=1.0)		
Abut 1	24" dia. PP	20.0	300	0	N/A	0	-31 (a-I) N/A (b-I) N/A (a-II) N/A (b-II) N/A (c) N/A (d)	-31
Piers	96" CIDH	-16.0 to 20.0 (varies)	5,150	0	2,700	0	-127 (a-I) N/A (b-I) -85 (a-II) N/A (b-II) -58 (a-III) N/A (c) N/A (d)	-129
Abut 21	24" dia. PP	20.0	300	0	N/A	N/A	-31 (a-I) N/A (b-I) N/A (a-II) N/A (b-II) N/A (c) N/A (d)	-31

Notes:

1. *Resistance factor φ_{qs} is for skin friction and φ_{qp} is for end bearing.*
2. *Design tip elevations are controlled by: (a-I) Compression (Strength Limit), (b-I) Tension (Strength Limit), (a-II) Compression (Extreme Event-During Earthquake), (a-III) Compression (Extreme Event-Post Earthquake/Downdrag), (b-II) Tension (Extreme Event), (c) Settlement, and (d) Lateral.*
3. *Design tip elevation for lateral load was provided by the structural engineer.*
4. *The specified tip elevation shall not be raised above the design tip elevations for tension, lateral, and tolerable settlement.*
5. *N/A = not applicable or not available.*
6. *For CIDH piles, the pile tip elevation has been lowered 2 feet to account for the bottom portion of the pile that cannot be tested using gamma-gamma testing.*

Settlement of piles imposing the design axial load is expected to be less than ½ inch. Settlements should be essentially complete shortly after completion of the bridge superstructure.

Lateral pile analysis will be performed by the structural engineer. Soil parameters for lateral pile analysis will be provided in the FR following our field investigation and laboratory testing for this project.

13.1.1 Special Considerations for Driven Piles

Driven piles should be constructed in accordance with the requirements of Caltrans *Standard Specifications* Section 49-2.

Due to the presence of hard/very dense soil layers, difficult driving conditions may be encountered prior to reaching the specified tip elevations. The contractor should have all equipment available onsite to install the piles to the design tip elevation. For this project, jetting or vibrating of piles is not an allowable method of pile installation.

13.1.2 Driven Pile Acceptance Criteria

The contractor should prepare and submit a complete Driving System Submittal per Caltrans' *Standard Specifications* Section 49-2.01A(3)(b) prior to construction.

Static or dynamic pile load testing to evaluate driven pile axial capacity is not considered necessary. Driven pile acceptance criteria should be based on the criteria set forth in Section 49-2.01A(4)(c) of Caltrans' *Standard Specifications*. The piles must be driven to at least nominal driving resistance and specified tip elevations shown on project plans. Specifically, within the last foot of pile driving, a formula correlating the installation hammer blows and manufacturer's hammer energy rating to the nominal driving resistance is required for driven pile field acceptance.

Piles that demonstrate "refusal" as much as 3 feet above specified tip elevation may be accepted without review/consultation. Acceptance of piles meeting formula bearing at levels higher than this should be made only on the basis of specific review by Geocon. Driving "refusal" can be defined as piles achieving 1½ times the nominal resistance in compression.

Piles that do not attain the required nominal driving resistance at the specified tip may be considered acceptable with formula bearing on redrive after a minimum 24-hour "set period." Depending on the soil conditions at the pile location, a longer set period may result in a higher driving resistance during redrive. If there is more than one "soft" pile, then Geocon will designate which pile(s) is/are to be redriven. Do not use a cold hammer for redriving.

If the nominal driving resistance is attained for the pile designated to be redriven, the remaining piles in that footing are considered satisfactory and further driving will not be required. If redriving the designated pile demonstrates that the nominal driving resistance has not been attained, redrive all "soft" piles in the footing until the nominal driving resistance is attained.

13.1.3 Special Considerations for CIDH Concrete Piles

Pile construction should conform to the requirements of Caltrans' *Standard Specifications* Section 49, including the preparation and submittal of a complete Pile Installation Plan per Section 49-3.02A(3)(b) by the contractor prior to construction.

Groundwater/seepage will be encountered within the foundation construction depths. Zones of gravel and cobbles have been noted in Unit 3 soils (Section 7.3.2) and may be present in other soil units. CIDH concrete pile installation will require using the wet construction methods (including the installation of PVC inspection pipes for acceptance testing) and the use of temporary casing will be required. Wet construction methods may require concrete placement under slurry. The contractor should review subsurface conditions and select the appropriate wet construction methods. Geocon should be contacted if permanent casing is proposed, since the geotechnical capacity may be affected.

The standard specification that allows the contractor to revise specified pile tip elevations is intended for driven piles only. Tip elevation revision is not allowed for drilled shafts. An engineered length for skin friction resistance primarily controls the specified CIDH pile depth, and the drilling process has no inherent measurement (analogous to blow count) to verify the resistance.

A Geocon representative should observe all CIDH pile excavations prior to placing reinforcing steel or concrete. If unanticipated soil conditions are encountered, foundation modifications may be required.

13.2 Retaining Walls/Wingwalls

Table 13.2 summarizes our preliminary lateral earth pressure recommendations in terms of equivalent fluid pressure (EFP) for design.

TABLE 13.2
PRELIMINARY LATERAL EARTH PRESSURES

Condition	Equivalent Fluid Density
Active	35 pcf
At-rest	55 pcf
Seismic Increment	10 pcf

Note: pcf = pounds per cubic foot

Unrestrained walls should be designed using the active case. Unrestrained walls are those that are allowed to rotate more than 0.001H (where H is the height of the wall). Walls restrained from movement should be designed using the at-rest case. The above soil pressures assume level backfill under drained conditions within an area bounded by the wall and a 1:1 plane extending upward from the base of the wall.

To resist lateral movement of retaining wall foundations, a passive earth pressure equivalent to a fluid density of 350 pounds per cubic foot (pcf) may be used for footings or shear keys poured neat against properly compacted engineered fill soils or undisturbed natural soil. This passive pressure is based on the assumption that a horizontal surface extends at least 5 feet or three times the depth of the footing or shear key, whichever is greater, beyond the face of the retaining wall foundation. If sloping ground is present in front of footings, a reduced passive resistance will apply. We should be contacted if this condition exists. A friction coefficient of 0.35 may be used for resistance to sliding between soil and concrete. Combined passive resistance and friction may be utilized for design provided that the passive resistance is reduced by 50%.

Backfill soil placed behind walls and wing walls should be primarily granular in nature and conform to Caltrans requirements for structure backfill (*Standard Specifications* Section 19-3.02). All structure backfill should be compacted to 95 percent of the maximum density as determined by CTM 216.

Walls should have a back-drainage system similar to Caltrans' *Revised Standard Plan RSP B0-3, Bridge Detail 3-1* or an approved geocomposite chimney type drain material. The back-drainage system should provide positive drainage to daylight and be maintained such that it does not clog with debris and allow a buildup of hydrostatic pressure.

13.3 Embankment and Approach Fill Earthwork

From a geotechnical perspective, embankments and fill slopes may be constructed at inclinations of 2:1 or flatter. Embankments constructed in accordance with Caltrans requirements should possess adequate factor of safety against slope instability. Consideration should be given to the use of slope paving, rip-rap, or other surface treatments to minimize surficial erosion until adequate erosion-resistant vegetation can become established. All roadway drainage should be directed to appropriate collection and discharge facilities to prevent run-off from flowing over the tops of slopes.

Based on the field explorations and experience in the area, soil generated from onsite and local excavations are likely suitable for use as embankment and general fill. However, some screening and selection may be required depending on excavation location and intended use. For example, retaining wall (structure) backfill may require the use of primarily granular (sandy) soil rather than silty or clayey

soil. Similarly, select, low-expansive soil may be required within specific portions of the bridge approach embankments, near the abutments. All grading should be performed in conformance with Section 19 of Caltrans' *Standard Specifications* or equivalent.

Backfill placed within the full width of the embankment and within 150 feet of the abutment is considered structure backfill. All structure backfill should be compacted to 95 percent of the maximum density as determined by ASTM D1557. All compaction on the project should be based on this test method. All other backfill should be compacted to a minimum of 90 percent relative compaction.

Structural fill should be compacted in horizontal lifts not exceeding 8 inches (loose thickness) and brought to final design elevations. Each lift should be moisture-conditioned and compacted. New fill should be benched into existing embankment fill as the fill is placed. Benches should extend at least 3 feet laterally into the existing embankment fill.

New embankments and roadway areas will be supported on primarily very loose to medium dense granular soils and/or soft to stiff cohesive soils that will experience settlement as fill is placed. Minor surface settlement may occur primarily as a result of compression within the new fill itself. Settlement magnitudes and time durations will need to be estimated once a site-specific field investigation and laboratory testing program is performed. Per Caltrans (1959), consolidation tests indicate that clayey silt soils may consolidate up to 2 feet with up to 30 feet of few fill embankment construction; however, no settlement duration was provided. New fill should be placed as soon as practical to allow settlement to occur prior to construction of overlying pavement sections.

13.3.1 Materials for Fill

Excavated soil generated from cut operations at the site are suitable for use as general fill in structural areas provided they are examined and selectively placed during grading in accordance with the following recommendations:

- Deleterious material, material with greater than 3% organics, and debris should be exported from the site and not incorporated into structural fill. We anticipate limited quantities of these materials (primarily organics).
- Backfill placed behind retaining walls should consist of "structure backfill" meeting Section 19-3.02B of Caltrans' *Standard Specifications*. In addition to the criteria shown in Section 19-3.02B, structure backfill should have a "very low" to "low" expansion potential (Expansion Index of 50 or less), a Liquid Limit less than 50, and a Plasticity Index of 15 or less.

- Import fill material should be primarily granular with a “very low” to “low” expansion potential (Expansion Index less than 50), a Liquid Limit less than 50, Plasticity Index of 15 or less, be free of organic material and construction debris, and not contain rock larger than 6 inches in greatest dimension.

- Environmental characteristics and corrosion potential of import soil materials should also be considered. Proposed import materials should be sampled, tested, and approved by Geocon prior to its transportation to the site.

13.3.2 Fill Area Preparation and Fill Placement

Areas to be developed should be cleared and stripped of existing structures/pavements, obstructions, trees, bushes, grass, roots, and the upper few inches of soil containing organic debris. Soils/organics removed by stripping can be transported offsite or stockpiled for use in landscaping. Existing drainage and utility lines or other existing subsurface structures that are not to be utilized, if any, should be removed, destroyed or abandoned in compliance with applicable regulations.

In general, all loose, soft, or wet surficial soil in the areas planned to receive new improvements or fill materials should be removed to expose competent materials. The actual removal depth is dependent upon the depth to competent materials.

All earthwork, grading, and engineered fill placement and relative compaction testing for new fill should conform per Caltrans’ *Standard Specifications*, Section 19. New embankment fill placed on sloping ground and adjacent to existing embankments/slopes should be keyed and benched in accordance with Caltrans’ *Standard Specifications*. Ponding or jetting of backfill should not be permitted.

14.0 GENERAL NOTES TO DESIGNER

This preliminary report has been prepared for project planning purposes only. Site-specific subsurface investigation and geotechnical laboratory testing will be required for project design. This report is prepared based on the currently available project information including the proposed structures and foundations described herein. Geocon must be contacted for review and possible revised recommendations if the proposed structures and foundations are changed.

15.0 CONSTRUCTION CONSIDERATIONS

15.1 Construction Advisories

Traffic control with roadway, lane, and shoulder closures and detours are anticipated during construction. In addition, there are overhead and underground utilities along or near the proposed bridge alignment. The Contractor should verify these utility conditions and plan the construction activities accordingly.

Commercial structures exist immediately adjacent and residential structures within approximately 200 feet of the proposed driven pile foundation locations. The impact of noise and vibration due to pile driving may need to be mitigated by limitation on hours of the day for driving piles. The recommendations of the Caltrans *Transportation and Construction Guidance Manual*, including Chapter 9 (*General Procedures for Addressing Vibration Issues*) should be followed. Evaluation for specific pile driving equipment can be performed once the contractor completes their Driving System Submittal.

15.2 Construction Considerations that Influence Specifications

All grading should be performed in conformance with Section 19 of Caltrans' *Standard Specifications* or equivalent. Backfill placed behind retaining walls should have a very low to low expansion potential. The extent and placement of the low-expansive soils should conform to Caltrans' *Geotechnical Manual, Embankments* (December 2014) Figure 1. Quality assurance during construction should conform to Caltrans *Standard Specifications* Section 6-2.01A, including the use of the CTM 216 test method for relative compaction testing.

The Contractor should verify the existing utility line conditions. These areas should not be used for stockpiling of construction materials. Any conflicts should be reviewed prior to construction.

15.3 Construction Monitoring and Instrumentation

Site grading, footing excavations, pile excavation and driving activities, removal of any unsuitable soils or oversize material, and replacement and compaction of backfill and subgrade should be observed by the Geotechnical Engineer of Record. Faces of cut slopes in alluvial materials should be observed by an engineering geologist for indications of instability. Appropriate field tests should be conducted to provide quality control, quality assurance for structural fills and related earthwork elements.

The Contractor should execute a monitoring program for structures in proximity to any deep excavations so that appropriate modifications to the excavation/shoring system and/or foundation type are implemented to minimize the surface deflection or structure damage in a timely manner.

16.0 DISCLAIMER AND CONTACT INFORMATION

The preliminary recommendations contained in this report are provided for project feasibility analysis only and are based on specific project information regarding structure type, location, and design loads that have been provided by Dokken Engineering and on existing geotechnical data in the general project vicinity. A site-specific geotechnical investigation including laboratory testing will be required in order to provide design-level recommendations for the project.

Any questions regarding the above recommendations should be directed to the Rancho Cordova Office of Geocon at 916-852-9118.

17.0 CLOSURE

17.1 Foundation and Grading Plan Review

Geocon should review the grading plans and foundation plans as project design progresses to determine whether additional analysis and/or recommendations are required.

17.2 Limitations and Uniformity of Conditions

The preliminary recommendations of this report are based on a review of existing geotechnical information and will be revised following our geotechnical investigation for this project. If the proposed construction will differ from that anticipated herein, Geocon should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon.

Our professional services were performed in accordance with generally acceptable geotechnical engineering principles and practices in the site area at this time. No warranty is provided, express or implied.

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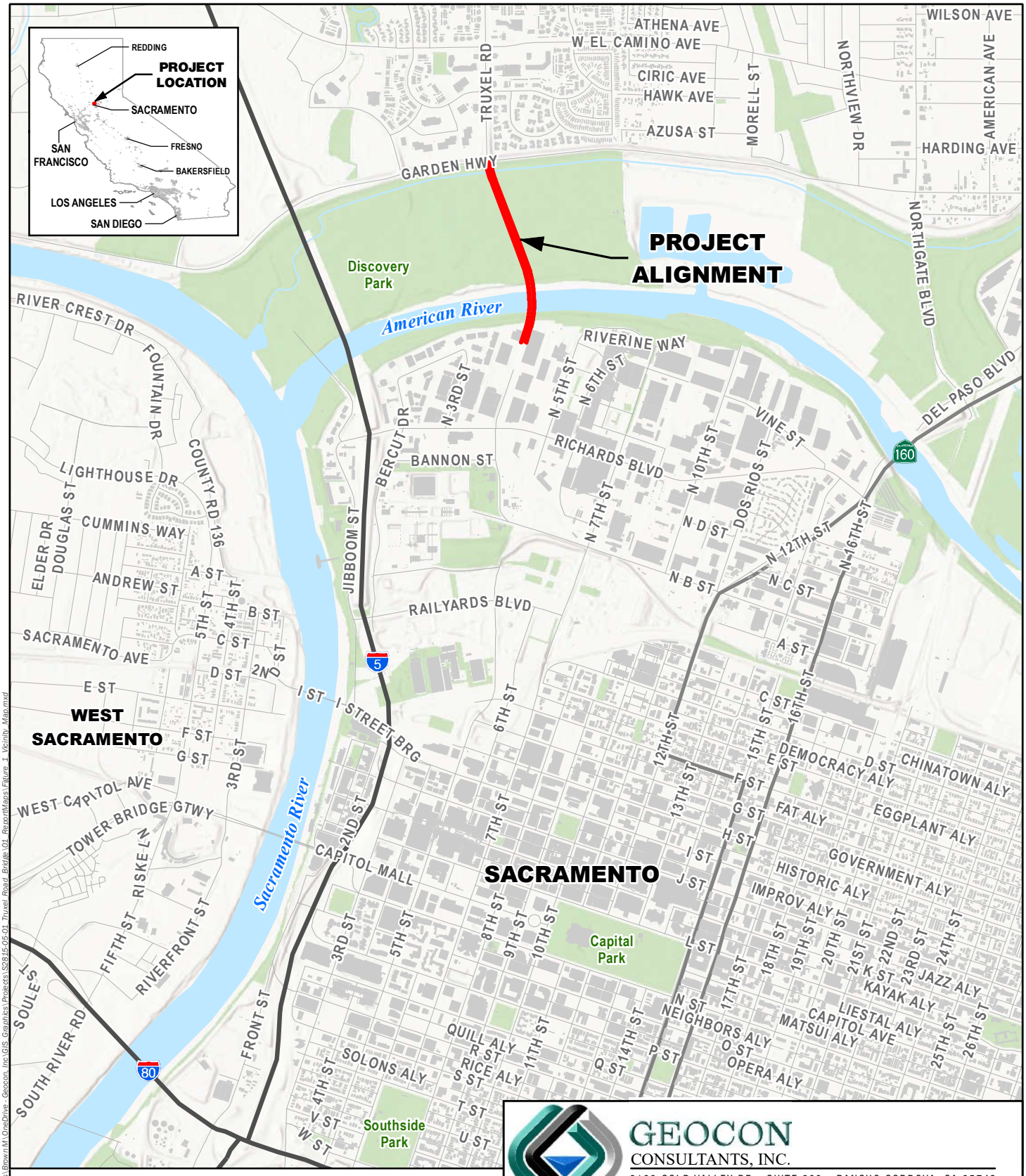
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22. Unpublished reports, aerial photographs, and maps on file with Geocon Incorporated.



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Scale in Feet

Truxel Road Bridge

Sacramento, California

VICINITY MAP

S2815-05-01	July 2024	Figure 1

GEOCON 7/18/2024 USER Brown M PATH C:\Users\Brown M\OneDrive - Geocon, Inc\GIS Graphics\Projects\S2815-05-01 Truxel Road Bridge\01 Report\Maps\Figure 1 Vicinity Map.mxd



Legend

B2	Approximate Exploratory Boring Location (Geocon 2022)
CPT2020-2	Approximate Cone Penetration Test Location (Geocon 2020)
CPT5	Approximate Cone Penetration Test Location (Geocon 2014)
WCSBAR_002M	Approximate Boring Location (DWR 2008)
D-1	Approximate Boring Location (Caltrans 1959)
	American River Bridge Explorations, 1963-64 (See Appendix A, for reference only)

Proposed Bridge Design Drawing by Dokken Engineering

N

0 500

Scale in Feet

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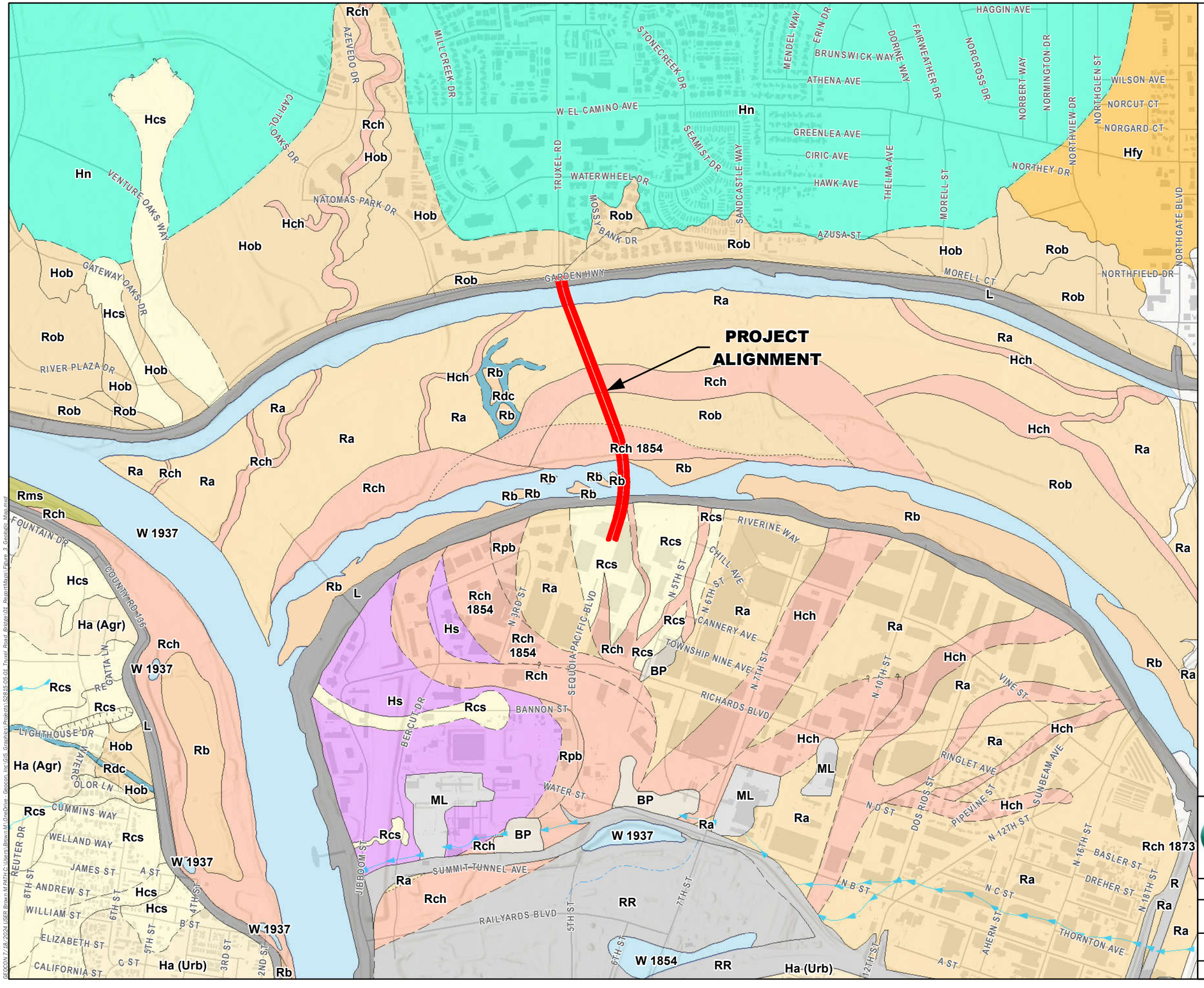
Truxel Road Bridge

Sacramento,
California

SITE PLAN

S2815-05-01	July 2024	Figure 2

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Unit Explanation

Ha	Alluvial Deposits
Ra	Alluvial deposits; undifferentiated
Hfy	Alluvial fan deposits
Hn	Basin deposits
BP	Borrow pit
Rb	Channel bar deposits
Hch/Rch	Channel deposits
Rms	Channel meander scroll deposits
Hcs/Rcs	Crevasse splay deposits
Rdc	Distributary channel deposits
L	Levee
ML	Made land
Hs	Marsh deposits
Hob/Rob	Overbank deposits
Rpb	Point bar
RR	Railroad embankment
R	Road embankment
W	Water

Notes:

1. R=Recent, H=Holocene, and lowercase letters represent the actual deposit type.
2. Geologic data from the CA Department of Water Resources Flood Emergency Response Informaiton Exchange (FERIX) *https://ferix.water.ca.gov/lep/*

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Truxel Road Bridge

Sacramento, California

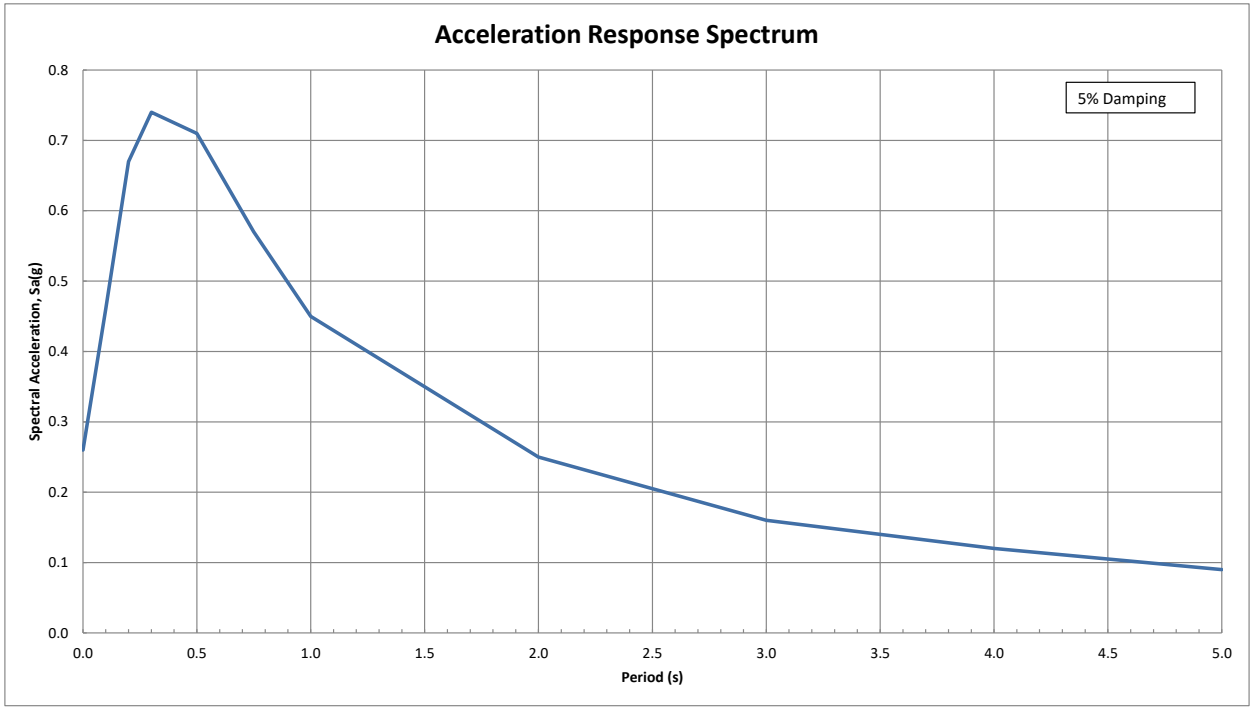
GEOLOGIC MAP

S2815-05-01	July 2024	Figure 3

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ARS Data for: ***Truxel Road Bridge***

Period, T (s)	Spectral Acceleration, S_a (g)
0.00	0.26
0.10	0.46
0.20	0.67
0.30	0.74
0.50	0.71
0.75	0.57
1.00	0.45
2.00	0.25
3.00	0.16
4.00	0.12
5.00	0.09



Latitude, degrees
38.604300
Longitude, degrees
-121.496300

Seismic Loading Table

Soil Profile (V_{S30}):	213	m/s
or:	699	ft/s
PGA Mean Moment Magnitude (M) for PGA:	6.68	
Rupture Distance: R:	89.1	km
or:	55.4	mi
PGA (HPGA):	**0.26**	**g**

The ARS curve was developed based on the USGS 2014 national Seismic Hazard Map for a 975 year return period (Hazard Model/Edition Dynamic Conterminous U.S. 2014 (Update) (V4.2.0) hazard data obtained by using ARS Online v3.1.0). Modifications for basin effects and/or near fault effects were applied, where applicable, per Appendix B of SDC v2.0 with October 2019 Interim Revisions.

SEE Design - Ground Motion Data Sheet

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Truxel Road Bridge

Sacramento,
California

RECOMMENDED PRELIMINARY DESIGN RESPONSE SPECTRUM

S2815-05-01	July 2024	Figure 4

APPENDIX A

APPENDIX A

PREVIOUS BORING LOGS, LOGS OF TEST BORINGS, AND LABORATORY TESTING BY OTHERS

UNIFIED SOIL CLASSIFICATION

MAJOR DIVISIONS					TYPICAL NAMES
COARSE-GRAINED SOILS (MORE THAN HALF IS COARSER THAN NO. 200 SIEVE)	GRAVELS (MORE THAN HALF COARSE FRACTION IS LARGER THAN NO.4 SIEVE SIZE)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
			GP		POORLY GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM		SILTY GRAVELS, SILTY GRAVELS WITH SAND
			GC		CLAYEY GRAVELS, CLAYEY GRAVELS WITH SAND
	SANDS (MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO.4 SIEVE SIZE)	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
			SP		POORLY GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM		SILTY SANDS WITH OR WITHOUT GRAVEL
			SC		CLAYEY SANDS WITH OR WITHOUT GRAVEL
FINE-GRAINED SOILS (MORE THAN HALF IS FINER THAN NO. 200 SIEVE)	SILTS AND CLAYS (LIQUID LIMIT 50% OR LESS)		ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTS WITH SANDS AND GRAVELS
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, CLAYS WITH SANDS AND GRAVELS, LEAN CLAYS
			OL		ORGANIC SILTS OR CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50%)		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC CLAYS OR CLAYS OF MEDIUM TO HIGH PLASTICITY
	HIGHLY ORGANIC SOILS		PT		PEAT AND OTHER HIGHLY ORGANIC SOILS

BORING/TRENCH LOG LEGEND

- No Recovery
- Shelby Tube Sample
- Bulk Sample
- SPT Sample
- Modified California Sample
- Groundwater Level (At Completion)
- Groundwater Level (Seepage)

PENETRATION RESISTANCE

SAND AND GRAVEL			SILT AND CLAY			
RELATIVE DENSITY	BLOWS PER FOOT (SPT)*	BLOWS PER FOOT (MOD-CAL)*	CONSISTENCY	BLOWS PER FOOT (SPT)*	BLOWS PER FOOT (MOD-CAL)*	COMPRESSIVE STRENGTH (tsf)
VERY LOOSE	0 - 4	0 - 6	VERY SOFT	0 - 2	0 - 3	0 - 0.25
LOOSE	5 - 10	7 - 16	SOFT	3 - 4	4 - 6	0.25 - 0.50
MEDIUM DENSE	11 - 30	17 - 48	MEDIUM STIFF	5 - 8	7 - 13	0.50 - 1.0
DENSE	31 - 50	49 - 79	STIFF	9 - 15	14 - 24	1.0 - 2.0
VERY DENSE	OVER 50	OVER 79	VERY STIFF	16 - 30	25 - 48	2.0 - 4.0
			HARD	OVER 30	OVER 48	OVER 4.0

*NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE LAST 12 INCHES OF AN 18-INCH DRIVE

MOISTURE DESCRIPTIONS

FIELD TEST	APPROX. DEGREE OF SATURATION, S (%)	DESCRIPTION
NO INDICATION OF MOISTURE; DRY TO THE TOUCH	S<25	DRY
SLIGHT INDICATION OF MOISTURE	25≤S<50	DAMP
INDICATION OF MOISTURE; NO VISIBLE WATER	50≤S<75	MOIST
MINOR VISIBLE FREE WATER	75≤S<100	WET
VISIBLE FREE WATER	100	SATURATED

QUANTITY DESCRIPTIONS

APPROX. ESTIMATED PERCENT	DESCRIPTION
<5%	TRACE
5 - 10%	FEW
11 - 25%	LITTLE
26 - 50%	SOME
>50%	MOSTLY

GRAVEL/COBBLE/BOULDER DESCRIPTIONS

CRITERIA	DESCRIPTION
PASS THROUGH A 3-INCH SIEVE AND BE RETAINED ON A NO. 4 SIEVE (#4 TO 3")	GRAVEL
PASS A 12-INCH SQUARE OPENING AND BE RETAINED ON A 3-INCH SIEVE (3"-12")	COBBLE
WILL NOT PASS A 12-INCH SQUARE OPENING (>12")	BOULDER

BEDDING SPACING DESCRIPTIONS

THICKNESS/SPACING	DESCRIPTOR
GREATER THAN 10 FEET	MASSIVE
3 TO 10 FEET	VERY THICKLY BEDDED
1 TO 3 FEET	THICKLY BEDDED
3 ⅝-INCH TO 1 FOOT	MODERATELY BEDDED
1 ⅛-INCH TO 3 ⅝-INCH	THINLY BEDDED
⅝-INCH TO 1 ⅛-INCH	VERY THINLY BEDDED
LESS THAN ⅝-INCH	LAMINATED

STRUCTURE DESCRIPTIONS

CRITERIA	DESCRIPTION
ALTERNATING LAYERS OF VARYING MATERIAL OR COLOR WITH LAYERS AT LEAST ¼-INCH THICK	STRATIFIED
ALTERNATING LAYERS OF VARYING MATERIAL OR COLOR WITH LAYERS LESS THAN ¼-INCH THICK	LAMINATED
BREAKS ALONG DEFINITE PLANES OF FRACTURE WITH LITTLE RESISTANCE TO FRACTURING	FISSURED
FRACTURE PLANES APPEAR POLISHED OR GLOSSY, SOMETIMES STRIATED	SLICKENSIDED
COHESIVE SOIL THAT CAN BE BROKEN DOWN INTO SMALLER ANGULAR LUMPS WHICH RESIST FURTHER BREAKDOWN	BLOCKY
INCLUSION OF SMALL POCKETS OF DIFFERENT SOIL, SUCH AS SMALL LENSES OF SAND SCATTERED THROUGH A MASS OF CLAY	LENSED
SAME COLOR AND MATERIAL THROUGHOUT	HOMOGENOUS

CEMENTATION/INDURATION DESCRIPTIONS

FIELD TEST	DESCRIPTION
CRUMBLES OR BREAKS WITH HANDLING OR LITTLE FINGER PRESSURE	WEAKLY CEMENTED/INDURATED
CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE	MODERATELY CEMENTED/INDURATED
WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE	STRONGLY CEMENTED/INDURATED

IGNEOUS/METAMORPHIC ROCK STRENGTH DESCRIPTIONS

FIELD TEST	DESCRIPTION
MATERIAL CRUMBLES WITH BARE HAND	WEAK
MATERIAL CRUMBLES UNDER BLOWS FROM GEOLOGY HAMMER	MODERATELY WEAK
⅛-INCH INDENTATIONS WITH SHARP END FROM GEOLOGY HAMMER	MODERATELY STRONG
HAND-HELD SPECIMEN CAN BE BROKEN WITH **ONE** BLOW FROM GEOLOGY HAMMER	STRONG
HAND-HELD SPECIMEN CAN BE BROKEN WITH **COUPLE** BLOWS FROM GEOLOGY HAMMER	VERY STRONG
HAND-HELD SPECIMEN CAN BE BROKEN WITH **MANY** BLOWS FROM GEOLOGY HAMMER	EXTREMELY STRONG

IGNEOUS/METAMORPHIC ROCK WEATHERING DESCRIPTIONS

DEGREE OF DECOMPOSITION	FIELD RECOGNITION	ENGINEERING PROPERTIES
SOIL	DISCOLORED, CHANGED TO SOIL, FABRIC DESTROYED	EASY TO DIG
COMPLETELY WEATHERED	DISCOLORED, CHANGED TO SOIL, FABRIC MAINLY PRESERVED	EXCAVATED BY HAND OR RIPPING (Saprolite)
HIGHLY WEATHERED	DISCOLORED, HIGHLY FRACTURED, FABRIC ALTERED AROUND FRACTURES	EXCAVATED BY HAND OR RIPPING, WITH SLIGHT DIFFICULTY
MODERATELY WEATHERED	DISCOLORED, FRACTURES, INTACT ROCK-NOTICEABLY WEAKER THAN FRESH ROCK	EXCAVATED WITH DIFFICULTY WITHOUT EXPLOSIVES
SLIGHTLY WEATHERED	MAY BE DISCOLORED, SOME FRACTURES, INTACT ROCK-NOT NOTICEABLY WEAKER THAN FRESH ROCK	REQUIRES EXPLOSIVES FOR EXCAVATION, WITH PERMEABLE JOINTS AND FRACTURES
FRESH	NO DISCOLORATION, OR LOSS OF STRENGTH	REQUIRES EXPLOSIVES

IGNEOUS/METAMORPHIC ROCK JOINT/FRACTURE DESCRIPTIONS

FIELD TEST	DESCRIPTION
NO OBSERVED FRACTURES	UNFRACTURED/UNJOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT 1 TO 3 FOOT INTERVALS	SLIGHTLY FRACTURED/JOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT 4-INCH TO 1 FOOT INTERVALS	MODERATELY FRACTURED/JOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT 1-INCH TO 4-INCH INTERVALS WITH SCATTERED FRAGMENTED INTERVALS	INTENSELY FRACTURED/JOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT LESS THAN 1-INCH INTERVALS; MOSTLY RECOVERED AS CHIPS AND FRAGMENTS	VERY INTENSELY FRACTURED/JOINTED

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KEY TO LOGS | Figure A1

PROJECT NO. **S9498-05-20** PROJECT NAME **Township 9 Additional Exploration**

BORING B1

ELEV. (MSL.) **~20'** DATE COMPLETED **9/1/22**

ENG./GEO. **T. Henderson** DRILLER **VW Drilling**

EQUIPMENT **Truck Mounted CME 55 w/ 8" Hollow Stem Auger & Mud Rotary** HAMMER TYPE **Automatic | 140 lb**

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
0	B1-BULK			SM	**FILL** Medium dense, damp, light gray, Silty SAND with Gravel				
5	B1-5.5 B1-6			SM	**ALLUVIUM** Very loose, damp, light gray, Silty SAND	6			
10	B1-10.5 B1-11			ML	Medium stiff, damp, dark brown, SILT with some sand	7			
15	B1-15.5 B1-16			SP	Loose, damp, brown, Poorly Graded SAND	12			
20	B1-20.5 B1-21				- moist	15			

Figure 4, Log of Boring, page 1 of 5

GEOCON

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **S9498-05-20** PROJECT NAME **Township 9 Additional Exploration**

BORING B1

ELEV. (MSL.) **~20'** DATE COMPLETED **9/1/22**

ENG./GEO. **T. Henderson** DRILLER **VW Drilling**

EQUIPMENT **Truck Mounted CME 55 w/ 8" Hollow Stem Auger & Mud Rotary** HAMMER TYPE **Automatic | 140 lb**

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
25									
26	B1-25.5 B1-26				- grayish brown	15			
27									
28									
29									
30									
31	B1-30.5 B1-31				- medium dense, bluish gray	21			
32									
33									
34									
35									
36	B1-35.5 B1-36					19			
37									
38									
39									
40									
41	B1-40.5 B1-41				- becomes coarse sand	27			
42									
43				GP	Dense, moist, gray, Poorly Graded GRAVEL with Sand and Silt				
44									
45									
46	B1-46					63			
47									
48									
49									

Figure 5, Log of Boring, page 2 of 5

GEOCON

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◥ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **S9498-05-20** PROJECT NAME **Township 9 Additional Exploration**

BORING B1

ELEV. (MSL.) **~20'** DATE COMPLETED **9/1/22**

ENG./GEO. **T. Henderson** DRILLER **VW Drilling**

EQUIPMENT **Truck Mounted CME 55 w/ 8" Hollow Stem Auger & Mud Rotary** HAMMER TYPE **Automatic | 140 lb**

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
50					Dense to very dense, moist, gray, Poorly Graded GRAVEL with Sand and Silt				
51									
52									
53									
54									
55					- rig chatter increases				
56									
57									
58									
59									
60									
61									
62									
63									
64									
65									
66									
67									
68									
69									
70									
71									
72									
73									
74									

Figure 6, Log of Boring, page 3 of 5

GEOCON

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **S9498-05-20** PROJECT NAME **Township 9 Additional Exploration**

BORING B1

ELEV. (MSL.) ~20' DATE COMPLETED 9/1/22

ENG./GEO. T. Henderson DRILLER VW Drilling

EQUIPMENT Truck Mounted CME 55 w/ 8" Hollow Stem Auger & Mud Rotary HAMMER TYPE Automatic | 140 lb

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
75					Dense to very dense, moist, gray, Poorly Graded GRAVEL with Sand and Silt				
76									
77									
78									
79									
80									
81									
82									
83				SM	Very dense, moist, grayish brown, Silty SAND				
84									
85									
86	B1-85.5 B1-86					81			
87									
88									
89									
90	B1-90			SP	Dense, moist, gray, Poorly Graded SAND				
91						50			
92									
93									
94									
95	B1-95			CL-ML	Hard, moist, light brown, Clayey SILT				
96						74/9			
97									
98									
99									

Figure 7, Log of Boring, page 4 of 5

IN PROGRESS S9498-05-20 TOWNSHIP 9 ADDITIONAL EXPLORATION.GPJ 09/20/22

GEOCON

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **S9498-05-20** PROJECT NAME **Township 9 Additional Exploration**

BORING B1

ELEV. (MSL.) **~20'** DATE COMPLETED **9/1/22**

ENG./GEO. **T. Henderson** DRILLER **VW Drilling**

EQUIPMENT **Truck Mounted CME 55 w/ 8" Hollow Stem Auger & Mud Rotary** HAMMER TYPE **Automatic | 140 lb**

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
100									
101	B1-100.5			ML	Hard, moist, gray, SILT, PP>4.5 tsf	98/10			
102									
103									
104									
105	B1-105			SP	Very dense, moist, grayish olive brown, Poorly Graded SAND				
106									
107									
108									
109									
110	B1-110			SM	Very dense, moist, grayish olive brown, Sitly SAND				
111						68			
					BORING TERMINATED AT 111.5 FEET GROUNDWATER NOT MEASURED BACKFILLED WITH NEAT CEMENT GROUT AND CAPPED WITH SOIL CUTTINGS				

Figure 8, Log of Boring, page 5 of 5

GEOCON

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **S9498-05-20** PROJECT NAME **Township 9 Additional Exploration**

BORING B2

ELEV. (MSL.) **~21'** DATE COMPLETED **9/2/22**

ENG./GEO. **T. Henderson** DRILLER **VW Drilling**

EQUIPMENT **Truck Mounted CME 55 w/ 8" Hollow Stem Auger & Mud Rotary** HAMMER TYPE **Automatic | 140 lb**

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
0	B2-BULK			ML	**FILL** Medium stiff, damp, light brown to brown, SILT with Sand				
5	B2-5.5 B2-6			ML	**ALLUVIUM** Stiff, moist, light brown, SILT with Sand	9			
10	B2-10 B2-10.5 B2-11			SP	Loose, damp, brown, Poorly Graded SAND	9			
15	B2-15.5 B2-16				- olive brown	9			
20	B2-20.5 B2-21		▼		- grayish brown - yellowish brown	10			

Figure 9, Log of Boring, page 1 of 4

GEOCON

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **S9498-05-20** PROJECT NAME **Township 9 Additional Exploration**

BORING B2

ELEV. (MSL.) **~21'** DATE COMPLETED **9/2/22**

ENG./GEO. **T. Henderson** DRILLER **VW Drilling**

EQUIPMENT **Truck Mounted CME 55 w/ 8" Hollow Stem Auger & Mud Rotary** HAMMER TYPE **Automatic | 140 lb**

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
25	B2-25				- olive brown to gray				
26						6			
27									
28									
29									
30	B2-30				- very loose, wet, gray				
31						2			
32									
33									
34									
35	B2-35				- medium dense				
36						14			
37									
38									
39									
40	B2-40				- loose				
41						8			
42									
43									
44									
45	B2-45								
46						9			
47				GP	Dense, wet, dark gray, Poorly Graded GRAVEL				
48									
49									

Figure 10, Log of Boring, page 2 of 4

GEOCON

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **S9498-05-20** PROJECT NAME **Township 9 Additional Exploration**

BORING B2

ELEV. (MSL.) **~21'** DATE COMPLETED **9/2/22**

ENG./GEO. **T. Henderson** DRILLER **VW Drilling**

EQUIPMENT **Truck Mounted CME 55 w/ 8" Hollow Stem Auger & Mud Rotary** HAMMER TYPE **Automatic | 140 lb**

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
50	B2-50				Dense, wet, dark gray, Poorly Graded GRAVEL				
51						47			
52									
53									
54									
55									
56									
57									
58									
59									
60					- rig chatter increases				
61									
62									
63									
64									
65									
66									
67									
68									
69									
70					- drill bit gets stuck on gravel fragments, pushing rig off the ground to drill through				
71									
72									
73									
74									

Figure 11, Log of Boring, page 3 of 4

GEOCON

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)

⊠ ... DISTURBED OR BAG SAMPLE ◥ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **S9498-05-20** PROJECT NAME **Township 9 Additional Exploration**

BORING B2

ELEV. (MSL.) **~21'** DATE COMPLETED **9/2/22**

ENG./GEO. **T. Henderson** DRILLER **VW Drilling**

EQUIPMENT **Truck Mounted CME 55 w/ 8" Hollow Stem Auger & Mud Rotary** HAMMER TYPE **Automatic | 140 lb**

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
75					Dense, wet, dark gray, Poorly Graded GRAVEL				
76									
77									
78				ML	Hard, moist, grayish brown, SILT with Sand, PP>4.5 tsf				
79									
80									
81									
82									
83									
84									
85									
86	B2-85.5 B2-86			SP	Very dense, moist, tannish gray, Poorly Graded SAND with Silt	82			

BORING TERMINATED AT 86.5 FEET
GROUNDWATER ENCOUNTERED AT 22 FEET
BACKFILLED WITH NEAT CEMENT GROUT AND CAPPED WITH SOIL CUTTINGS

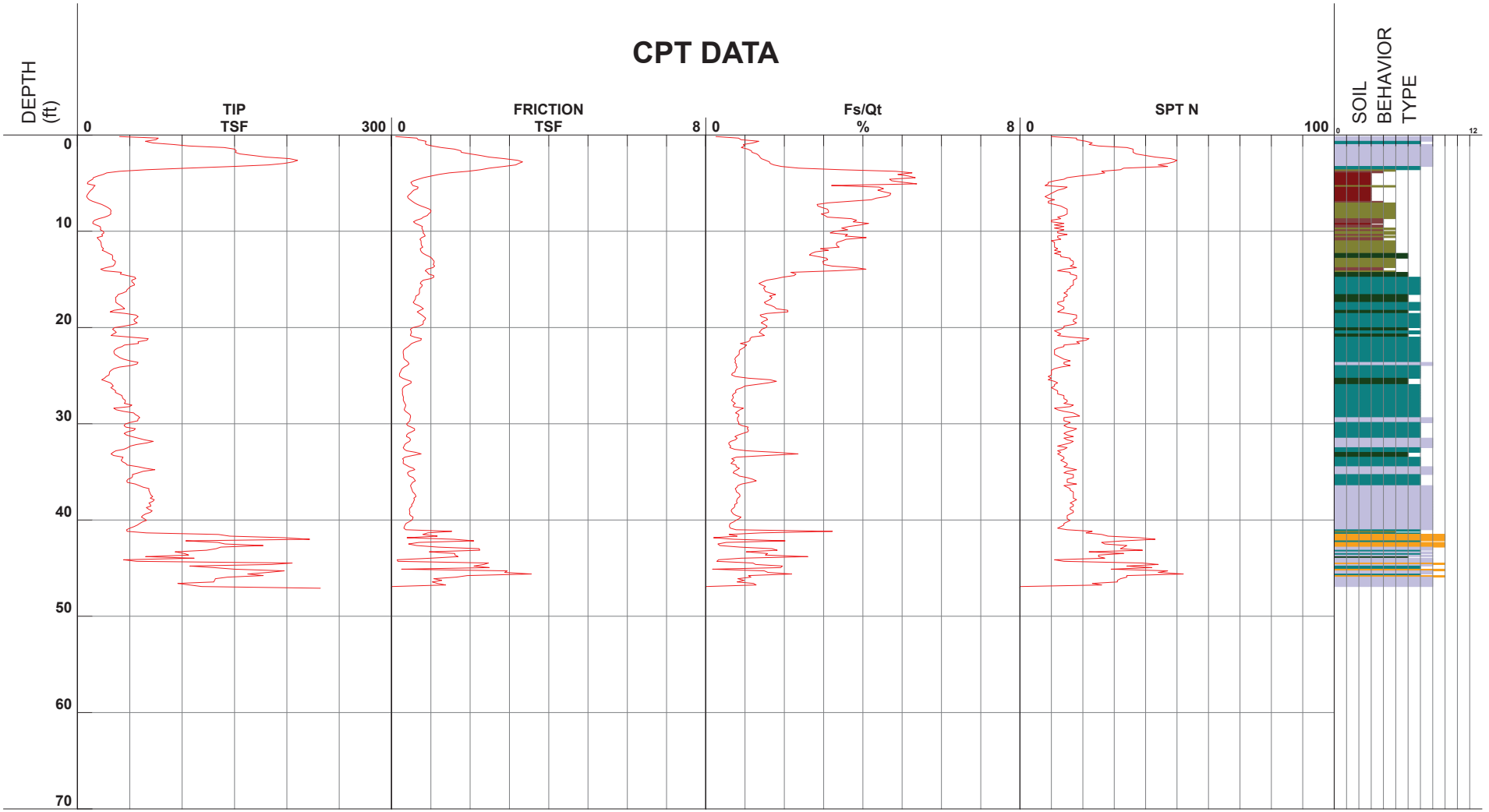
Figure 12, Log of Boring, page 4 of 4

GEOCON

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◥ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 10cm squared

S*Soil behavior type and SPT based on data from UBC-1983

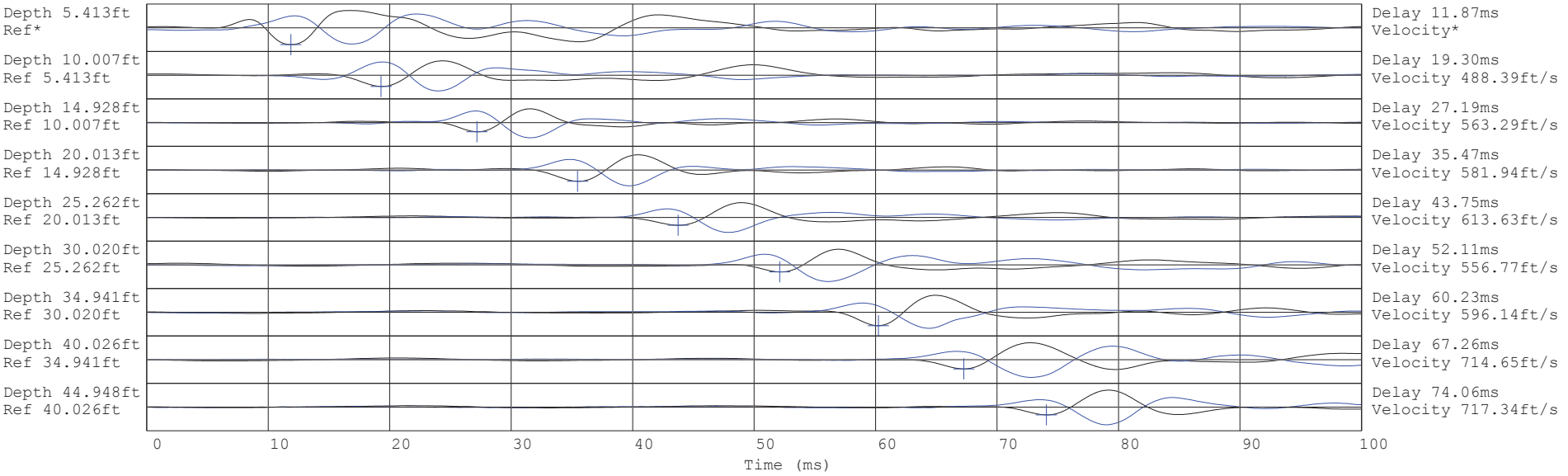
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PHONE 916.852.9118 – FAX 916.852.9132

CPT1

Township Nine – Parcels 8 and 15A

Sacramento, California

S9498-05-11	December 2014	Figure A1



Hammer to Rod String Distance 1.778 (m)
* = Not Determined

GEOCON
CONSULTANTS, INC.
3160 GOLD VALLEY DR – SUITE 800 – RANCHO CORDOVA, CA 95742
PHONE 916.852.9118 – FAX 916.852.9132

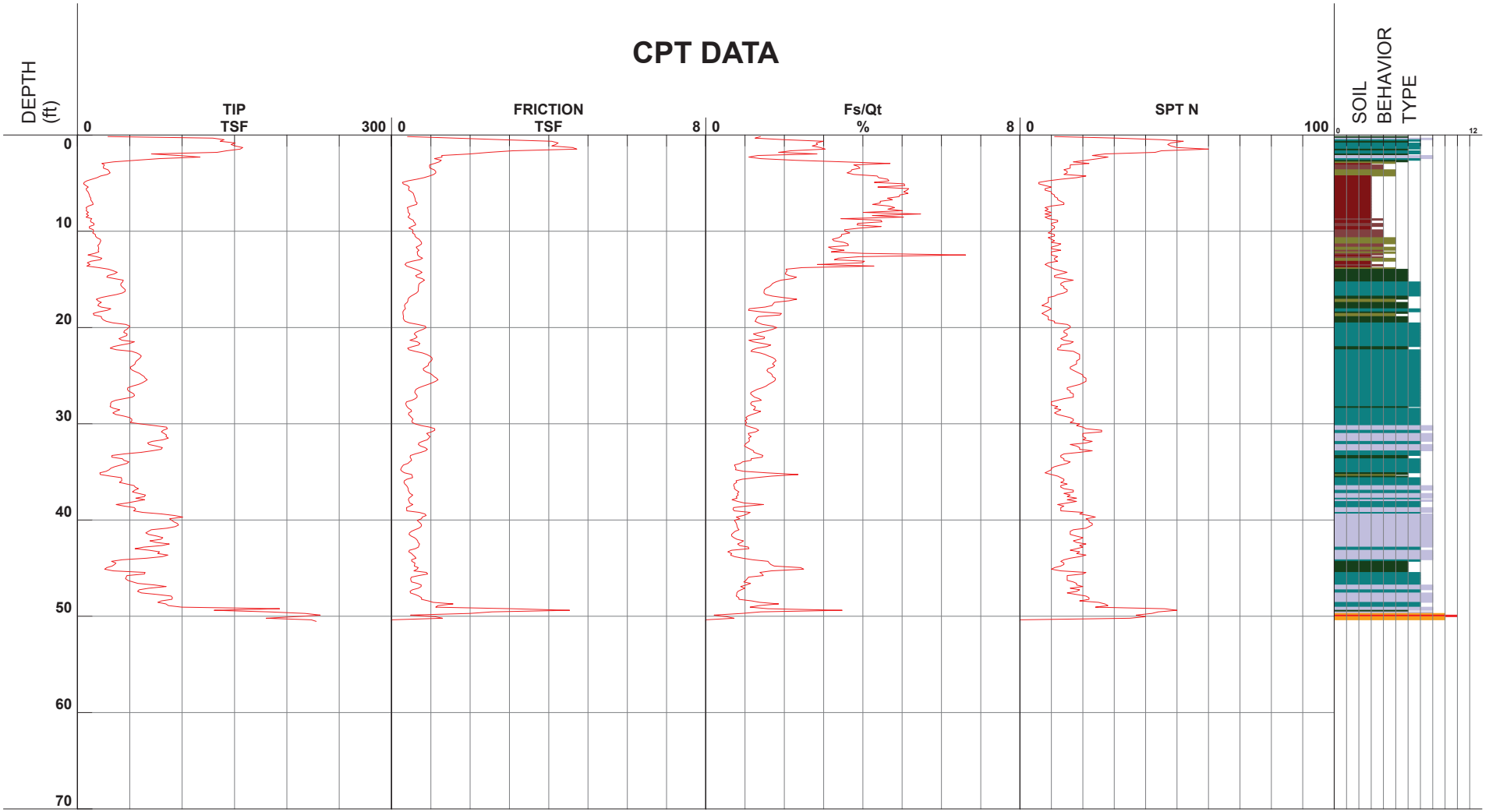
Shear Wave Velocity Waveforms – CPT1

Township Nine – Parcels 8 and 15A

Sacramento, California

S9498-05-11	December 2014	Figure A6

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 10cm squared

S*Soil behavior type and SPT based on data from UBC-1983

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3160 GOLD VALLEY DR – SUITE 800 – RANCHO CORDOVA, CA 95742
PHONE 916.852.9118 – FAX 916.852.9132

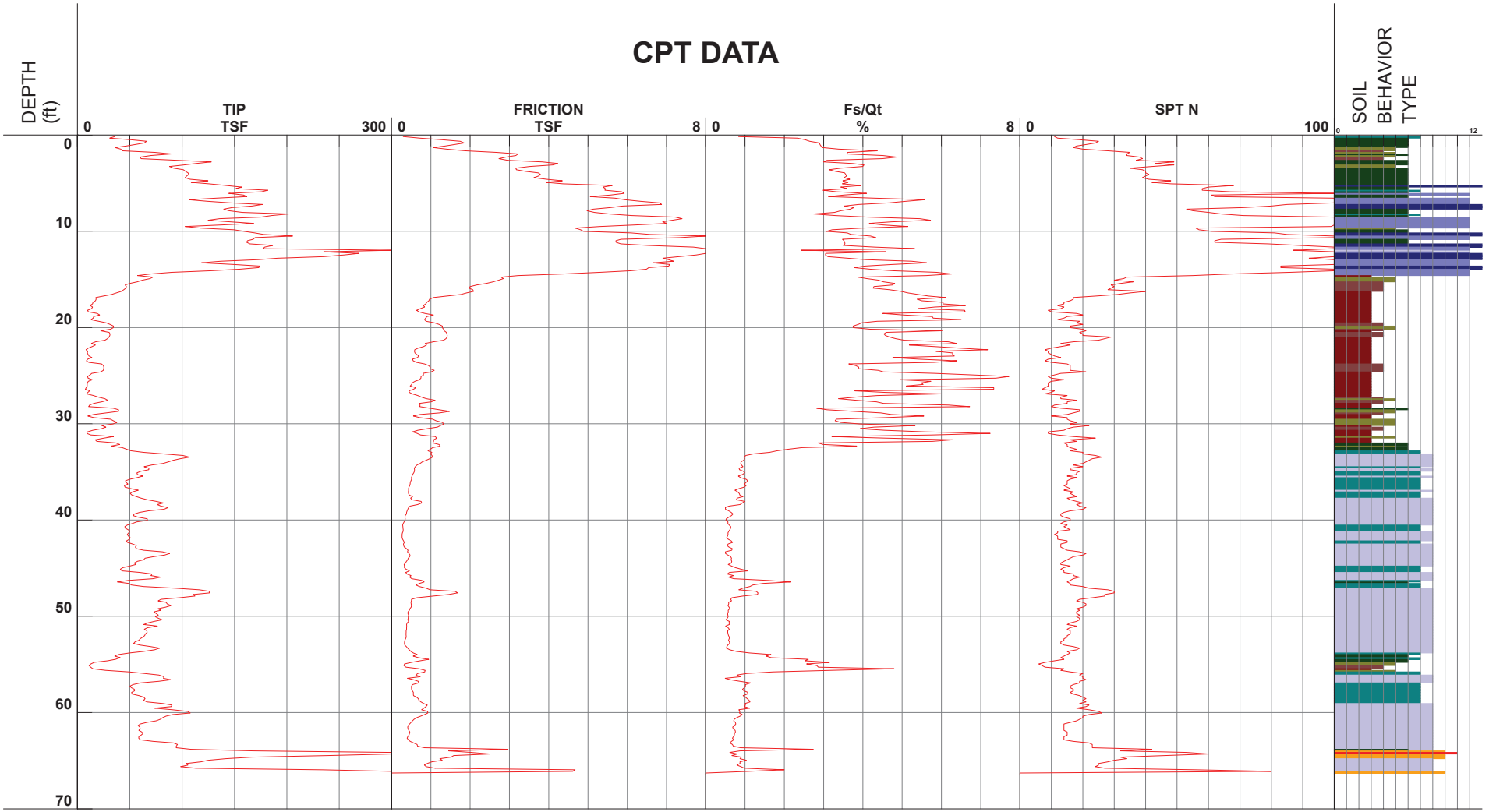
CPT2

Township Nine – Parcels 8 and 15A

Sacramento, California

S9498-05-11	December 2014	Figure A2

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 10cm squared

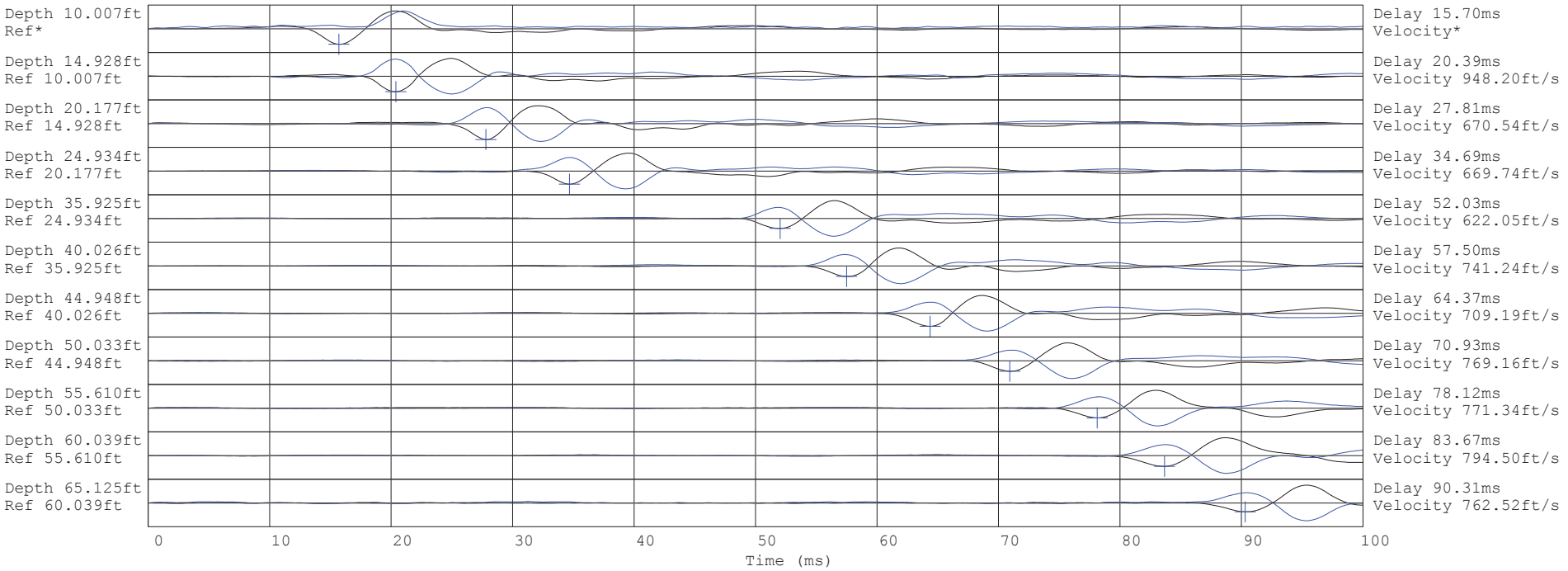
S*Soil behavior type and SPT based on data from UBC-1983

GEOCON CONSULTANTS, INC.
3160 GOLD VALLEY DR – SUITE 800 – RANCHO CORDOVA, CA 95742
PHONE 916.852.9118 – FAX 916.852.9132

CPT5

Township Nine – Parcels 8 and 15A
Sacramento, California

S9498-05-11	December 2014	Figure A5



Hammer to Rod String Distance 1.778 (m)
* = Not Determined

GEOCON
CONSULTANTS, INC.
3160 GOLD VALLEY DR – SUITE 800 – RANCHO CORDOVA, CA 95742
PHONE 916.852.9118 – FAX 916.852.9132

Shear Wave Velocity Waveforms – CPT5

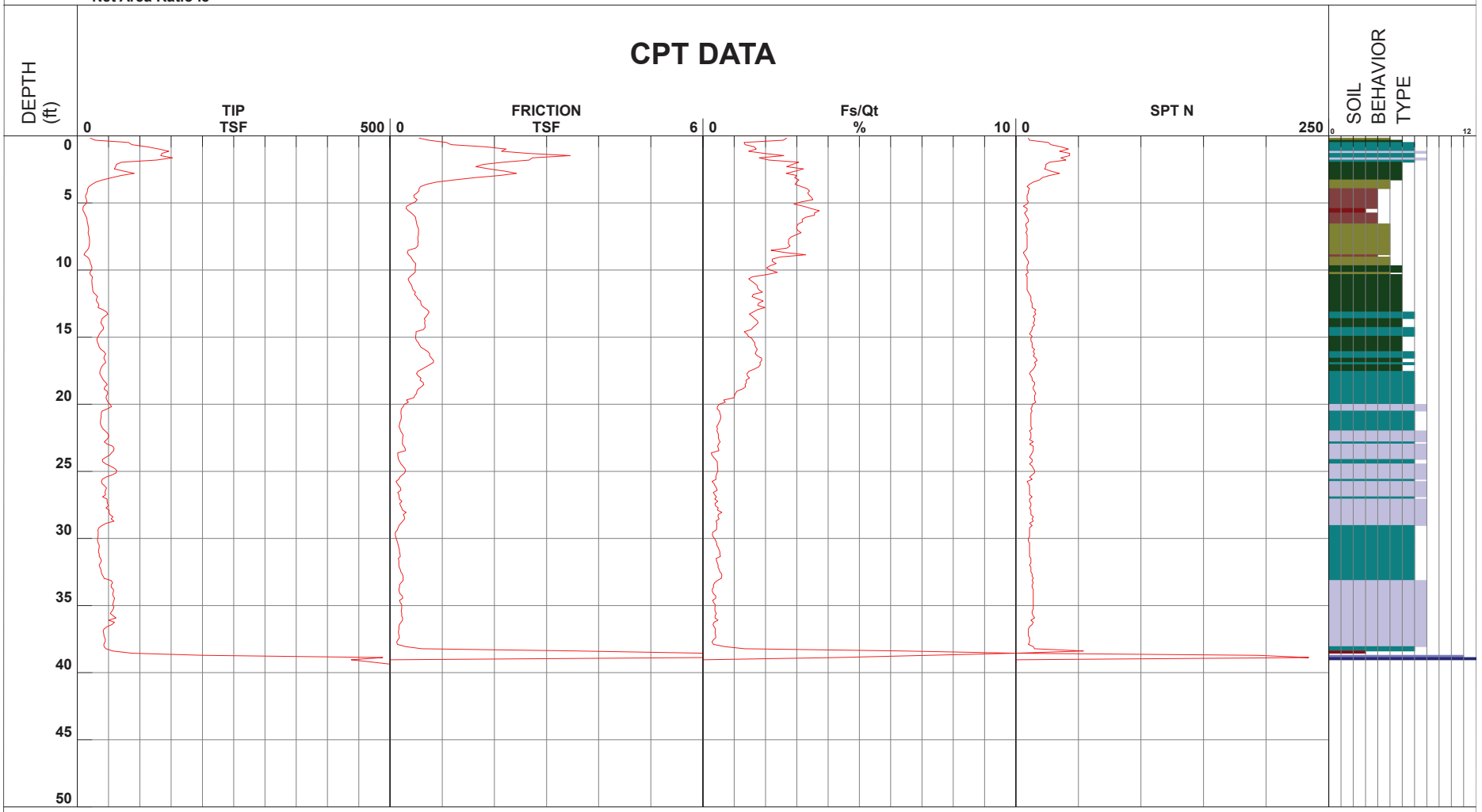
Township Nine – Parcels 8 and 15A

Sacramento, California

S9498-05-11	December 2014	Figure A7

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

GEOCON CONSULTANTS, INC.
3160 GOLD VALLEY DR – SUITE 800 – RANCHO CORDOVA, CA 95742
PHONE 916.852.9118 – FAX 916.852.9132

CPT1

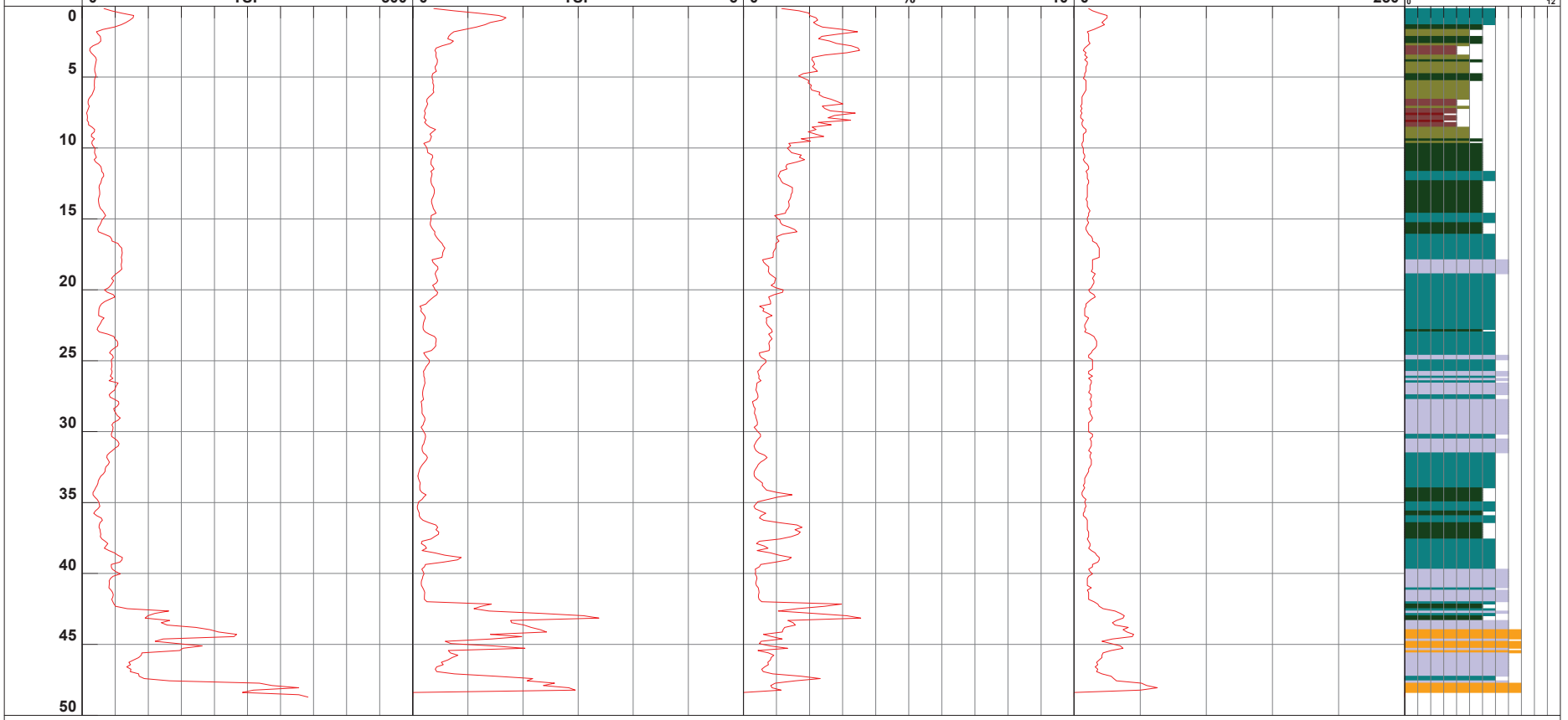
Township 9 – Seven Parcels

North of Richards Boulevard between 5th and 7th Streets
Sacramento, California

S9498-05-18	September 2020	Figure A1

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

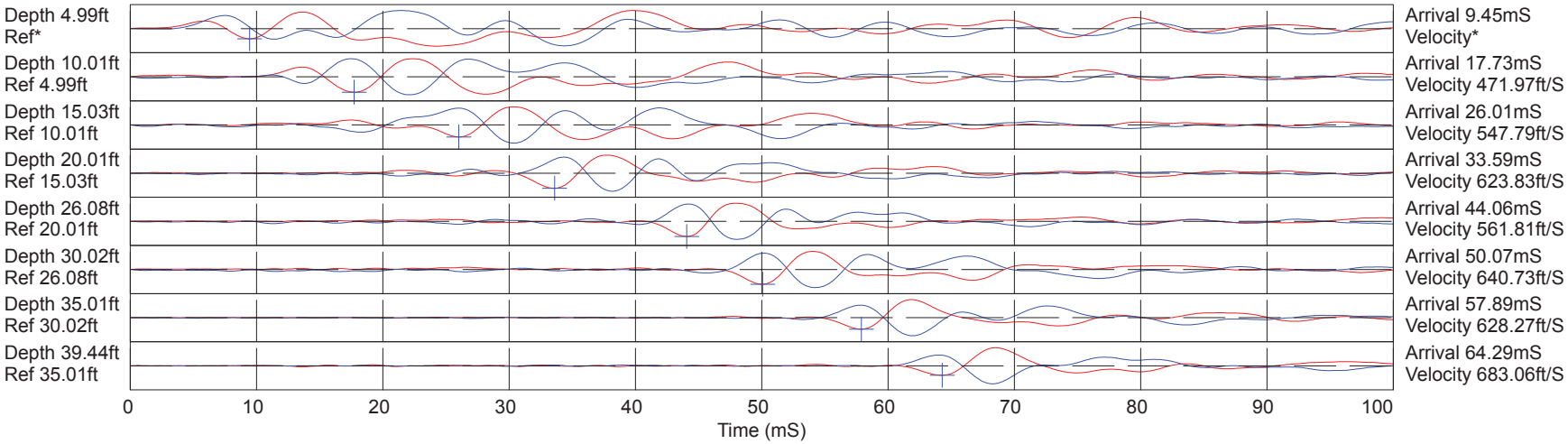
GEOCON CONSULTANTS, INC.
3160 GOLD VALLEY DR – SUITE 800 – RANCHO CORDOVA, CA 95742
PHONE 916.852.9118 – FAX 916.852.9132

CPT2

Township 9 – Seven Parcels

North of Richards Boulevard between 5th and 7th Streets
Sacramento, California

S9498-05-18	September 2020	Figure A2



Hammer to Rod String Distance (ft): 5.83
* = Not Determined

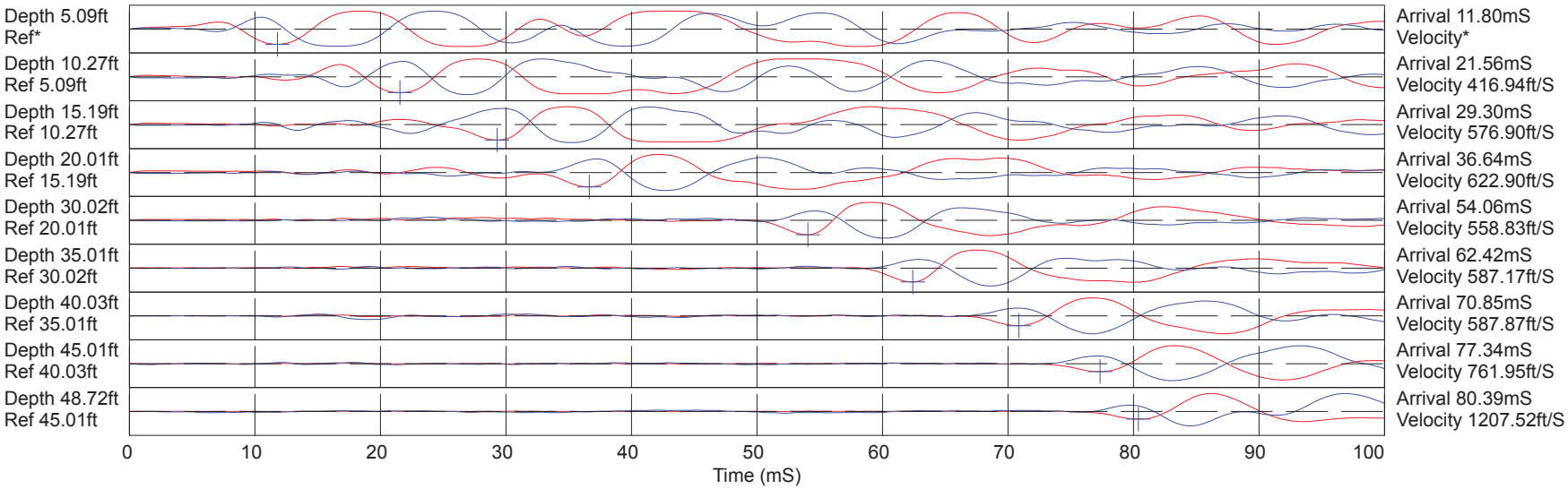
GEOCON
CONSULTANTS, INC.
3160 GOLD VALLEY DR – SUITE 800 – RANCHO CORDOVA, CA 95742
PHONE 916.852.9118 – FAX 916.852.9132

Shear Wave Velocity Waveforms – CPT1

Township 9 – Seven Parcels

North of Richards Boulevard between 5th and 7th Streets
Sacramento, California

S9498-05-18	September 2020	Figure A4



Hammer to Rod String Distance (ft): 5.83
* = Not Determined

GEOCON
CONSULTANTS, INC.
3160 GOLD VALLEY DR – SUITE 800 – RANCHO CORDOVA, CA 95742
PHONE 916.852.9118 – FAX 916.852.9132

Shear Wave Velocity Waveforms – CPT2

Township 9 – Seven Parcels

North of Richards Boulevard between 5th and 7th Streets
Sacramento, California

S9498-05-18	September 2020	Figure A5

GEOLOGIC LEGEND

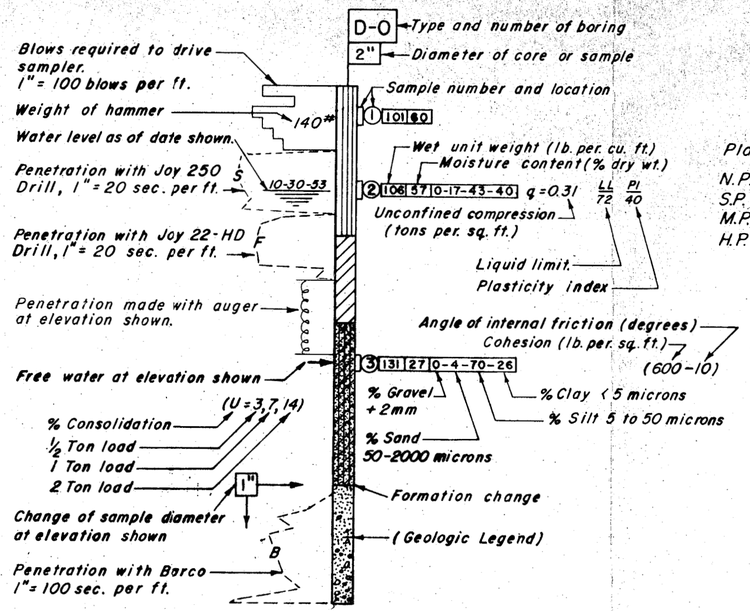
SOIL TYPES

- Gravel
- Sand
- Silt
- Clay
- Claypan
- Hardpan
- Sandy Gravel
- Gravelly Sand
- Loam
- Sandy Loam
- Silty Sand
- Sandy Silt
- Sandy Clay
- Clayey Sand
- Silty Clay
- Clayey Silt
- Peat
- Topsoil
- Organic Silt
- Organic Clay
- Shells
- Fill

ROCK TYPES

- Sandstone
- Shale
- Slate
- Schist
- Volcanics
- Unclassified Intrusives
- Ultra-basic Intrusives (Serpentine)
- Sandstone, Shale, Unclass.-Intrus. — Decomposed, Weathered or Fractured

BORING LEGEND
CROSS-SECTION & PROFILE SHEETS



Plasticity

N.P. = Non Plastic
S.P. = Slightly
M.P. = Moderately Plastic
H.P. = Highly Plastic

NOTE Borings made by District III personnel and equipment.
Location of borings taken from Boring Records dated 2-17-59 to 2-20-59 inclusive.

NOTE - All borings are numbered consecutively regardless of type of boring

BORING LEGEND - PLAN SHEETS

● A-0	Auger (Continuous helix)	● R-0	Rotary Boring
● B-0	Bucket Boring	● J-0	Jetted Boring
● C-0	Core Boring	× V-0	Vane borer test
● C-0(E)	Electric log of Boring	■ SP-0	Settlement Platform
● D-0	Drive Boring	▲ Z-0	Piezometer
● D-0(P)	Probe Boring		

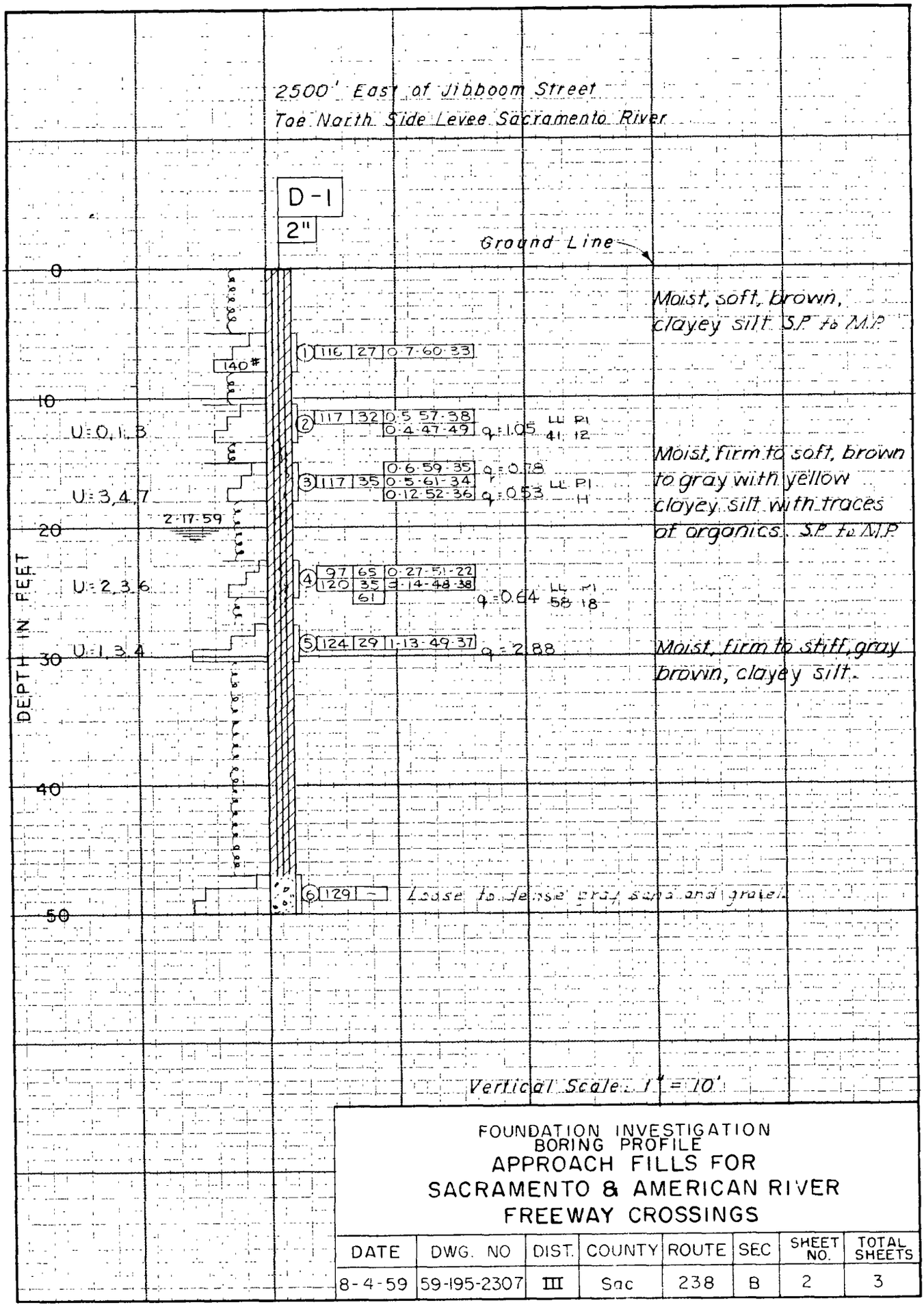
STATE OF CALIFORNIA DIVISION OF HIGHWAYS
MATERIALS & RESEARCH DEPARTMENT

FOUNDATION INVESTIGATION

APPROACH FILLS FOR
SACRAMENTO & AMERICAN RIVER
FREEWAY CROSSINGS

DWG. NO. 59-194-2307	SUBMITTED BY: J. W. Smith, SR. MATERIALS & RESEARCH ENG'R.	DATE 8-4-59
DRAWN BY R.P.	APPROVED BY: George B. Sherman, SUPV. MATERIALS & RESEARCH ENG'R.	SHEET NO. 1 OF 3 SHEETS
CHECKED BY W.K.		

B-30



FOUNDATION INVESTIGATION
BORING PROFILE

APPROACH FILLS FOR SACRAMENTO & AMERICAN RIVER FREEWAY CROSSINGS

DATE	DWG. NO	DIST.	COUNTY	ROUTE	SEC	SHEET NO.	TOTAL SHEETS
8-4-59	59-195-2307	III	Sac	238	B	2	3

STATE OF CALIFORNIA DIVISION OF HIGHWAYS
MATERIALS AND RESEARCH DEPARTMENT

Job No. 2307-Q-20

SUMMARY OF TESTS—FOUNDATION INVESTIGATION

Work Order 3QT617R

LOCATION BELTLINE FREEWAY DIST III CO SAC. RTE 238 SEC B

Date Reported 8-4-59

	FIELD DATA					TEST RESULTS																										
	Boring No.	Sample No.	Tube No.	Jar	Elev. Depth	UNIT WEIGHT LBS PER CU FT Wet	UNIT WEIGHT LBS PER CU FT Dry	MOIST CONT % dry weight	SPEC GRAV	VOIDS RATIO	GRAIN SIZE ANALYSIS Grvl	Sand	Silt	Clay	Col'd	ATTERBERG LIMITS LL	PI	CONSOLIDATION % OF ORIGINAL HEIGHT LOAD—TONS PER SQ. FT. 1/8	1/4	1/2	1	2	4	8	SHEAR DATA σ_3 T. S. F.	$\sigma_1-\sigma_3$ T. S. F.	COHESION psf	ANGLE OF INTERNAL FRICTION	UNCONF. COMP. STRENGTH T/Ft^2
*	01	1	IV		5'	121		27			0	7	60	33	10																
			III			117																										
			II			112																										
			I			116																										
				A																												
*		2	IV		10'	117		32			0	5	57	38	13																
			III			117																										
			II			116		33	2.72		0	4	47	49	25			0.0	0.1	0.5	1.5	3.0	5.6	9.5								
			I			117		32								41	12														1.05
				A																												
*		3	V		15'	117		36			0	6	59	35	11																
*			IV			117		34			0	5	61	34	12	—	11														
			III			117		33																								0.78
			II			116		32	2.71		0	12	52	36	16			0.7	1.3	2.7	4.5	6.8	9.7	13.3								
			I			116		38								43	14														0.53
				A																												
*		4	IV		22'	97		65			0	27	51	22	7																
			III			99																										
			II			119		35	2.74		0	14	48	38	18			0.1	—	1.6	3.3	5.8	9.2	13.3								
			I			122		61								58	18														0.64
				A																												

REMARKS

* TEST RESULTS DETERMINED BY DIST. III LABORATORY

SHEET NO 1 OF 3 SHEETS

Form T-239 (Rev. 9-3-56)
(Rev. 10-4-58)

STATE OF CALIFORNIA — DIVISION OF HIGHWAYS
MATERIALS AND RESEARCH DEPARTMENT

Job No. 2307-9-20

Work Order 30T617R

SUMMARY OF TESTS—FOUNDATION INVESTIGATION

Date Reported 8-4-59

LOCATION BELTLINE FREEWAY DIST III CO SAC. RTE 238 SEC B

FIELD DATA					TEST RESULTS																								
					UNIT WEIGHT		MOIST CONT	SPEC GRAV	VOIDS RATIO	GRAIN SIZE ANALYSIS					ATTERBERG LIMITS		CONSOLIDATION % OF ORIGINAL HEIGHT							SHEAR DATA				UNCONF. COMP.
Boring No.	Sample No.	Tube No.	Jar	Elev. Depth	LBS PER CU FT		% dry weight										LOAD—TONS PER SQ. FT.							σ_3 T. S. F.	$\sigma_1-\sigma_3$ T. S. F.	COHESION psf	ANGLE OF INTERNAL FRICTION	COMP STRENGTH T/Ft²
					Wet	Dry				Grvl	Sand	Silt	Clay	Col'd	LL	PI	1/8	1/4	1/2	1	2	4	8					
D1	5		A	27'	—																								
		II			122		30	2.75		1	13	49	37	16			0.0	0.6	1.5	2.7	4.5	7.2	10.6					
		I			125		27																					2.88
	6		A	47'	—																								
		II			122																								
		I			136																								
D3	1		B	12'																									
*		V			112		15			0	33	44	23	9															
*		IV			121		16			0	23	52	25	10															
		III			124																								
		II			128																								
		I			130																								
			A																										
*	2	V		17'	111		16			0	34	42	24	11															
*		IV			124		15			0	48	35	17	6	-	NP													
		III			123		17			0	55	26	19	9															2.44
		II			129		17	2.76		0	53	30	17	8			0.0	0.4	1.0	1.9	2.8	4.0	5.5					
		I			130		18								29	8												1.38
			A																										

REMARKS

* TEST RESULTS DETERMINED BY DIST. III LABORATORY

SHEET NO 2 OF 3 SHEETS

Form T-239 (Rev. 9-3-56)
(Rev. 10-44-58)

DATE STARTED	DATE COMPLETED	GROUND ELEVATION	ELEVATION DATUM	TOTAL DEPTH OF BORING
6/5/08	6/5/08	36.74 ft	NAVD 88	70.0 ft
DRILLING CONTRACTOR		**DRILLER'S NAME**	**HELPER'S NAME**	**TOTAL DEPTH OF FILL**
Gregg Drilling & Testing, Inc.		E. Santellan	R. Ryon/M. Ageev	10 ft
DRILLING METHOD		**DRILL RIG MAKE AND MODEL**		**CONSULTANT COMPANY**
0 - 3 ft: HA, 3 - 11.5 ft: HSA, 11.5 - 70 ft: Rotary Wash		MARL M-10 (Gregg Rig No. D-44)		GEI Consultants, Inc.
DRILL BIT SIZE AND TYPE (HOLE DIAMETER)		**DRILLING ROD TYPE AND DIAMETER**		**FIELD LOGGER**
5-inch drag bit		6" HSA, 94mm		M. Horse
☒ VERTICAL ☐ INCLINED		**CASING TYPE, DIAMETER, INSTALLATION DEPTH** Surface, 6-in., 10 ft		**FIELD LOG REVIEWER** G. Bradner
SAMPLER TYPE(S)		**HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP**		**HAMMER EFFICIENCY**
Bag, DCore(2.5"), PCore(2.5"), Shelby(2.37"), SPT(1.375")		Marl, automatic, 140 lbs / 30-inch drop		83%
BOREHOLE BACKFILL OR COMPLETION		**GROUNDWATER READING: DURING DRILLING**		**AFTER DRILLING (DATE-TIME)**
5% bentonite grout		N/A due to rotary wash drilling method		

Elevation, feet	Depth, feet	Material Graphics	CLASSIFICATION OF MATERIALS (Description)	Sample Location	Sample Number	Recovery, %	Blows per 6 in. [Blows per ft]	N_{60}(ASTM)	PP or TV, tsf	LABORATORY DATA: Water Content, %	Liquid Limit	Plasticity Index	Fines, % < #200	Other Lab Tests	REMARKS
	0		Asphalt and Gravel Road Base.												
	1		[LEVEE FILL] LEAN CLAY with Sand (CL); dark olive brown (2.5Y 3/3); moist; 85% very high dry strength fines; 10% fine to medium sand; 5% subrounded gravel, max. 1/2 in..		1										S01A_001_002B
35	2				2					17	38	15			S02A_002_003B
	3				3	100									S03A_003_004T Pushed Shelby tube at 1000 psi; tube damaged
	4		[LEVEE FILL] SILTY SAND (SM); dense; dark yellowish brown (10YR 3/6); 72% fine to medium sand; 27% medium plasticity fines; 1% fine to coarse, subrounded gravel, max.		4	56	10 13 18	43					27	HD	S04A_004_006S
	5		1.2 in.; portion of fines are clay-sized.				[31]								
	6		[LEVEE FILL] SANDY LEAN CLAY (CL); very stiff; dark olive brown (2.5Y 3/3); moist; 50% medium plasticity, medium dry strength fines; 40% fine to medium sand; 10% fine to coarse, subrounded gravel, max. 1 in..		5	44			3.25P						S05A_007_007P
30	7														
	8														
← FILL	9														
	10		[Approximate bottom of Levee Fill at10'].												
	11		Poorly Graded SAND with Silt (SP-SM); medium dense; yellowish brown (10YR 5/4); dry; 94% fine to medium sand; 6% fines; 0% gravel.		6	67	3 4 5 [9]	12		2			6		S06A_010_012S
25	12														S07A_012_012P Driller notes very easy drilling
	13				7	10									
	14														
	15		SANDY SILT (ML); medium dense; brown (10YR 5/3); moist; 62% low plasticity, low dry strength fines; 38% fine sand; 0% gravel.		8	44	4 5 7	17	1.0P				62	HD	S08A_015_017S
	16						[12]								Sample numbers 9 and 10 not used
20	17														S11A_017_018P
	18				11	64									
	19														
	20														

Final Report Version 5/21/2010

Borehole Location: South Bank Crest **County:** Sacramento
Coordinates: Northing: 1,980,607.03 **Easting:** 6,709,533.17
Latitude: 38.59961 **Longitude:** -121.48260
Levee Station or Milepost: 1078+45 **Levee Mile:** 1.51
Levee Segment
Survey Method: GIS/LiDAR **Coord. System:** CA State Plane Zone II
Channel / River Name / Feature: American River

LOG OF BORING
WCSBAR_001B
Sheet 1 of 4

Urban Levee Geotechnical Evaluations Program
Engineering Support Services

DWR LEVEE U/NU SOIL LOG REV1; AMERICAN RIVER LEVEE BORINGS 6-16-2010.GPJ; DWR OFFICIAL LIBRARY 032210.GLB; 6/16/10

Elevation, feet	Depth, feet	Material Graphics	CLASSIFICATION OF MATERIALS (Description)	Sample Location	Sample Number	Recovery, %	Blows per 6 in. [Blows per ft]	N_{60}(ASTM)	PP or TV, tsf	LABORATORY DATA: Water Content, %	LABORATORY DATA: Liquid Limit	LABORATORY DATA: Plasticity Index	LABORATORY DATA: Fines, % < #200	LABORATORY DATA: Other Lab Tests	REMARKS
	20		SILTY SAND (SM); medium dense; dark yellowish brown (10YR 4/6); wet; 56% fine sand; 44% low plasticity fines; 0% gravel; portion of fines are clay-sized.		12	44	7 9 10 [19]	26	0.75P				44	HD	S12A_020_022S
15	21														
	22				13	69				40				SG	S13A_023_023P
	23														
	24														
	25				14	44	5 7 8 [15]	21							S14A_025_027S
	26														
10	27		SANDY SILT (ML); medium dense; dark yellowish brown (10YR 4/6); moist; 60% low plasticity, low dry strength, rapid dilatancy fines; 40% fine sand; 0% gravel.		15	14			0.75P						S15A_027_027P
	28														
	29														
	30		As above except 42% sand; 58% fines.		16	44	5 7 4 [11]	15					58	HD	S16A_030_032S
5	31														
	32		LEAN CLAY (CL); medium stiff; very dark greenish gray (10GY 3/1); wet; 95% very high dry strength, low toughness fines; 5% sand; 0% gravel.		17	62			0.75P	46	48	29			S17A_033_033P
	33														
	34														
	35		SILTY SAND (SM); medium dense; greenish black (10GY 2.5/1); moist; 81% fine to medium sand; 19% fines; 0% gravel.		18	72	8 11 11 [22]	30		30			19		S18A_035_037S
0	36														
	37				19	100									S19B_037_038P S19A_040_040P
	38														
	39		Well-Graded SAND with Silt (SW-SM); medium dense; dark olive gray (5Y 3/2); moist; 89% fine to coarse sand; 11% fines; 0% gravel.												
	40				20	61	8 8 9 [17]	24		21			11		S20A_040_042S
-5	41														
	42				21	55									S21A_043_043P
	43														
	44														
	45														

Final Report Version 5/21/2010

Borehole Location: South Bank Crest **County:** Sacramento
Coordinates: Northing: 1,980,607.03 **Easting:** 6,709,533.17
Latitude: 38.59961 **Longitude:** -121.48260
Levee Station or Milepost: 1078+45 **Levee Mile:** 1.51
Levee Segment
Survey Method: GIS/LiDAR **Coord. System:** CA State Plane Zone II
Channel / River Name / Feature: American River

LOG OF BORING
WCSBAR_001B
Sheet 2 of 4

Urban Levee Geotechnical Evaluations Program
Engineering Support Services

DWR LEVEE U/NU SOIL LOG REV1; AMERICAN RIVER LEVEE BORINGS 6-16-2010.GPJ; DWR OFFICIAL LIBRARY 032210.GLB; 6/16/10

Elevation, feet	Depth, feet	Material Graphics	CLASSIFICATION OF MATERIALS (Description)	Sample Location	Sample Number	Recovery, %	Blows per 6 in. [Blows per ft]	N_{60}(ASTM)	PP or TV, tsf	LABORATORY DATA: Water Content, %	LABORATORY DATA: Liquid Limit	LABORATORY DATA: Plasticity Index	LABORATORY DATA: Fines, % < #200	LABORATORY DATA: Other Lab Tests	REMARKS
	45		Well-Graded SAND with Silt (SW-SM); as above.		22	72	8 10 11 [21]	29							S22A_045_047S
-10	46 47 48 49				23	86									Box 1 Representative S23A_048_048P
	50		Poorly Graded SAND with Silt (SP-SM); medium dense; dark olive gray (5Y 3/2); moist; 92% fine to coarse sand; 8% fines; 0% gravel.		24	67	9 10 10 [20]	28		22			8		S24A_050_052S
-15	51 52 53 54				25	38									Box 2 Representative S25A_052_053P
	55		Well-Graded GRAVEL (GW); dense; cobbles present.		26	0	17 19 15 [34]	47							No Recovery Driller notes gravels/cobbles
-20	56 57 58 59		Well-Graded SAND with Silt (SW-SM); medium dense; dark olive gray (5Y 3/2); moist; 89% fine to coarse sand; 11% fines; 0% gravel.		27	60									S27A_057_058P
	60				28	61	8 10 9 [19]	26		22			11		S28A_060_062S
-25	61 62 63		Gravel and Cobbles.		29	0									No Recovery Rig chatter
	64 65				30	0	50/4"								Rig shaking; driller notes gravel/cobbles No Recovery
-30	66 67						[REF]								No Recovery Rig chatter and shaking; driller notes gravel/cobbles
	68 69 70				31	0									2.75 in. cobble fragments in core barrel slough

Final Report Version 5/21/2010

Borehole Location: South Bank Crest **County:** Sacramento
Coordinates: Northing: 1,980,607.03 **Easting:** 6,709,533.17
Latitude: 38.59961 **Longitude:** -121.48260
Levee Station or Milepost: 1078+45 **Levee Mile:** 1.51
Levee Segment
Survey Method: GIS/LiDAR **Coord. System:** CA State Plane Zone II
Channel / River Name / Feature: American River

LOG OF BORING
WCSBAR_001B

Urban Levee Geotechnical Evaluations Program
Engineering Support Services

DWR LEVEE U/NU SOIL LOG REV1; AMERICAN RIVER LEVEE BORINGS 6-16-2010.GPJ; DWR OFFICIAL LIBRARY 032210.GLB; 6/16/10

Elevation, feet	Depth, feet	Material Graphics	CLASSIFICATION OF MATERIALS (Description)	Sample Location	Sample Number	Recovery, %	Blows per 6 in. [Blows per ft]	N_{60}(ASTM)	PP or TV, tsf	LABORATORY DATA: Water Content, % / Liquid Limit / Plasticity Index / Fines, % < #200 / Other Lab Tests	REMARKS
	70		Borehole terminated at 70 feet. Backfilled with 5% bentonite grout.								
-35	71										
	72										
	73										
	74										
	75										
	76										
-40	77										
	78										
	79										
	80										
	81										
-45	82										
	83										
	84										
	85										
	86										
-50	87										
	88										
	89										
	90										
	91										
-55	92										
	93										
	94										
	95										

Final Report Version 5/21/2010

Borehole Location: South Bank Crest **County:** Sacramento
Coordinates: Northing: 1,980,607.03 **Easting:** 6,709,533.17
Latitude: 38.59961 **Longitude:** -121.48260
Levee Station or Milepost: 1078+45 **Levee Mile:** 1.51
Levee Segment
Survey Method: GIS/LiDAR **Coord. System:** CA State Plane Zone II
Channel / River Name / Feature: American River

LOG OF BORING
WCSBAR_001B
Sheet 4 of 4

Urban Levee Geotechnical Evaluations Program
Engineering Support Services

DWR LEVEE U/NU SOIL LOG REV1; AMERICAN RIVER LEVEE BORINGS 6-16-2010.GPJ; DWR OFFICIAL LIBRARY 032210.GLB; 6/16/10

DATE STARTED 6/19/08	**DATE COMPLETED** 6/20/08	**GROUND ELEVATION** 41.18 ft	**ELEVATION DATUM** NAVD 88	**TOTAL DEPTH OF BORING** 97.0 ft
DRILLING CONTRACTOR Boart Longyear/Prosonic		**DRILLER'S NAME** C. Hill	**HELPER'S NAME** D. King/S. McNulty	**TOTAL DEPTH OF FILL** 20 ft
DRILLING METHOD 0 - 97 ft: Sonic		**DRILL RIG MAKE AND MODEL** ProSonic, Full-size Sonic		**CONSULTANT COMPANY** GEI Consultants, Inc.
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6-inch OD carbide		**DRILLING ROD TYPE AND DIAMETER** 6-inch OD sonic		**FIELD LOGGER** M. Horse
☒ **VERTICAL** ☐ **INCLINED**		**CASING TYPE, DIAMETER, INSTALLATION DEPTH** None		**FIELD LOG REVIEWER** J. Myers
SAMPLER TYPE(S) 4-inch ID core barrel		**HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP** None		**HAMMER EFFICIENCY** N/A%
BOREHOLE BACKFILL OR COMPLETION See piezometer installation notes		**GROUNDWATER READING:**	**DURING DRILLING** 36 ft	**AFTER DRILLING (DATE-TIME)** 35.11 ft on 6/26/08 9:25AM

Elevation, feet	Depth, feet	Material Graphics	CLASSIFICATION OF MATERIALS (Description)	Sample Location	Sample Number	Blows per 6 in. (Blows per ft)	N_{60}(ASTM)	PP or TV, tsf	LABORATORY DATA: Water Content, %	Liquid Limit	Plasticity Index	Fines, % < #200	Other Lab Tests	Piezometer Installation Schematic	REMARKS AND PIEZOMETER INSTALLATION NOTES
	0		Gravel Road Base; compacted.												
40	1		[LEVEE FILL] SANDY LEAN CLAY (CL); very stiff; olive brown (2.5Y 4/4); moist; 70% medium plasticity, very high dry strength, slow dilatancy, medium toughness fines; 30% fine to medium sand; 0% gravel.		S01A			2.5P 0.45T							Piezometer Cap 12" Morrison Flush Mounted Vault Ready Mix Concrete
	2														
	3		As above except very dark grayish brown (10YR 3/2); 45% sand; 55% fines.												
	4														
	5		[LEVEE FILL] Poorly Graded SAND with Silt (SP-SM); olive yellow (2.5Y 6/8); dry; 94% fine to medium sand; 6% low plasticity fines; 0% gravel.		Box1										
35	6														
	7														
	8				S02A							6	HD		
	9														
	10														
30	11														
	12														
	13		[LEVEE FILL] SILTY SAND with Gravel (SM); olive brown (2.5Y 4/3); dry; 60% fine to medium sand; 20% fine to coarse, subrounded to rounded gravel, max. 1.25 in.; 20% low plasticity fines.												
	14														
	15				S02B							7	HD		
	16		[LEVEE FILL] Poorly Graded SAND with Silt (SP-SM); olive brown (2.5Y 4/3); dry; 93% fine to medium sand; 7% low plasticity fines; 0% gravel.		Box2										
25	17														
	18		[LEVEE FILL] LEAN CLAY with Sand (CL); stiff; light olive brown (2.5Y 5/4); moist; 85% very high dry strength, no dilatancy, medium toughness fines; 15% fine sand; 0% gravel.		S03A			1.75P 0.35T	17	28	13				
FILL	19		1-foot thick Sandy Lean Clay (CL) lense; 40% fine sand; 60% medium plasticity fines.												
	20														

Final Report Version 5/21/2010

Borehole Location: South Bank Crest **County:** Sacramento
Coordinates: Northing: 1,981,351.55 **Easting:** 6,706,270.57
Latitude: 38.60170 **Longitude:** -121.49400
Levee Station or Milepost: 1044+59 **Levee Mile:** 0.88
Levee Segment
Survey Method: GIS/LiDAR **Coord. System:** CA State Plane Zone II
Channel / River Name / Feature: American River

LOG OF BORING
WCSBAR_002M
Sheet 1 of 5

Urban Levee Geotechnical Evaluations Program
Engineering Support Services

DWR LEVEE U/NU SOIL + PIEZ LOG REV1; AMERICAN RIVER LEVEE BORINGS 6-16-2010.GPJ; DWR OFFICIAL LIBRARY 032210.GLB; 6/16/10

Elevation, feet	Depth, feet	Material Graphics	CLASSIFICATION OF MATERIALS (Description)	Sample Location	Sample Number	Blows per 6 in. (Blows per ft)	N_{60}(ASTM)	PP or TV, tsf	LABORATORY DATA: Water Content, %	LABORATORY DATA: Liquid Limit	LABORATORY DATA: Plasticity Index	LABORATORY DATA: Fines, % < #200	LABORATORY DATA: Other Lab Tests	Piezometer Installation Schematic	REMARKS AND PIEZOMETER INSTALLATION NOTES
20	20														
	21		CLAYEY SAND (SC); 60% fine to medium sand; 40% medium plasticity fines; 0% gravel.												
	22		Poorly Graded SAND with Silt (SP-SM); dark yellowish brown (10YR 4/6); dry; 90% fine to medium sand; 10% low plasticity fines; 0% gravel.		S03B							10			
	23														
	24		LEAN CLAY (CL); 95% medium plasticity fines; 5% sand; 0% gravel.												5% Bentonite Grout
	25				Box3										
	26		SILTY SAND (SM); very dark grayish brown (10YR 3/2); moist; 55% fine sand; 45% low plasticity fines; 0% gravel.		S03C										
15	27														
	28		LEAN CLAY with Sand (CL); dark yellowish brown (10YR 3/6); moist; 77% medium plasticity fines; 23% fine sand; 0% gravel.												2" ID Sch. 40 PVC Blank Casing
	29														
	30				S04A							77			
10	31		As above except dark olive gray (5Y 3/2).												
	32														
	33														
	34														
	35		SANDY ELASTIC SILT (MH); very soft; very dark gray (2.5Y 3/1); moist; 53% medium plasticity, medium dry strength, rapid dilatancy, low toughness fines; 47% fine sand; 0% gravel.												
5	36		As above except wet.		S04B							53	HD		
	37														
	38							0.1P							
	39		ELASTIC SILT (MH); very soft; very dark gray (2.5Y 3/1); wet; 90% medium plasticity, medium dry strength, rapid dilatancy, low toughness fines; 10% fine sand; 0% gravel.		Box4										
	40							0.1P							
0	41		Poorly Graded SAND with Silt (SP-SM); greenish black (5G 2.5/1); wet; 90% fine to medium sand; 10% low plasticity fines; 0% gravel.												
	42														
	43				S04C										
	44														
	45														

Final Report Version 5/21/2010

Borehole Location: South Bank Crest **County:** Sacramento
Coordinates: Northing: 1,981,351.55 **Easting:** 6,706,270.57
Latitude: 38.60170 **Longitude:** -121.49400
Levee Station or Milepost: 1044+59 **Levee Mile:** 0.88
Levee Segment
Survey Method: GIS/LiDAR **Coord. System:** CA State Plane Zone II
Channel / River Name / Feature: American River

LOG OF BORING
WCSBAR_002M
Sheet 2 of 5

Urban Levee Geotechnical Evaluations Program
Engineering Support Services

DWR LEVEE U/NU SOIL + PIEZ LOG REV1; AMERICAN RIVER LEVEE BORINGS 6-16-2010.GPJ; DWR OFFICIAL LIBRARY 032210.GLB; 6/16/10

Elevation, feet	Depth, feet	Material Graphics	CLASSIFICATION OF MATERIALS (Description)	Sample Location	Sample Number	Blows per 6 in. [Blows per ft]	N_{60} (ASTM)	PP or TV, tsf	LABORATORY DATA: Water Content, %	LABORATORY DATA: Liquid Limit	LABORATORY DATA: Plasticity Index	LABORATORY DATA: Fines, % < #200	LABORATORY DATA: Other Lab Tests	Piezometer Installation Schematic	REMARKS AND PIEZOMETER INSTALLATION NOTES
	45		Poorly Graded SAND with Silt (SP-SM); as above.		Box5										
-5	46														
	47														
	48														
	49														
	50				S05A										Transition Seal (3/8" Bentonite Chips)
-10	51														
	52														
	53		As above except dark olive gray (5Y 3/2); 94% fine to medium, predominantly medium sand; 6% fines.												
	54														
	55				S05B							6			Filter Pack (RMC Pacific Monterey #3 [8x20])
-15	56				Box6										
	57														
	58														
	59														
	60				S05C										
-20	61														
	62														2" ID Sch. 40 PVC Screen (0.020" slot)
	63														
	64		Poorly Graded GRAVEL (GP); greenish black (10GY 2.5/1); wet; 86% fine to coarse, subrounded to rounded gravel, max. 3 in.; 11% fine to medium sand; 3% fines.		Box7										
	65		As above except increasing gravel; decreasing sand.		S05D							3			
-25	66														
	67														2" ID Sch. 40 PVC End Cap
	68		Poorly Graded SAND with Silt (SP-SM); greenish black (5G 2.5/1); wet; 94% fine to medium, subrounded to rounded sand; 6% fines; 0% gravel.		S06A							6			
	69														
	70														

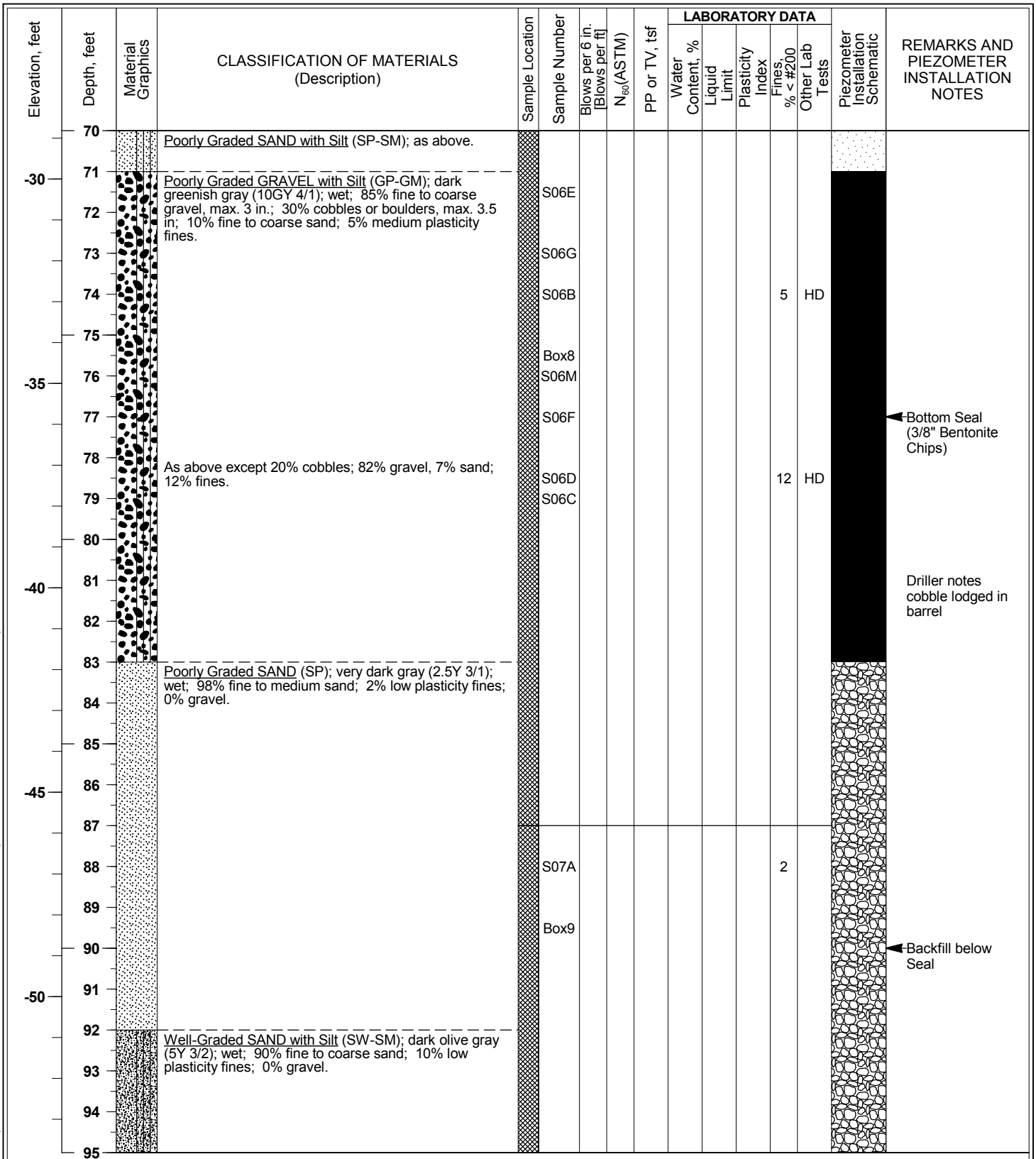
Final Report Version 5/21/2010

Borehole Location: South Bank Crest **County:** Sacramento
Coordinates: Northing: 1,981,351.55 **Easting:** 6,706,270.57
Latitude: 38.60170 **Longitude:** -121.49400
Levee Station or Milepost: 1044+59 **Levee Mile:** 0.88
Levee Segment
Survey Method: GIS/LiDAR **Coord. System:** CA State Plane Zone II
Channel / River Name / Feature: American River

LOG OF BORING
WCSBAR_002M
Sheet 3 of 5

Urban Levee Geotechnical Evaluations Program
Engineering Support Services

DWR LEVEE U/NU SOIL + PIEZ LOG REV1; AMERICAN RIVER LEVEE BORINGS 6-16-2010.GPJ; DWR OFFICIAL LIBRARY 032210.GLB; 6/16/10



Final Report Version 5/21/2010

Borehole Location: South Bank Crest **County:** Sacramento
Coordinates: **Northing:** 1,981,351.55 **Easting:** 6,706,270.57
Latitude: 38.60170 **Longitude:** -121.49400
Levee Station or Milepost: 1044+59 **Levee Mile:** 0.88
Levee Segment
Survey Method: GIS/LiDAR **Coord. System:** CA State Plane Zone II
Channel / River Name / Feature: American River

LOG OF BORING
WCSBAR_002M
Sheet 4 of 5

Urban Levee Geotechnical Evaluations Program
Engineering Support Services

DWR LEVEE U/NU SOIL + PIEZ LOG REV1; AMERICAN RIVER LEVEE BORINGS 6-16-2010.GPJ; DWR OFFICIAL LIBRARY 032210.GLB; 6/16/10

Elevation, feet	Depth, feet	Material Graphics	CLASSIFICATION OF MATERIALS (Description)	Sample Location	Sample Number	Blows per 6 in. (Blows per ft)	N_{60}(ASTM)	PP or TV, tsf	LABORATORY DATA: Water Content, %	LABORATORY DATA: Liquid Limit	LABORATORY DATA: Plasticity Index	LABORATORY DATA: Fines, % < #200	LABORATORY DATA: Other Lab Tests	Piezometer Installation Schematic	REMARKS AND PIEZOMETER INSTALLATION NOTES
	95		LEAN CLAY (CL); yellowish brown (10YR 5/4); moist; 90% medium plasticity, medium toughness fines; 10% fine to medium sand; 0% gravel.												
-55	96														
	97														
	98		Borehole terminated at 97 feet.												
	99														
	100														
-60	101														
	102														
	103														
	104														
	105														
-65	106														
	107														
	108														
	109														
	110														
-70	111														
	112														
	113														
	114														
	115														
-75	116														
	117														
	118														
	119														
	120														

Final Report Version 5/21/2010

Borehole Location: South Bank Crest **County:** Sacramento
Coordinates: **Northing:** 1,981,351.55 **Easting:** 6,706,270.57
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LOG OF BORING
WCSBAR_002M
Sheet 5 of 5

Urban Levee Geotechnical Evaluations Program
Engineering Support Services

DWR LEVEE U/NU SOIL + PIEZ LOG REV1; AMERICAN RIVER LEVEE BORINGS 6-16-2010.GPJ; DWR OFFICIAL LIBRARY 032210.GLB; 6/16/10

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DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
3	SAC				

17-Jul-24
GEOTECHNICAL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER RONALD ERIC LOUTZENHISER NO. 2865 CIVIL STATE OF CALIFORNIA

PROJECT NAME

LOG OF TEST BORINGS 1 OF 5

As-Built Vertical Datum: Unknown | Datum Conversion: Unknown

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

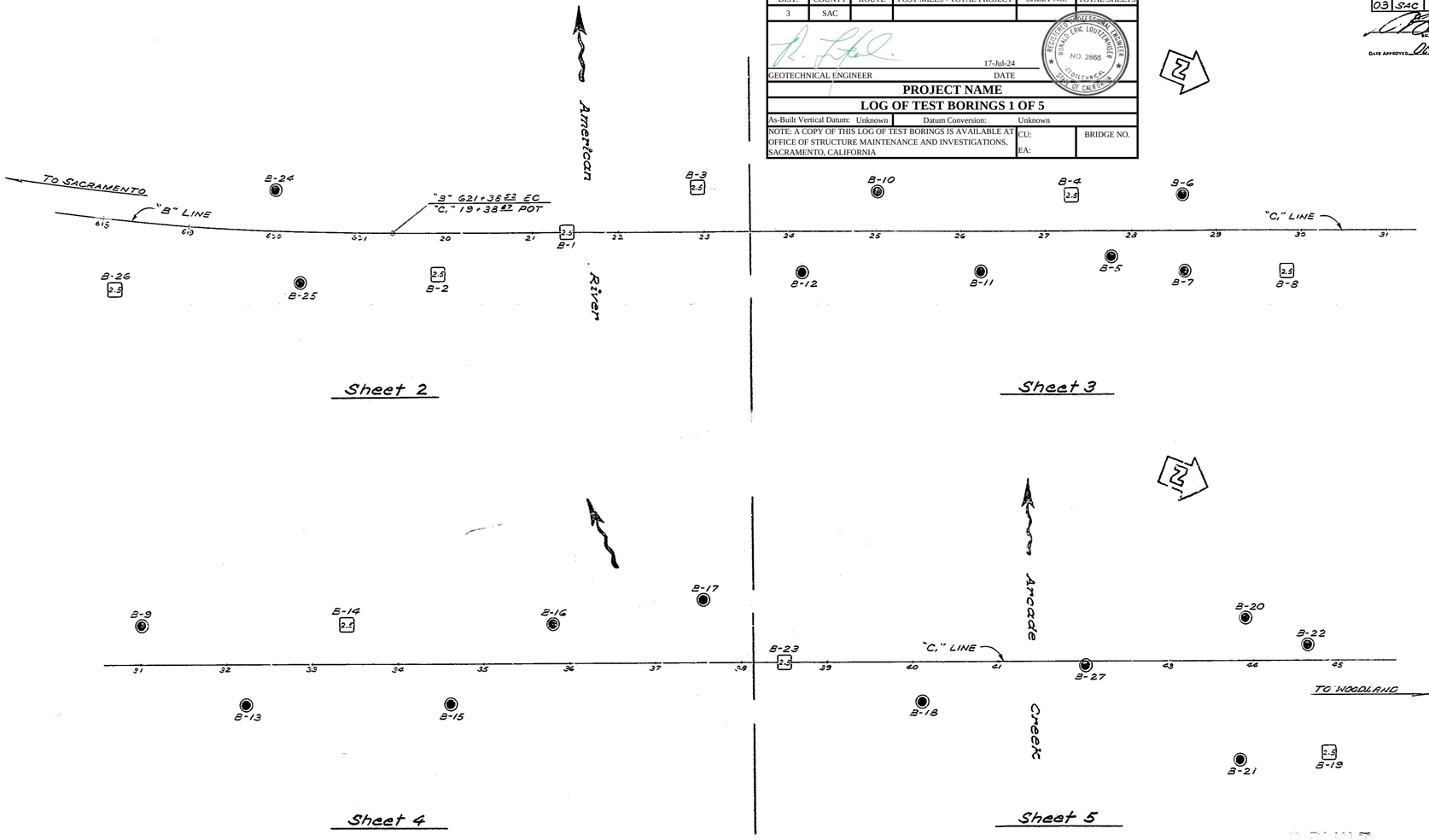
CU:
EA:
BRIDGE NO.

FED. ROAD DIV. NO.	STATE	F. A. PROJECT No.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
03	SAC	5	24/25.8	175	119

BEFORE ENGINEER (CIVIL) SACRAMENTO — LICENSE 5963

DATE APPROVED: October 25, 1965



BM "MON G-49"
T-bar & cap 15'± deep, set in concrete 445'± E of SE corner abutment of Jibboom Street Bridge.
Elev. 37.42

BM "MON G-51"
T-bar & cap 537.93' Rt "C," 43+50.32 POT
Elev. 36.56

AS BUILT PLANS
Contract No. 14-061744
Date Completed 3-68
Document No. 30000057

LEGEND OF BORING OPERATIONS

- Piezometer
- 2½" Core Penetrometer
- Sampler Boring (Cal)
- Rotary Boring (Cal)
- Auger Boring (Cal)
- Jet Boring
- Core Boring
- Test Pit
- Penetration Boring
- Rotary Boring
- 1" Soil Tube

LEGEND OF EARTH MATERIALS

Gravel	Silty Clay or Clayey Silt	Peat, Humus or Organic Matter	Fill Material
Sand	Silt	Clay	Igneous Rock
Sedimentary Rock	Silty Clay or Clayey Sand	Sandy Silt or Silty Sand	Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Diagram shown the base for estimated percentage of grade size distribution used in determining the classification of soils. If gravel is present in appreciable amounts the term "gravelly" may be added to the basic classification. The terms "coarse," "medium" and "fine" may be used to describe sand, silt and gravel. Refer to grade size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	W. R. Hoar 7-64
DRAWN	W. K. Endow 10-8-64
CHECKED	W. R. Hoar 10-9-64

Approved Recommended for Approval: Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

175

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SHEET 1 OF 93 97

AMERICAN RIVER BRIDGE

LOG OF TEST BORINGS NO.1

SCALE 1"=60' | BRIDGE 24-63 R/L | FILE | DRAWING 2468-2

Disregard prints bearing earlier numbers → PREL. DRAWING No. PR-

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
03	SAC	5	24½/25.8	176	179

BRIDGE ENGINEER — CIVIL ENGINEER—LATHE 1563

DATE APPROVED: October 25, 1965

LEGEND OF BORING OPERATIONS

Penetrometer
22½° Cone Penetrometer
Sampler Boring (Dry)
Rotary Boring (Wet)
Auger Boring (Dry)
Jet Boring
Cone Boring
Test Pit

1" Soil Tube

Penetration Boring

Rock Core Boring

LEGEND OF EARTH MATERIALS

Gravel — Silty Clay or Clayey Silt
Sand — Peat and Organic Matter
Silt — Fill Material
Clay — Igneous Rock
Sandy Clay or Silty Clay — Sedimentary Rock
Sandy Silt or Silty Sand — Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRAIN SIZE LIMITS

Diagram showing the size ranges for gravel, sand, silt and clay. Boundaries between these classes are defined on the basis of grain diameter in millimeters. Particles larger than the term "gravel" may be added to the class name, viz. "coarse," "medium" and "fine." Particles smaller than the term "clay" may be added to the class name, viz. "colloidal." Where used, the following terms refer to standard grain size limits.

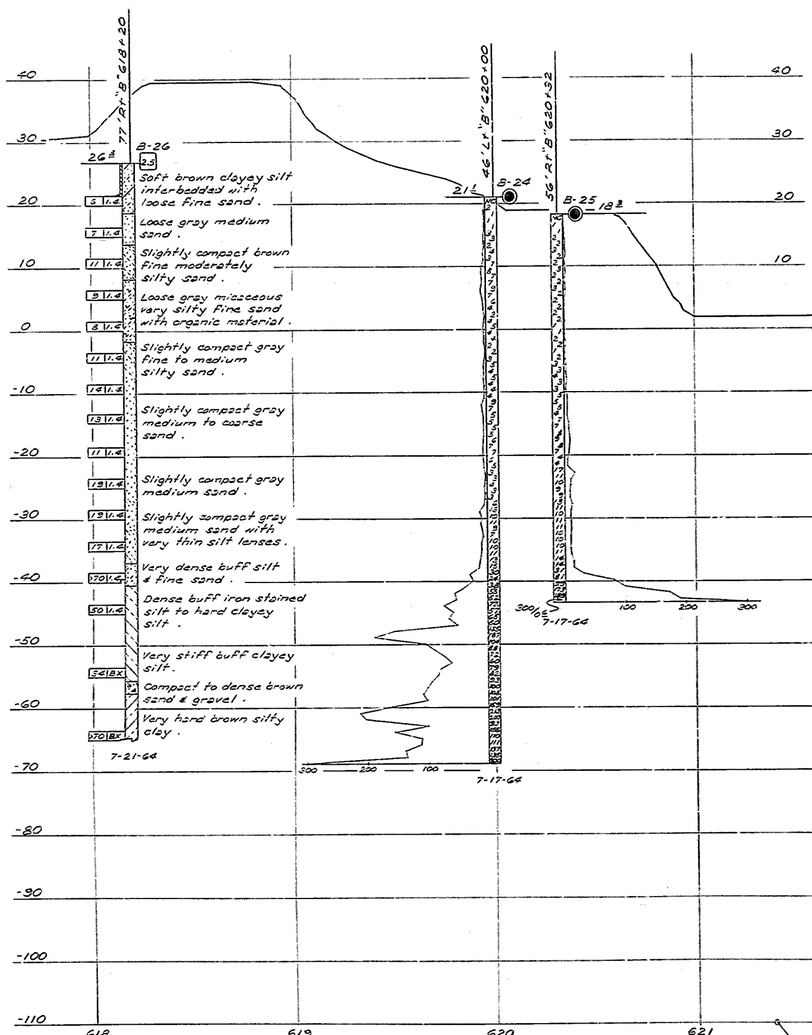
NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

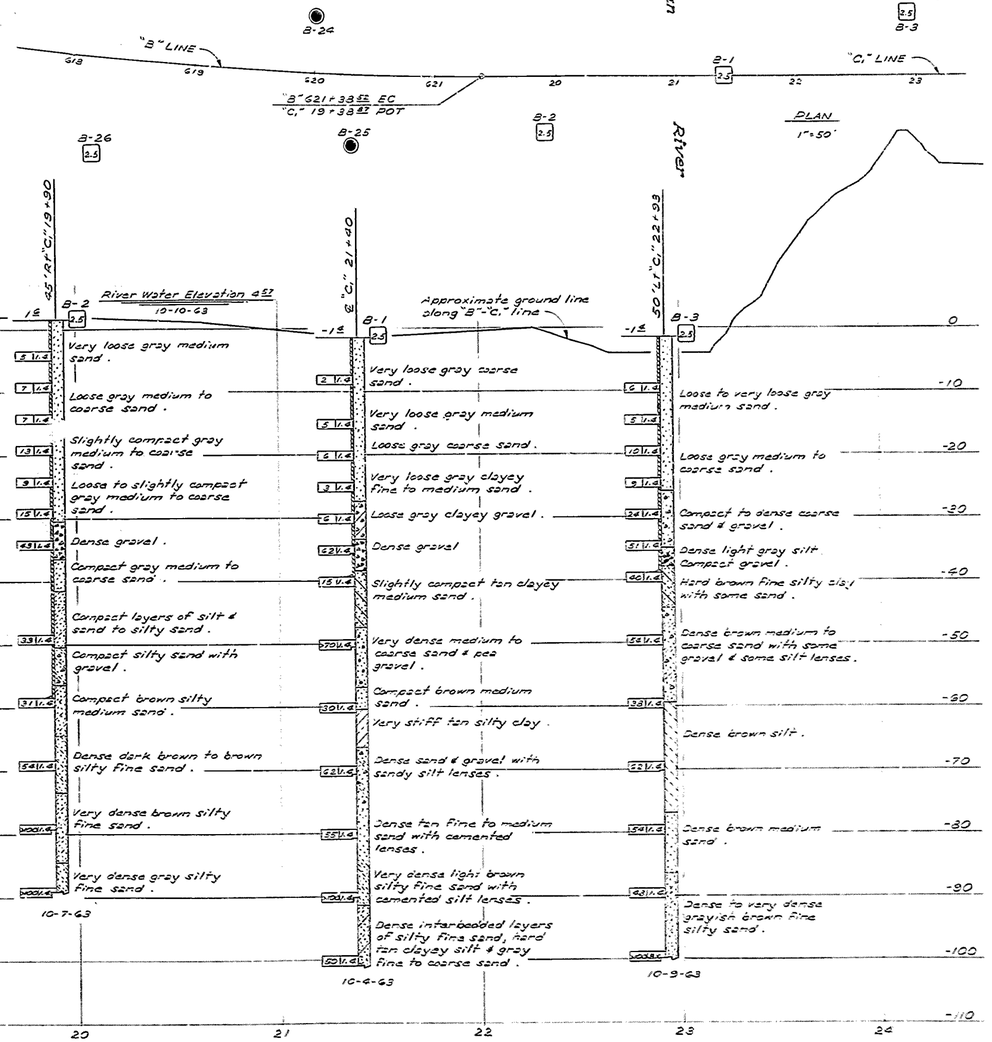
FIELD STUDY	by R. Hagar 3-64
DRAWN	by R. Hagar 10-25-64
CHECKED	by R. Hagar 10-25-64

Approved/Recommended by: [signature] Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

176





American River

PLAN
1"=50'

"B"-621+38.52 EC
"C" 19+38.52 POT

PROFILE
VERT. 1"=10'
HORIZ. 1"=30'

AS BUILT PLANS
Contract No. 14-061794
Date Completed 3-68
Document No. 3000007

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. It does not attest to the accuracy or validity of the information contained in the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
3	SAC				

[signature] 17-Jul-24
GEOTECHNICAL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER RONALD ERIC LOUTZENHISER NO. 2865 CIVIL ENGINEER STATE OF CALIFORNIA

PROJECT NAME
LOG OF TEST BORINGS 2 OF 5

As-Built Vertical Datum: Unknown | Datum Conversion: Unknown

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: EA: | BRIDGE NO.

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
SHEET 1 OF 94 97

AMERICAN RIVER BRIDGE

LOG OF TEST BORINGS NO. 2

SCALE AS NOTED | BRIDGE 24-63 R/L | FILE | DRAWING 2459-3

Disregard prints bearing earlier numbers → PREL. DRAWING No. PR-.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

FED. ROAD DIV. NO.	STATE	F. A. PROJECT No.	SHEET No.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	LOG-TR	SECTION	SHEET No.	TOTAL SHEETS
03	SAC	5	20 8/28	177	179

BRIDGE ENGINEER — CIVIL ENGINEER—LOCATION STUDY

DATE APPROVED: October 25, 1965

AS BUILT PLANS
Contract No. 14-061744
Date Completed 3-68
Document No. 30000057

LEGEND OF BORING OPERATIONS

PENETROMETER
2½" CORE PENETROMETER
SAMPLER BORING (DRY)
ROTARY BORING (DRY)
AUGER BORING (DRY)
JET BORING
CORE BORING
TEST PIT

Top Hole El. 8.48 — Ground surface — Bottom of boring — Log of boring — Description of material — Graphic representation of soil drilling rate — Water surface — Pulled casing — Sample taken — Undisturbed sample (U.D.S.) — Standard penetration test (S.P.T.) — Undisturbed material change — Uncontrolled material change — Driven casing — Sheet piling — Rock core — Rock bolt

ROTARY BORING
1" SOIL TUBE

LEGEND OF EARTH MATERIALS

Gravel — Silty Clay or Clayey Silt — Sandy Clay or Clayey Sand — Sandy Silt or Silty Sand
Sand — Peat, Muck, Organic Matter
Silt — Fill Material
Clay — Igneous Rock — Sedimentary Rock — Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Diagram showing the basis for estimates of grain size distribution used in determining the classification of soils.
If sand is present in appreciable quantities, the classification is governed by the clay sand, viz. "gravelly sand." The terms "gravelly" and "silty" are used to describe sand, gravel or cobbles when they fall within the standard grade size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	by R. Yager 7-64
DRAWN	by K. Erdow 10-1-64
CHECKED	by R. Hayashi 10-9-64

Approved Recommended [signature] Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

177

B-10 B-4 B-6 B-12 B-11 B-5 B-7 B-8

"C" LINE

PLAN
1"=50'

PROFILE
VERT. 1"=10'
HORIZ. 1"=30'

Approximate ground line along "C" line

Loose brown & grayish brown silty fine sand - some mica.
Very soft blue gray clay & silty sand - interbedded.
Very soft gray clayey micaceous silt to dark gray silt with layers of organic matter.
Very soft gray silty clay, clayey silt & clay.
Very loose dark gray fine sandy silt - organic
Very loose to loose dark gray micaceous silt with some organic matter.
Soft dark gray clayey silt interbedded with medium sand. Compact brown sand.
Loose gray silt.
Very dense blue-gray fine to medium sand, gravel & cobbles.
Very stiff blue - tan clayey silty clay to gray silty clay to clayey silt.
Dense brown fine silty sand.
Very dense brown fine silty sand with some scattered small gravel.
Dense buff fine silty sand interbedded with hard silty clay.
Soft brown silty clay.
Very soft to soft brown silty clay.
Stiff brown clayey silt.
Very loose brown silt.
Very soft brown clayey silt.
Very dense gray fine & coarse sand, gravel & cobbles - some clay binder.
Very dense brown sand, gravel & cobbles.
Dense brown fine silty sand.
Dense brown interbedded silt & fine sand.

GWS EL. 65 6-11-64
GWS EL. 23 6-10-64
GWS EL. 158 6-8-64
GWS EL. 58 6-10-64

G-11-64 G-10-64 G-10-64 G-8-64 G-5-64 G-4-64 G-4-64 G-8-64

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. It does not attest to the accuracy or validity of the information contained in the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
3	SAC				

17-Jul-24
GEOTECHNICAL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — RONALD ERIC LOUVENGER — NO. 2865 — CIVIL — STATE OF CALIFORNIA

PROJECT NAME

LOG OF TEST BORINGS 3 OF 5

As-Built Vertical Datum: Unknown | Datum Conversion: Unknown

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: EA: | BRIDGE NO.

AS BUILT
REGISTERED PROFESSIONAL ENGINEER
SIGNATURE
DATE

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
SHEET 93 OF 97

AMERICAN RIVER BRIDGE

LOG OF TEST BORINGS NO.3

SCALE AS Noted | BRIDGE 24-68 ½ | FILE | DRAWING 2703-4

Disregard prints bearing earlier numbers → PREL. DRAWING No. PR-.

FED. ROAD DIV. NO.	STATE	F. A. PROJECT No.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
03	SAC	5	28A	178	179

DATE APPROVED: October 25, 1965

AS BUILT PLANS
Contract No. 14-061744
Date Completed 3-68
Document No. 30000057

LEGEND OF BORING OPERATIONS

Penetrometer
2½" Core Penetrometer
Sampler Boring (Cal)
Rotary Boring (Wet)
Auger Boring (Dry)
Jet Boring
Core Boring
Test Pit

Penetration Boring
Rotary "C" Boring
1" Soil Tube

LEGEND OF EARTH MATERIALS

Gravel
Sand
Silt
Clay
Silty Clay or Clayey Silt
Peat, Humus or Organic Matter
Fill Material
Igneous Rock
Sandy Clay or Clayey Sand
Sandy Silt or Silty Sand
Sedimentary Rock
Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Diagram showing the basis for estimates of mode size distribution used in determining classifications. If gravel is present in appreciable quantities the term "gravelly" is added to the term describing the finer fraction, viz. "gravelly sand". The terms "sandy" and "silty" are used to describe fine sand, silt and gravel. Refer to Bridge Office Manual for limits.

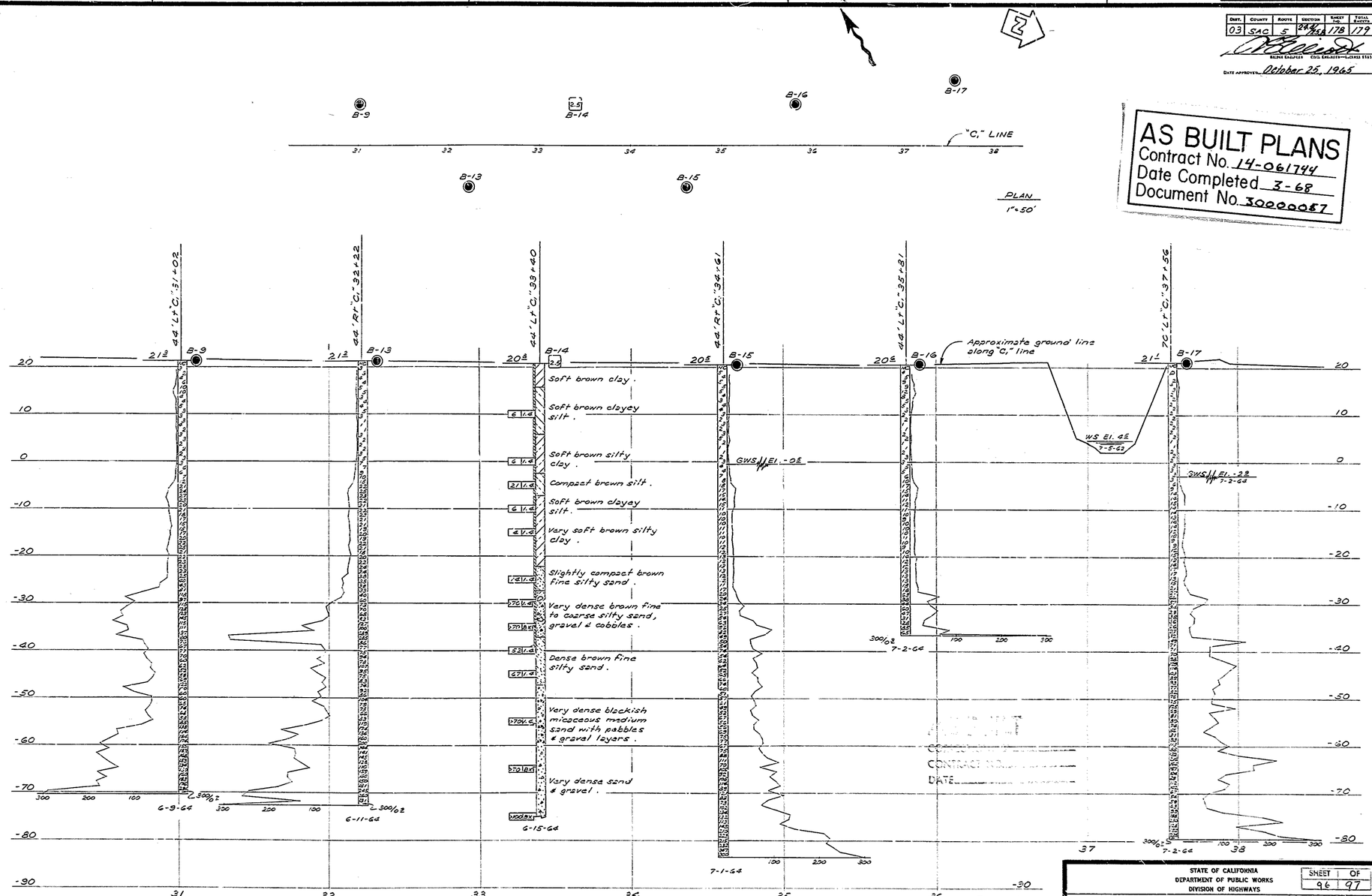
NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	R. Hager 7-64
DRAWN	R.C. Snow 10-21-64
CHECKED	R. Kohaget 10-9-64

Approved Recommended by: [signature] Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

178



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SHEET 96 OF 97

AMERICAN RIVER BRIDGE

LOG OF TEST BORINGS NO. 4

SCALE As Noted | BRIDGE 24-68 R/L | FILE | DRAWING 2459-5

Disregard prints bearing earlier numbers → PREL. DRAWING No. PR-.

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DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
3	SAC				

[signature] 17-Jul-24
GEOTECHNICAL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER ROMALDO ERIC LOUTZENHISER NO. 2865 CIVIL STATE OF CALIFORNIA

PROJECT NAME

LOG OF TEST BORINGS 4 OF 5

As-Built Vertical Datum: Unknown | Datum Conversion: Unknown

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU:
EA:

BRIDGE NO.

FED. ROAD DIV. NO.	STATE	F. A. PROJECT No.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
03	SAC	5	24.8/25.8	179	179

BRIDGE ENG. R.E. Elliott — CIVIL ENGINEER—LICENSE 5565

DATE AS BUILT: October 25, 1965

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. It does not attest to the accuracy or validity of the information contained in the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
3	SAC				

GEOTECHNICAL ENGINEER — 17-Jul-24 — DATE

REGISTERED PROFESSIONAL ENGINEER — RONALD ERIC LOUTZENHISER — NO. 2865 — GEOTECHNICAL — STATE OF CALIFORNIA

PROJECT NAME

LOG OF TEST BORINGS 5 OF 5

As-Built Vertical Datum: Unknown | Datum Conversion: Unknown

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: EA: | BRIDGE NO.

AS BUILT PLANS
Contract No. 14-061744
Date Completed 3-68
Document No. 30000057

LEGEND OF BORING OPERATIONS

Penetrometer; 2½" Cone Penetrometer; Sampler Boring (SAM); Rotary Boring (ROT); Auger Boring (AUG); Jet Boring; Cone Boring; Test Pit

Penetration Boring — Rotary Boring — 1st Soil Line

LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Silty Clay or Clayey Silt; Peat and/or Organic Matter; Fill Material; Igneous Rock; Sedimentary Rock; Metamorphic Rock; Sandy Clay or Clayey Sand; Sandy Silt or Silty Sand

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

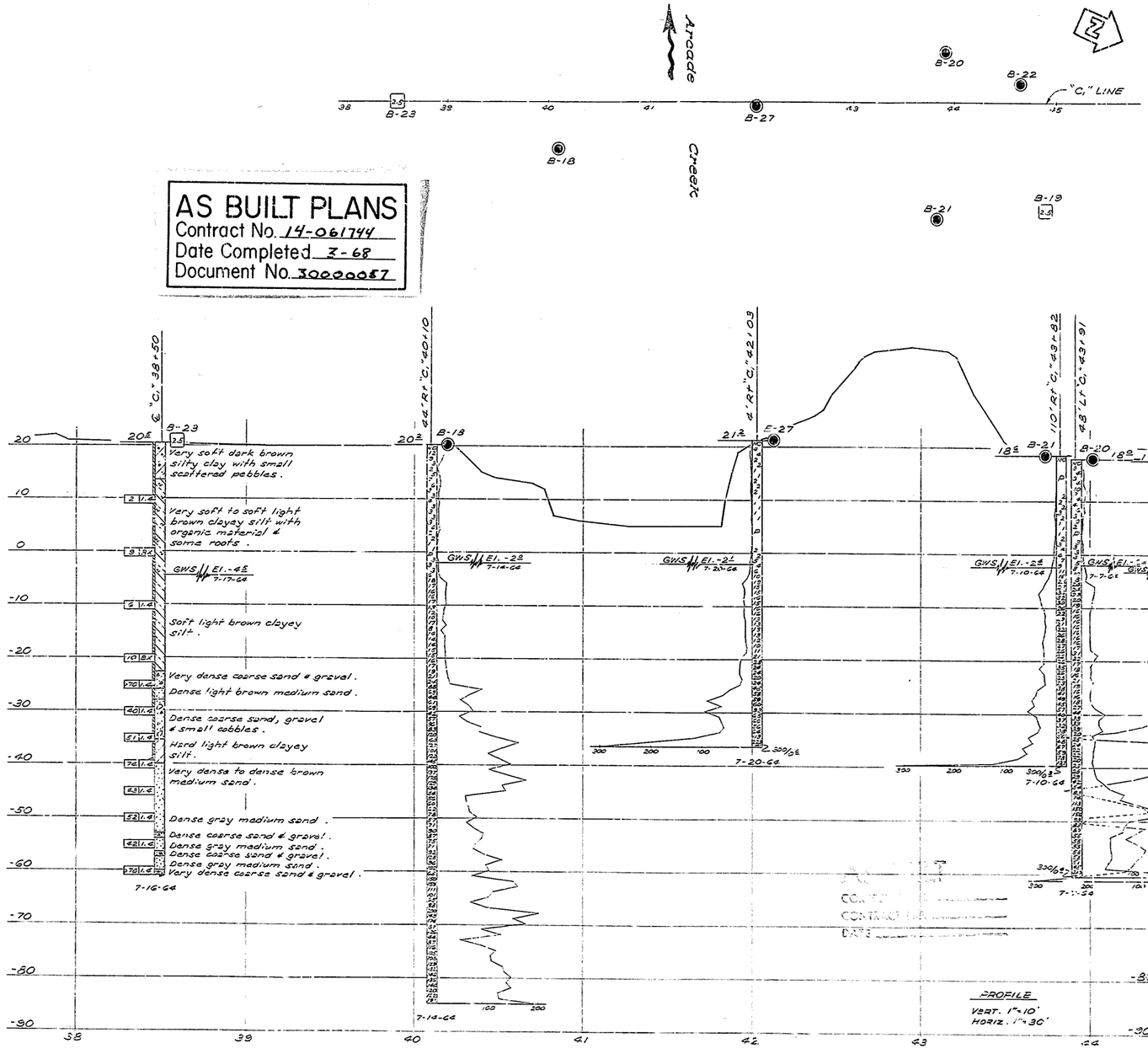
Diagram showing the basis for estimated or grade size distribution used in determining classification of earth materials. If gravel is present in appreciable quantities the terms "gravelly" may be added to the basic classification, i.e. "gravelly sand." The terms "coarse," "medium," and "fine" may be added to "sand," "gravel," "silt and gravel," refer to standard grade size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY by K. Hoover 7-64
DRAWN by K. Engdow 10-21-64
CHECKED by R. Hudson 10-31-64
R.C.E. 16661

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

179



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SHEET | CS
97 | 97

AMERICAN RIVER BRIDGE

LOG OF TEST BORINGS NO. 5

SCALE As Noted | BRIDGE 24-68 R/L | FILE | DRAWING 2468-6

Disregard prints bearing earlier numbers → PREL. DRAWING No. PR-

APPENDIX B

APPENDIX B

ANALYSES AND CALCULATIONS

ARS Online V3.1.0

Using the tool: Specify latitude and longitude in decimal degrees in the input boxes below. Alternatively, **Google Maps** can be used to find the site location. Specify the time-averaged shear-wave velocity in the upper 30m (Vs30) in the input box. After submitting the data, the USGS 2014 hazard data for a 975-year return period will be reported along with adjustment factors required by Caltrans Seismic Design Criteria (SDC) V2.0.

Latitude: 38.6043 **Longitude:** -121.4963 **Vs30 (m/s):** 213 Submit

Caltrans Design Spectrum (5% damping)

Period(s)	Sa_{2014}(g)	$Basin_{2014}$	Near Fault Amp	Design Sa_{2014}(g)
PGA	0.26	1	1	0.26
0.10	0.46	1	1	0.46
0.20	0.67	1	1	0.67
0.30	0.74	1	1	0.74
0.50	0.71	1	1	0.71
0.75	0.57	1	1	0.57
1.0	0.45	1	1	0.45
2.0	0.25	1	1	0.25
3.0	0.16	1	1	0.16
4.0	0.12	1	1	0.12
5.0	0.09	1	1	0.09

Copy table

Deaggregation (based on 2014 hazard)

Mean moment magnitude (for PGA)	6.68
Mean site-source distance, km (for Sa at 1s)	89.1

Option: recalculate Near Fault amplification with user specified distance

Site-source distance, km: 89.1 Update

Liquefaction Analysis

S2815-05-01
B1 (2022, Township 9, no lab)

Project: **S2815-05-01**
Project No.: Truxel Road Bridge at American River
Boring: **B1 (2022, Township 9, no lab)**
By: REL
Date: 6/9/2024

Boring Elevation:	20.0	feet
Groundwater (GW) Depth:	21.0	feet
Groundwater (GW) Elevation:	-1.0	feet
Hammer Energy Ratio (ER_i):	80.0	%
Hammer Weight:	140	pounds
Hammer Drop:	30	inches
Drilling Rod Stick-up:	2	feet

Only fill in/edit shaded boxes.

GW Depth (Design)[1]:	-3.0	feet
Site PGA:	0.26	g
Mean Magnitude (M):	6.68	

Liquefaction Factor of Safety[2]: 1.00

GW Elevation (Design)= 23.0 feet

MSF= 1.34

z = sample depth in meters

r_d = Stress Reduction Coefficient
$(1 - 0.4113*z^{0.5} + 0.04052*z + 0.001753*z^{1.5}) / (1 - 0.4177*z^{0.5} + 0.05729*z - 0.006205*z^{1.5} + 0.001210*z^2)$

CSR = Cyclic Stress Ratio
$0.65\ (PGA)\ (\sigma_{vo} / \sigma'_{vo}) * r_d$

$(N_1)_{60}$ = Field blow counts corrected per Caltrans *Geotechnical Manual, Liquefaction Evaluation* module
Field N * C_E * C_N * C_B * C_R * C_S

Fines Content %	α	β
FC ≤ 5%	0	1.0
5% < FC < 35%	exp[1.76 - (190/FC^2)]	[0.99 + ($FC^{1.5}$ /1,000)]
FC ≥ 35%	5.0	1.2

$(N_1)_{60cs}$ = Clean sand value (modified $(N_1)_{60}$ for fines content)
$\alpha + \beta^*(N_1)_{60}$

$CRR_{7.5}$ = Cyclic Resistance Ratio, for M=7.5 earthquake
$1/[34-(N_1)_{60cs}] + (N_1)_{60c}/135 + 50/[10*(N_{1cs})_{60}+45]^2 - 1/200$

MSF = Magnitude Scaling Factor
$10^{2.24} / M^{2.56}$

Overburden Correction	
D_R	f
$D_R \le 40$	0.8
$40 < D_R < 80$	$1 - 0.005*D_R$
$D_R \ge 80$	0.6

D_R = Relative Density (%)
$100 * [(N_1)_{60cs}/46]^{0.5}$

P_a = Atmospheric pressure (defined)
2.116 ksf

K_σ = Overburden stress correction factor, $K_\sigma \le 1.0$
$(\sigma'_{vo}/P_a)^{(f-1)}$

K_α = Static shear stress correction, requires additional research
1.0 (Recommended value)

FS = Factor of Safety against liquefaction
$(CRR_{7.5}/CSR) * MSF * K_\sigma * K_\alpha$

S_r = Undrained residual shear strength of liquefied soil
$2{,}116*\exp(-8.444 + 0.109*(N_1)_{60} + 5.379*(\sigma'_{vo}/2{,}116)^{0.1})$

References:

Boulanger and Idriss, *Liquefaction Susceptibility Criteria for Silts and Clays* (ASCE JGGE, November 2006)
Caltrans *Geotechnical Manual, Liquefaction Evaluation* module (January 2020)
Caltrans *ARS Online* (https://arsonline.dot.ca.gov/)
Idriss and Boulanger, *Soil Liquefaction During Earthquakes* (2008)
Youd, et al, *Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils* (ASCE JGGE, April 2001)

Data														Screening Checks			Overburden Stresses			CSR[6]		CRR (SPT)					Corrections				Liquefaction Potential?		Residual Shear Strength
Sample Number	Sample Depth (feet)	Depth to Bottom of Layer (feet)	Top of Layer Elevation (feet)	Sample Elevation (feet)	Bottom of Layer Elevation (feet)	Layer Thickness (feet)	Soil Type (USCS)	Field N	Total Unit Weight (pcf)	Average Grain Size, D50 (mm)	Percent Fines (-#200) (%)	Liquid Limit LL	Plasticity Index PI	"Clay-Like" Soil?[3]	Rock?[4]	Soil Above GW?[5]	Total Stress at Layer Midpoint (psf)	Effective Stress (at Time of Drilling) σ'_{vo} (psf)	Effective Stress (Design) σ'_{vo} (psf)	r_d	CSR	$(N1)_{60}$ (Caltrans, for liq. analysis)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$[7]	D_R (%)	f	K_σ	K_α	FS	FS ≤ 1.07[8]	S_r (psf)
5	5	9.9	20	15	10.1	9.9	SM	6	115.0								569	569	263	0.990	0.36	4	5.00	1.20	10	0.12	47.3	1	1.00	1.00	0.43	LIQ	58
10	10	14.9	10.1	10	5.1	5	ML	7	120.0								1,439	1,439	667	0.979	0.36	6	5.00	1.20	12	0.14	52.0	0.74	1.00	1.00	0.51	LIQ	108
15	15	21	5.1	5	-1	6.1	SP	12	115.0								2,089	2,089	972	0.969	0.35	6	5.00	1.20	12	0.13	51.2	0.74	1.00	1.00	0.50	LIQ	125
21.1	21.1	23	-1	-1.1	-3	2	SP	15	120.0								2,560	2,498	1,190	0.954	0.35	8	5.00	1.20	14	0.15	55.2	0.72	1.00	1.00	0.58	LIQ	166
25	25	28	-3	-5	-8	5	SP	15	120.0								2,980	2,699	1,391	0.942	0.34	7	5.00	1.20	13	0.14	53.7	0.73	1.00	1.00	0.56	LIQ	168
30	30	33	-8	-10	-13	5	SP	21	120.0								3,580	2,987	1,679	0.921	0.33	9	5.00	1.20	16	0.17	59.0	0.71	1.00	1.00	0.69	LIQ	237
35	35	38	-13	-15	-18	5	SP	19	120.0								4,180	3,275	1,967	0.891	0.32	8	5.00	1.20	15	0.16	57.1	0.71	1.00	1.00	0.67	LIQ	236
40	40	43	-18	-20	-23	5	SP	27	125.0								4,793	3,576	2,268	0.851	0.30	11	5.00	1.20	19	0.20	63.6	0.68	0.98	1.00	0.86	LIQ	353
45	45	83	-23	-25	-63	40	GP	63	130.0								7,705	5,084	3,776	0.804	0.28	22	5.00	1.20	32	NL							
85	85	89.9	-63	-65	-69.9	6.9	SM	81	130.0								10,754	6,669	5,362			25											
90	90	94.9	-69.9	-70	-74.9	5	SP	50	130.0								11,527	7,072	5,764			36											
95	95	99.9	-74.9	-75	-79.9	5	CL-ML	99	130.0								12,177	7,410	6,102			71											
100	100	104.9	-79.9	-80	-84.9	5	ML	118	130.0								12,827	7,748	6,440			53											
105	105	109.9	-84.9	-85	-89.9	5	SP	150	130.0								13,477	8,086	6,778			42											
110	110	111.5	-89.9	-90	-91.5	1.6	SM	68	130.0								13,906	8,309	7,001			46											

NOTES:

1. Design groundwater depth for liquefaction should be the measured (or an average) groundwater elevation. Per Caltrans, "use a higher elevation than measured only if there is clear evidence for seasonal or long-term fluctuations."
2. Per Caltrans, "use a factor of safety against liquefaction of 1.0"
3. Per Caltrans, "use Boulanger and Idriss (2006) to determine if fine-grained soils are likely to behave as sand-like material and thus should be considered as susceptible to liquefaction." (PI < 7, or PI < 5 if the LL < 27)
4. Per Caltrans, rock is not considered to be liquefiable.
5. Soils above design groundwater elevation are not considered saturated and therefore are non-liquefiable.
6. Per Caltrans, liquefaction analysis using this method is limited to a maximum depth of 70 feet (depth cutoff implemented in these calculations); use with caution below a depth of 50 feet.
7. NL = non-liquefiable. Per Caltrans, "for $(N_1)_{60cs} \ge 30$, clean granular soils are too dense to liquefy and are classified as non-liquefiable."
8. **LIQ** = potentially liquefiable (Factor of Safety is less than or equal to 1.0 for liquefaction in sand-like materials).

Liquefaction Settlement Analysis

S2815-05-01
B1 (2022, Township 9, no lab)

Project: **S2815-05-01**
Project No.: Truxel Road Bridge at American River
Boring: **B1 (2022, Township 9, no lab)**
By: REL
Date: 6/9/2024

Boring Elevation:	20.0	feet	GW Depth (Design):	-3.0	feet
Groundwater (GW) Depth:	21.0	feet	Site PGA:	0.26	g
Groundwater (GW) Elevation:	-1.0	feet	Mean Magnitude (M):	6.68	
Hammer Energy Ratio (ER_i):	80.0	%			
Hammer Weight:	140	pounds	Liquefaction Factor of Safety:	1.00	
Hammer Drop:	30	inches			
Drilling Rod Stick-up:	2	feet	GW Elevation (Design)=	23.0	feet
			MSF=	1.34	

$N1_{60}$ = Blow counts corrected for sampler size, hammer efficiency, and overburden pressure (per AASHTO)
CSR = Cyclic Stress Ratio (Youd, 2001)
$0.65\ (PGA)\ (\sigma_{vo} / \sigma'_{vo}) * r_d$
MSF = Magnitude Scaling Factor (Youd, 2001)
$10^{2.24} / M^{2.56}$
$CSR_{7.5}$ = Cyclic Resistance Ratio, for M=7.5 earthquake (Lee, 2007)
$CSR_{7.5} / MSF$
ε_v = Volumetric strain due to soil liquefaction, for $CSR_{7.5} / N1_{60} > 0.01$
$10 * (N1_{60})^{-0.6}$

References:

Caltrans *Geotechnical Manual, Liquefaction Evaluation* module (January 2020)
Caltrans *Geotechnical Manual, Liquefaction Induced Downdrag* module (January 2020)
Lee, *Earthquake-Induced Settlements in Saturated Sandy Soils* (ARPN Journal of Engineering and Applied Sciences (August 2007) - based on Tokimatsu and Seed (1987)
Youd, et al, *Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils* (ASCE JGGE, April 2001)

Data[1]												Calculation			
Sample Number	Sample Depth (feet)	Depth to Bottom of Layer (feet)	Top of Layer Elevation (feet)	Sample Elevation (feet)	Bottom of Layer Elevation (feet)	Layer Thickness (feet)	Soil Type (USCS)	Field N	$N1_{60}$ (AASHTO)	Liq. FS ≤ 1.0[2]	CSR	$CSR_{7.5}$	$CSR_{7.5} / N1_{60}$	ε_v (%)	Liquefaction Settlement (feet)
5	5	9.9	20	15	10.1	9.9	SM	6	5	LIQ	0.36	0.27	0.058	4.0	0.39
10	10	14.9	10.1	10	5.1	5	ML	7	7	LIQ	0.36	0.27	0.039	3.2	0.16
15	15	21	5.1	5	-1	6.1	SP	12	6	LIQ	0.35	0.26	0.040	3.3	0.20
21.1	21.1	23	-1	-1.1	-3	2	SP	15	8	LIQ	0.35	0.26	0.034	3.0	0.06
25	25	28	-3	-5	-8	5	SP	15	7	LIQ	0.34	0.25	0.034	3.0	0.15
30	30	33	-8	-10	-13	5	SP	21	10	LIQ	0.33	0.25	0.025	2.5	0.13
35	35	38	-13	-15	-18	5	SP	19	9	LIQ	0.32	0.24	0.027	2.7	0.14
40	40	43	-18	-20	-23	5	SP	27	12	LIQ	0.30	0.23	0.019	2.3	0.11
45	45	83	-23	-25	-63	40	GP	63	24						
85	85	89.9	-63	-65	-69.9	6.9	SM	81	27						
90	90	94.9	-69.9	-70	-74.9	5	SP	50	39						
95	95	99.9	-74.9	-75	-79.9	5	CL-ML	99	74						
100	100	104.9	-79.9	-80	-84.9	5	ML	118	56						
105	105	109.9	-84.9	-85	-89.9	5	SP	150	44						
110	110	111.5	-89.9	-90	-91.5	1.6	SM	68	48						

NOTES:
1 Detailed $N1_{60}$ calculation and liquefaction analysis are performed on separate spreadsheet tabs. A summary of pertinent results is presented here.
2 **LIQ** = potentially liquefiable (Factor of Safety is less than or equal to 1.0 for liquefaction in sand-like materials).

Total:	**1.34**	**feet**
	16.0	**inches**

Liquefaction Analysis

S2815-05-01
B2 (2022, Township 9, no lab)

Project: **S2815-05-01**
Project No.: Truxel Road Bridge at American River
Boring: **B2 (2022, Township 9, no lab)**
By: REL
Date: 6/9/2024

Boring Elevation:	21.0	feet
Groundwater (GW) Depth:	22.0	feet
Groundwater (GW) Elevation:	-1.0	feet
Hammer Energy Ratio (ER_i):	80.0	%
Hammer Weight:	140	pounds
Hammer Drop:	30	inches
Drilling Rod Stick-up:	2	feet

Only fill in/edit shaded boxes.

GW Depth (Design)[1]:	-2.0	feet
Site PGA:	0.26	g
Mean Magnitude (M):	6.68	

Liquefaction Factor of Safety[2]: 1.00

GW Elevation (Design)= 23.0 feet

MSF= 1.34

z = sample depth in meters

r_d = Stress Reduction Coefficient
$(1 - 0.4113*z^{0.5} + 0.04052*z + 0.001753*z^{1.5}) / (1 - 0.4177*z^{0.5} + 0.05729*z - 0.006205*z^{1.5} + 0.001210*z^2)$

CSR = Cyclic Stress Ratio
$0.65\ (PGA)\ (\sigma_{vo} / \sigma'_{vo}) * r_d$

$(N_1)_{60}$ = Field blow counts corrected per Caltrans *Geotechnical Manual, Liquefaction Evaluation* module
Field N * C_E * C_N * C_B * C_R * C_S

Fines Content %	α	β
FC ≤ 5%	0	1.0
5% < FC < 35%	exp[1.76 - (190/FC^2)]	[0.99 + ($FC^{1.5}$ /1,000)]
FC ≥ 35%	5.0	1.2

$(N_1)_{60cs}$ = Clean sand value (modified $(N_1)_{60}$ for fines content)
$\alpha + \beta^*(N_1)_{60}$

$CRR_{7.5}$ = Cyclic Resistance Ratio, for M=7.5 earthquake
$1/[34-(N_1)_{60cs}] + (N_1)_{60c}/135 + 50/[10*(N_{1cs})_{60}+45]^2 - 1/200$

MSF = Magnitude Scaling Factor
$10^{2.24} / M^{2.56}$

Overburden Correction	
D_R	f
$D_R \le 40$	0.8
$40 < D_R < 80$	$1 - 0.005*D_R$
$D_R \ge 80$	0.6

D_R = Relative Density (%)
$100 * [(N_1)_{60cs}/46]^{0.5}$

P_a = Atmospheric pressure (defined)
2.116 ksf

K_σ = Overburden stress correction factor, $K_\sigma \le 1.0$
$(\sigma'_{vo}/P_a)^{(f-1)}$

K_α = Static shear stress correction, requires additional research
1.0 (Recommended value)

FS = Factor of Safety against liquefaction
$(CRR_{7.5}/CSR) * MSF * K_\sigma * K_\alpha$

S_r = Undrained residual shear strength of liquefied soil
$2{,}116*\exp(-8.444 + 0.109*(N_1)_{60} + 5.379*(\sigma'_{vo}/2{,}116)^{0.1})$

References:

Boulanger and Idriss, *Liquefaction Susceptibility Criteria for Silts and Clays* (ASCE JGGE, November 2006)
Caltrans *Geotechnical Manual, Liquefaction Evaluation* module (January 2020)
Caltrans *ARS Online* (https://arsonline.dot.ca.gov/)
Idriss and Boulanger, *Soil Liquefaction During Earthquakes* (2008)
Youd, et al, *Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils* (ASCE JGGE, April 2001)

Data														Screening Checks			Overburden Stresses			CSR[6]		CRR (SPT)					Corrections				Liquefaction Potential?		Residual Shear Strength
Sample Number	Sample Depth (feet)	Depth to Bottom of Layer (feet)	Top of Layer Elevation (feet)	Sample Elevation (feet)	Bottom of Layer Elevation (feet)	Layer Thickness (feet)	Soil Type (USCS)	Field N	Total Unit Weight (pcf)	Average Grain Size, D50 (mm)	Percent Fines (-#200) (%)	Liquid Limit LL	Plasticity Index PI	"Clay-Like" Soil?[3]	Rock?[4]	Soil Above GW?[5]	Total Stress at Layer Midpoint (psf)	Effective Stress (at Time of Drilling) σ'_{vo} (psf)	Effective Stress (Design) σ'_{vo} (psf)	r_d	CSR	$(N1)_{60}$ (Caltrans, for liq. analysis)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$[7]	D_R (%)	f	K_σ	K_α	FS	FS ≤ 1.07[8]	S_r (psf)
5	5	9.9	21	16	11.1	9.9	ML	9	125.0								619	619	313	0.990	0.33	10	5.00	1.20	18	0.19	61.7	1	1.00	1.00	0.76	LIQ	121
10	10	13	11.1	11	8	3.1	SP	9	110.0								1,408	1,408	697	0.979	0.33	5	5.00	1.20	11	0.12	49.1	0.75	1.00	1.00	0.49	LIQ	97
15	15	18	8	6	3	5	SP	9	110.0								1,854	1,854	889	0.969	0.34	5	5.00	1.20	11	0.12	48.1	0.76	1.00	1.00	0.47	LIQ	105
20	20	22	3	1	-1	4	SP	10	110.0								2,349	2,349	1,104	0.957	0.34	5	5.00	1.20	11	0.12	49.4	0.75	1.00	1.00	0.48	LIQ	124
25	25	28	-1	-4	-7	6	SP	6	115.0								2,914	2,726	1,357	0.942	0.34	7	5.00	1.20	13	0.14	53.2	0.73	1.00	1.00	0.55	LIQ	162
30	30	33	-7	-9	-12	5	SP	2	95.0								3,496	2,966	1,596	0.921	0.34	2	5.00	1.20	8	0.09	40.6	0.80	1.00	1.00	0.36	LIQ	107
35	35	38	-12	-14	-17	5	SP	14	125.0								4,046	3,204	1,834	0.891	0.33	15	5.00	1.20	23	0.26	71.0	0.64	1.00	1.00	1.05		
40	40	43	-17	-19	-22	5	SP	8	120.0								4,659	3,504	2,134	0.851	0.31	8	5.00	1.20	15	0.16	57.0	0.71	1.00	1.00	0.68	LIQ	245
45	45	47	-22	-24	-26	4	SP	9	120.0								5,199	3,763	2,394	0.804	0.29	9	5.00	1.20	16	0.17	58.6	0.71	0.96	1.00	0.74	LIQ	281
50	50	78	-26	-29	-57	31	GP	47	130.0								7,454	4,926	3,557	0.753	0.27	41	5.00	1.20	54	NL							
85	85	86.5	-57	-64	-65.5	8.5	ML	82	130.0								10,021	6,261	4,892			41											

NOTES:
1 Design groundwater depth for liquefaction should be the measured (or an average) groundwater elevation. Per Caltrans, "use a higher elevation than measured only if there is clear evidence for seasonal or long-term fluctuations."
2 Per Caltrans, "use a factor of safety against liquefaction of 1.0"
3 Per Caltrans, "use Boulanger and Idriss (2006) to determine if fine-grained soils are likely to behave as sand-like material and thus should be considered as susceptible to liquefaction." (PI < 7, or PI < 5 if the LL < 27)
4 Per Caltrans, rock is not considered to be liquefiable.
5 Soils above design groundwater elevation are not considered saturated and therefore are non-liquefiable.
6 Per Caltrans, liquefaction analysis using this method is limited to a maximum depth of 70 feet (depth cutoff implemented in these calculations); use with caution below a depth of 50 feet.
7 NL = non-liquefiable. Per Caltrans, "for $(N_1)_{60cs} \ge 30$, clean granular soils are too dense to liquefy and are classified as non-liquefiable."
8 **LIQ** = potentially liquefiable (Factor of Safety is less than or equal to 1.0 for liquefaction in sand-like materials).

Liquefaction Settlement Analysis

S2815-05-01
B2 (2022, Township 9, no lab)

Project: **S2815-05-01**
Project No.: Truxel Road Bridge at American River
Boring: **B2 (2022, Township 9, no lab)**
By: REL
Date: 6/9/2024

Boring Elevation:	21.0	feet	GW Depth (Design):	-2.0	feet
Groundwater (GW) Depth:	22.0	feet	Site PGA:	0.26	g
Groundwater (GW) Elevation:	-1.0	feet	Mean Magnitude (M):	6.68	
Hammer Energy Ratio (ER_i):	80.0	%			
Hammer Weight:	140	pounds	Liquefaction Factor of Safety:	1.00	
Hammer Drop:	30	inches			
Drilling Rod Stick-up:	2	feet	GW Elevation (Design)=	23.0	feet
			MSF=	1.34	

$N1_{60}$ = Blow counts corrected for sampler size, hammer efficiency, and overburden pressure (per AASHTO)
CSR = Cyclic Stress Ratio (Youd, 2001)
$0.65\ (PGA)\ (\sigma_{vo} / \sigma'_{vo}) * r_d$
MSF = Magnitude Scaling Factor (Youd, 2001)
$10^{2.24} / M^{2.56}$
$CSR_{7.5}$ = Cyclic Resistance Ratio, for M=7.5 earthquake (Lee, 2007)
$CSR_{7.5} / MSF$
ε_v = Volumetric strain due to soil liquefaction, for $CSR_{7.5} / N1_{60} > 0.01$
$10 * (N1_{60})^{-0.6}$

References:

Caltrans *Geotechnical Manual, Liquefaction Evaluation* module (January 2020)
Caltrans *Geotechnical Manual, Liquefaction Induced Downdrag* module (January 2020)
Lee, *Earthquake-Induced Settlements in Saturated Sandy Soils* (ARPN Journal of Engineering and Applied Sciences (August 2007) - based on Tokimatsu and Seed (1987)
Youd, et al, *Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils* (ASCE JGGE, April 2001)

Data[1]												Calculation			
Sample Number	Sample Depth (feet)	Depth to Bottom of Layer (feet)	Top of Layer Elevation (feet)	Sample Elevation (feet)	Bottom of Layer Elevation (feet)	Layer Thickness (feet)	Soil Type (USCS)	Field N	$N1_{60}$ (AASHTO)	Liq. FS ≤ 1.0[2]	CSR	$CSR_{7.5}$	$CSR_{7.5} / N1_{60}$	ε_v (%)	Liquefaction Settlement (feet)
5	5	9.9	21	16	11.1	9.9	ML	9	11	LIQ	0.33	0.25	0.023	2.4	0.24
10	10	13	11.1	11	8	3.1	SP	9	6	LIQ	0.33	0.25	0.045	3.6	0.11
15	15	18	8	6	3	5	SP	9	5	LIQ	0.34	0.25	0.050	3.8	0.19
20	20	22	3	1	-1	4	SP	10	5	LIQ	0.34	0.26	0.049	3.7	0.15
25	25	28	-1	-4	-7	6	SP	6	7	LIQ	0.34	0.25	0.035	3.1	0.18
30	30	33	-7	-9	-12	5	SP	2	2	LIQ	0.34	0.25	0.109	6.0	0.30
35	35	38	-12	-14	-17	5	SP	14	16						
40	40	43	-17	-19	-22	5	SP	8	9	LIQ	0.31	0.23	0.027	2.7	0.14
45	45	47	-22	-24	-26	4	SP	9	9	LIQ	0.29	0.22	0.023	2.6	0.10
50	50	78	-26	-29	-57	31	GP	47	44						
85	85	86.5	-57	-64	-65.5	8.5	ML	82	44						

NOTES:
1 Detailed $N1_{60}$ calculation and liquefaction analysis are performed on separate spreadsheet tabs. A summary of pertinent results is presented here.
2 **LIQ** = potentially liquefiable (Factor of Safety is less than or equal to 1.0 for liquefaction in sand-like materials).

Total:	**1.41**	**feet**
	16.9	**inches**

Liquefaction Analysis

Project: S2815-05-01
Project No.: Truxel Road Bridge at American River
Boring: D-1
By: REL
Date: 6/11/2024

Boring Elevation:	15.0	feet
Groundwater (GW) Depth:	20.0	feet
Groundwater (GW) Elevation:	-5.0	feet
Hammer Energy Ratio (ER_i):	60.0	%
Hammer Weight:	140	pounds
Hammer Drop:	30	inches
Drilling Rod Stick-up:	2	feet

Only fill in/edit shaded boxes.

GW Depth (Design)[1]:	-8.0	feet
Site PGA:	0.26	g
Mean Magnitude (M):	6.68	

Liquefaction Factor of Safety[2]: 1.00

GW Elevation (Design)= 23.0 feet

MSF= 1.34

z = sample depth in meters
r_d = Stress Reduction Coefficient
$(1 - 0.4113*z^{0.5} + 0.04052*z + 0.001753*z^{1.5}) / (1 - 0.4177*z^{0.5} + 0.05729*z - 0.006205*z^{1.5} + 0.001210*z^2)$
CSR = Cyclic Stress Ratio
$0.65\ (PGA)\ (\sigma_{vo} / \sigma'_{vo}) * r_d$
$(N_1)_{60}$ = Field blow counts corrected per Caltrans *Geotechnical Manual, Liquefaction Evaluation* module
Field N * C_E * C_N * C_B * C_R * C_S

Fines Content %	α	β
FC ≤ 5%	0	1.0
5% < FC < 35%	exp[1.76 - (190/FC^2)]	[0.99 + ($FC^{1.5}$ /1,000)]
FC ≥ 35%	5.0	1.2

$(N_1)_{60cs}$ = Clean sand value (modified $(N_1)_{60}$ for fines content)
$\alpha + \beta*(N_1)_{60}$
$CRR_{7.5}$ = Cyclic Resistance Ratio, for M=7.5 earthquake
$1/[34-(N_1)_{60cs}] + (N_1)_{60c}/135 + 50/[10*(N_{1cs})_{60}+45]^2 - 1/200$
MSF = Magnitude Scaling Factor
$10^{2.24} / M^{2.56}$

Overburden Correction	
D_R	f
D_R ≤ 40	0.8
40 < D_R < 80	1 - 0.005*D_R
D_R ≥ 80	0.6

D_R = Relative Density (%)
$100 * [(N_1)_{60cs}/46]^{0.5}$
P_a = Atmospheric pressure (defined)
2.116 ksf

K_σ = Overburden stress correction factor, $K_\sigma \le 1.0$
$(\sigma'_{vo}/P_a)^{(f-1)}$
K_α = Static shear stress correction, requires additional research
1.0 (Recommended value)
FS = Factor of Safety against liquefaction
$(CRR_{7.5}/CSR) * MSF * K_\sigma * K_\alpha$

S_r = Undrained residual shear strength of liquefied soil
$2{,}116*\exp(-8.444 + 0.109*(N_1)_{60} + 5.379*(\sigma'_{vo}/2{,}116)^{0.1})$

References:
Boulanger and Idriss, *Liquefaction Susceptibility Criteria for Silts and Clays* (ASCE JGGE, November 2006)
Caltrans *Geotechnical Manual, Liquefaction Evaluation* module (January 2020)
Caltrans *ARS Online* (https://arsonline.dot.ca.gov/)
Idriss and Boulanger, *Soil Liquefaction During Earthquakes* (2008)
Youd, et al, *Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils* (ASCE JGGE, April 2001)

Data														Screening Checks			Overburden Stresses			CSR[6]		CRR (SPT)					Corrections					Liquefaction Potential?		Residual Shear Strength
Sample Number	Sample Depth (feet)	Depth to Bottom of Layer (feet)	Top of Layer Elevation (feet)	Sample Elevation (feet)	Bottom of Layer Elevation (feet)	Layer Thickness (feet)	Soil Type (USCS)	Field N	Total Unit Weight (pcf)	Average Grain Size, D50 (mm)	Percent Fines (-#200) (%)	Liquid Limit LL	Plasticity Index PI	"Clay-Like" Soil?[3]	Rock?[4]	Soil Above GW?[5]	Total Stress at Layer Midpoint (psf)	Effective Stress (at Time of Drilling) σ'_{vo} (psf)	Effective Stress (Design) σ'_{vo} (psf)	r_d	CSR	$(N1)_{60}$ (Caltrans, for liq. analysis)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$[7]	D_R (%)	f	K_σ	K_α	FS	FS ≤ 1.07[8]	S_r (psf)
1	5	8	15	10	7	8	ML	25	116.0		93.0						464	464	268	0.990	0.29	27	5.00	1.20	38	NL							
2	10	13	7	5	2	5	ML	30	117.0		96.0	41	29	YES			1,221	1,221	619			27											
3	15	20	2	0	-5	7	ML	19	117.0		95.0	43	29	YES			1,923	1,923	947			14											
4	22	25	-5	-7	-10	5	MH	16	120.0		86.0	58	40	YES			2,632	2,476	1,282			12											
5	27	37	-10	-12	-22	12	MH	29	124.0		86.0						3,676	2,990	1,795	0.934	0.32	20	5.00	1.20	29	0.39	78.9	0.61	1.00	1.00	1.64		
6	47	50	-22	-32	-35	13	GP	50	129.0								5,259	3,792	2,598	0.783	0.27	24	5.00	1.20	33	NL							

NOTES:
1 Design groundwater depth for liquefaction should be the measured (or an average) groundwater elevation. Per Caltrans, "use a higher elevation than measured only if there is clear evidence for seasonal or long-term fluctuations."
2 Per Caltrans, "use a factor of safety against liquefaction of 1.0"
3 Per Caltrans, "use Boulanger and Idriss (2006) to determine if fine-grained soils are likely to behave as sand-like material and thus should be considered as susceptible to liquefaction." (PI < 7, or PI < 5 if the LL < 27)
4 Per Caltrans, rock is not considered to be liquefiable.
5 Soils above design groundwater elevation are not considered saturated and therefore are non-liquefiable.
6 Per Caltrans, liquefaction analysis using this method is limited to a maximum depth of 70 feet (depth cutoff implemented in these calculations); use with caution below a depth of 50 feet.
7 NL = non-liquefiable. Per Caltrans, "for $(N_1)_{60cs} \ge 30$, clean granular soils are too dense to liquefy and are classified as non-liquefiable."
8 **LIQ** = potentially liquefiable (Factor of Safety is less than or equal to 1.0 for liquefaction in sand-like materials).

Liquefaction Analysis

S2815-05-01
WCSBAR_001B

Project: **S2815-05-01**
Project No.: Truxel Road Bridge at American River
Boring: **WCSBAR_001B**
By: REL
Date: 6/10/2024

Boring Elevation:	36.7	feet
Groundwater (GW) Depth:	34.9	feet
Groundwater (GW) Elevation:	1.8	feet
Hammer Energy Ratio (ER_i):	83.0	%
Hammer Weight:	140	pounds
Hammer Drop:	30	inches
Drilling Rod Stick-up:	2	feet

Only fill in/edit shaded boxes.

GW Depth (Design)[1]:	13.7	feet
Site PGA:	0.26	g
Mean Magnitude (M):	6.68	

Liquefaction Factor of Safety[2]: 1.00

GW Elevation (Design)= 23.0 feet

MSF= 1.34

z = sample depth in meters
r_d = Stress Reduction Coefficient
$(1 - 0.4113*z^{0.5} + 0.04052*z + 0.001753*z^{1.5}) / (1 - 0.4177*z^{0.5} + 0.05729*z - 0.006205*z^{1.5} + 0.001210*z^2)$
CSR = Cyclic Stress Ratio
0.65 (PGA) (σ_{vo} / σ'_{vo}) * r_d
$(N_1)_{60}$ = Field blow counts corrected per Caltrans *Geotechnical Manual, Liquefaction Evaluation* module
Field N * C_E * C_N * C_B * C_R * C_S

Fines Content %	α	β
FC ≤ 5%	0	1.0
5% < FC < 35%	exp[1.76 - (190/FC^2)]	[0.99 + ($FC^{1.5}$ /1,000)]
FC ≥ 35%	5.0	1.2

$(N_1)_{60cs}$ = Clean sand value (modified $(N_1)_{60}$ for fines content)
$\alpha + \beta*(N_1)_{60}$
$CRR_{7.5}$ = Cyclic Resistance Ratio, for M=7.5 earthquake
$1/[34-(N_1)_{60cs}] + (N_1)_{60c}/135 + 50/[10*(N_{1cs})_{60}+45]^2 - 1/200$
MSF = Magnitude Scaling Factor
$10^{2.24} / M^{2.56}$

Overburden Correction	
D_R	f
D_R ≤ 40	0.8
40 < D_R < 80	1 - 0.005*D_R
D_R ≥ 80	0.6

D_R = Relative Density (%)
$100 * [(N_1)_{60cs}/46]^{0.5}$
P_a = Atmospheric pressure (defined)
2.116 ksf

K_σ = Overburden stress correction factor, $K_\sigma \le 1.0$
$(\sigma'_{vo}/P_a)^{(f-1)}$
K_α = Static shear stress correction, requires additional research
1.0 (Recommended value)
FS = Factor of Safety against liquefaction
$(CRR_{7.5}/CSR) * MSF * K_\sigma * K_\alpha$

S_r = Undrained residual shear strength of liquefied soil
$2{,}116*\exp(-8.444 + 0.109*(N_1)_{60} + 5.379*(\sigma'_{vo}/2{,}116)^{0.1})$

References:

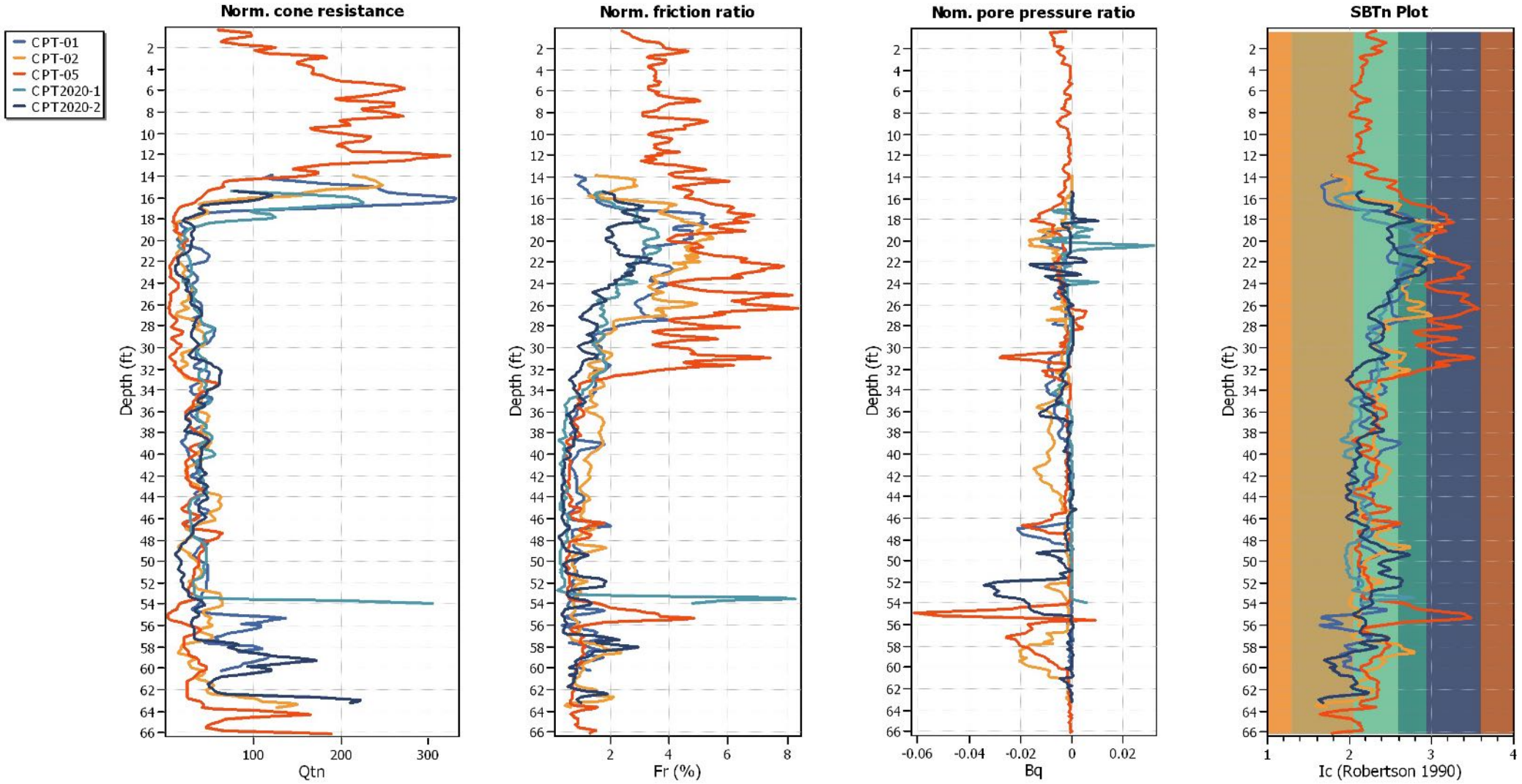
Boulanger and Idriss, *Liquefaction Susceptibility Criteria for Silts and Clays* (ASCE JGGE, November 2006)
Caltrans *Geotechnical Manual, Liquefaction Evaluation* module (January 2020)
Caltrans *ARS Online* (https://arsonline.dot.ca.gov/)
Idriss and Boulanger, *Soil Liquefaction During Earthquakes* (2008)
Youd, et al, *Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils* (ASCE JGGE, April 2001)

Data														Screening Checks			Overburden Stresses			CSR[6]		CRR (SPT)					Corrections				Liquefaction Potential?		Residual Shear Strength
Sample Number	Sample Depth (feet)	Depth to Bottom of Layer (feet)	Top of Layer Elevation (feet)	Sample Elevation (feet)	Bottom of Layer Elevation (feet)	Layer Thickness (feet)	Soil Type (USCS)	Field N	Total Unit Weight (pcf)	Average Grain Size, D50 (mm)	Percent Fines (-#200) (%)	Liquid Limit LL	Plasticity Index PI	"Clay-Like" Soil?[3]	Rock?[4]	Soil Above GW?[5]	Total Stress at Layer Midpoint (psf)	Effective Stress (at Time of Drilling) σ'_{vo} (psf)	Effective Stress (Design) σ'_{vo} (psf)	r_d	CSR	$(N1)_{60}$ (Caltrans, for liq. analysis)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$[7]	D_R (%)	f	K_σ	K_α	FS	FS ≤ 1.07[8]	S_r (psf)
4	4	8	36.7	32.7	28.7	8	SM	31	130.0		27.0					YES	520	520	520			57											
6	10	13.7	28.7	26.7	23	5.7	SP-SM	9	120.0		6.0					YES	1,382	1,382	1,382			13											
8	15	19.9	23	21.7	16.8	6.2	ML	12	125.0		62.0						2,112	2,112	1,918	0.969	0.18	15	5.00	1.20	23	0.25	70.4	0.65	1.00	1.00	1.89		
12	20	23	16.8	16.7	13.7	3.1	SM	19	125.0		44.0						2,693	2,693	2,209	0.957	0.20	23	5.00	1.20	33	NL							
14	25	26.5	13.7	11.7	10.2	3.5	SM	15	125.0		44.0						3,105	3,105	2,416	0.942	0.20	17	5.00	1.20	26	0.30	74.5	0.63	0.95	1.00	1.89		
16	30	34.9	10.2	6.7	1.8	8.4	ML	11	120.0		58.0						3,828	3,828	2,767	0.921	0.22	11	5.00	1.20	19	0.20	63.5	0.68	0.92	1.00	1.14		
18	35	39	1.8	1.7	-2.3	4.1	SM	22	125.0		19.0						4,588	4,460	3,137	0.891	0.22	22	3.43	1.07	27	0.34	76.7	0.62	0.86	1.00	1.78		
20	40	43	-2.3	-3.3	-6.3	4	SW-SM	17	125.0		11.0						5,095	4,714	3,391	0.851	0.22	17	1.21	1.03	18	0.19	62.9	0.69	0.86	1.00	1.04		
22	45	49.9	-6.3	-8.3	-13.2	6.9	SW-SM	21	125.0		11.0						5,776	5,055	3,732	0.804	0.21	20	1.21	1.03	21	0.23	68.3	0.66	0.82	1.00	1.24		
24	50	54.9	-13.2	-13.3	-18.2	5	SP-SM	20	125.0		8.0						6,520	5,428	4,105	0.753	0.20	18	0.30	1.01	19	0.20	63.7	0.68	0.81	1.00	1.07		
26	55	56.5	-18.2	-18.3	-19.8	1.6	GW	34	130.0								6,936	5,638	4,315	0.703	0.19	30	5.00	1.20	41	NL							
28	60	63	-19.8	-23.3	-26.3	6.5	SW-SM	19	125.0		11.0						7,446	5,896	4,573	0.659	0.18	17	1.21	1.03	18	0.19	62.9	0.69	0.78	1.00	1.13		
30	65	70	-26.3	-28.3	-33.3	7	GW	150	130.0								8,308	6,336	5,013	0.622	0.17	126	5.00	1.20	156	NL							

NOTES:
1 Design groundwater depth for liquefaction should be the measured (or an average) groundwater elevation. Per Caltrans, "use a higher elevation than measured only if there is clear evidence for seasonal or long-term fluctuations."
2 Per Caltrans, "use a factor of safety against liquefaction of 1.0"
3 Per Caltrans, "use Boulanger and Idriss (2006) to determine if fine-grained soils are likely to behave as sand-like material and thus should be considered as susceptible to liquefaction." (PI < 7, or PI < 5 if the LL < 27)
4 Per Caltrans, rock is not considered to be liquefiable.
5 Soils above design groundwater elevation are not considered saturated and therefore are non-liquefiable.
6 Per Caltrans, liquefaction analysis using this method is limited to a maximum depth of 70 feet (depth cutoff implemented in these calculations); use with caution below a depth of 50 feet.
7 NL = non-liquefiable. Per Caltrans, "for $(N_1)_{60cs} \ge 30$, clean granular soils are too dense to liquefy and are classified as non-liquefiable."
8 **LIQ** = potentially liquefiable (Factor of Safety is less than or equal to 1.0 for liquefaction in sand-like materials).

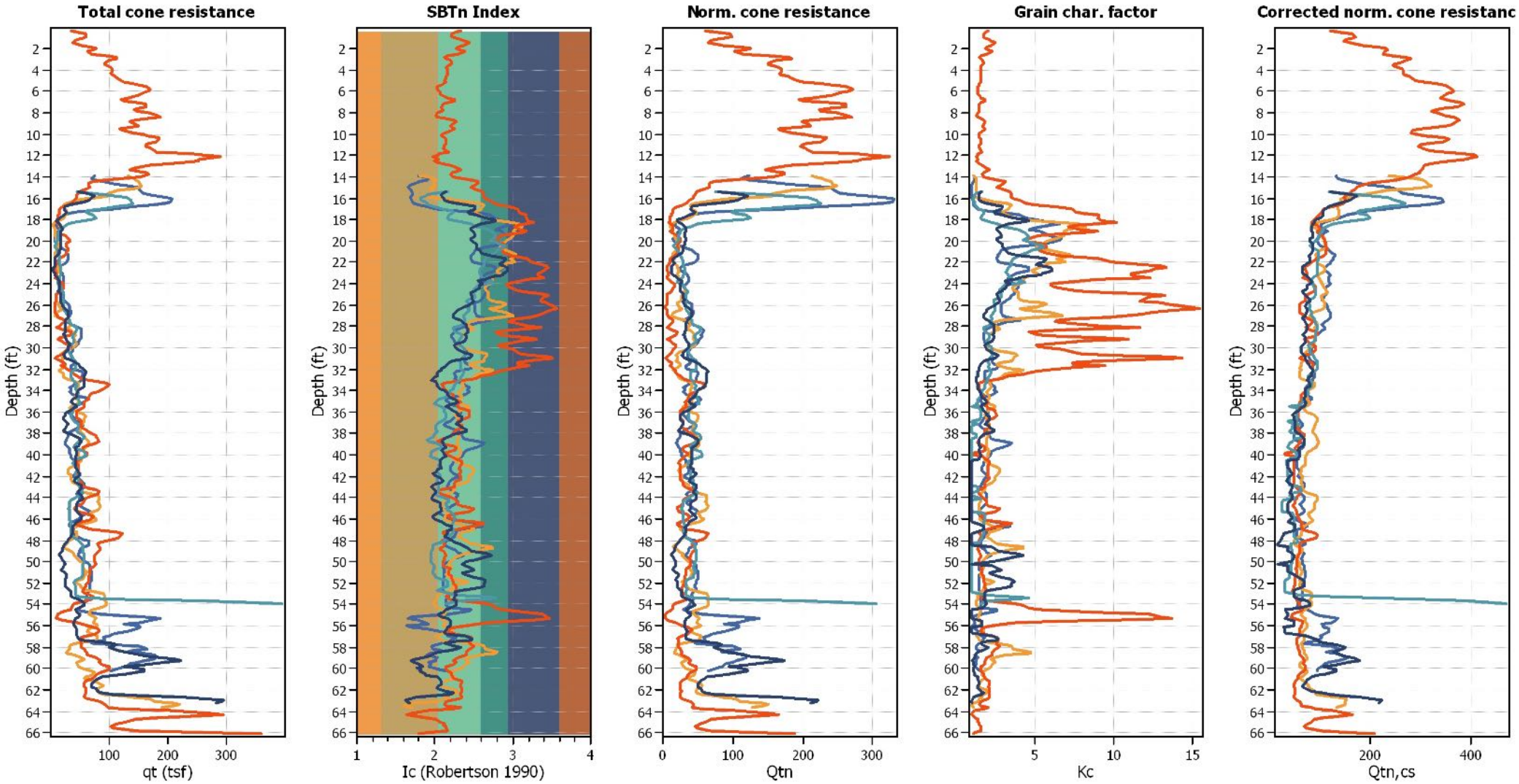
Project: Truxel Road Bridge at American River

Overlay Normalized Plots



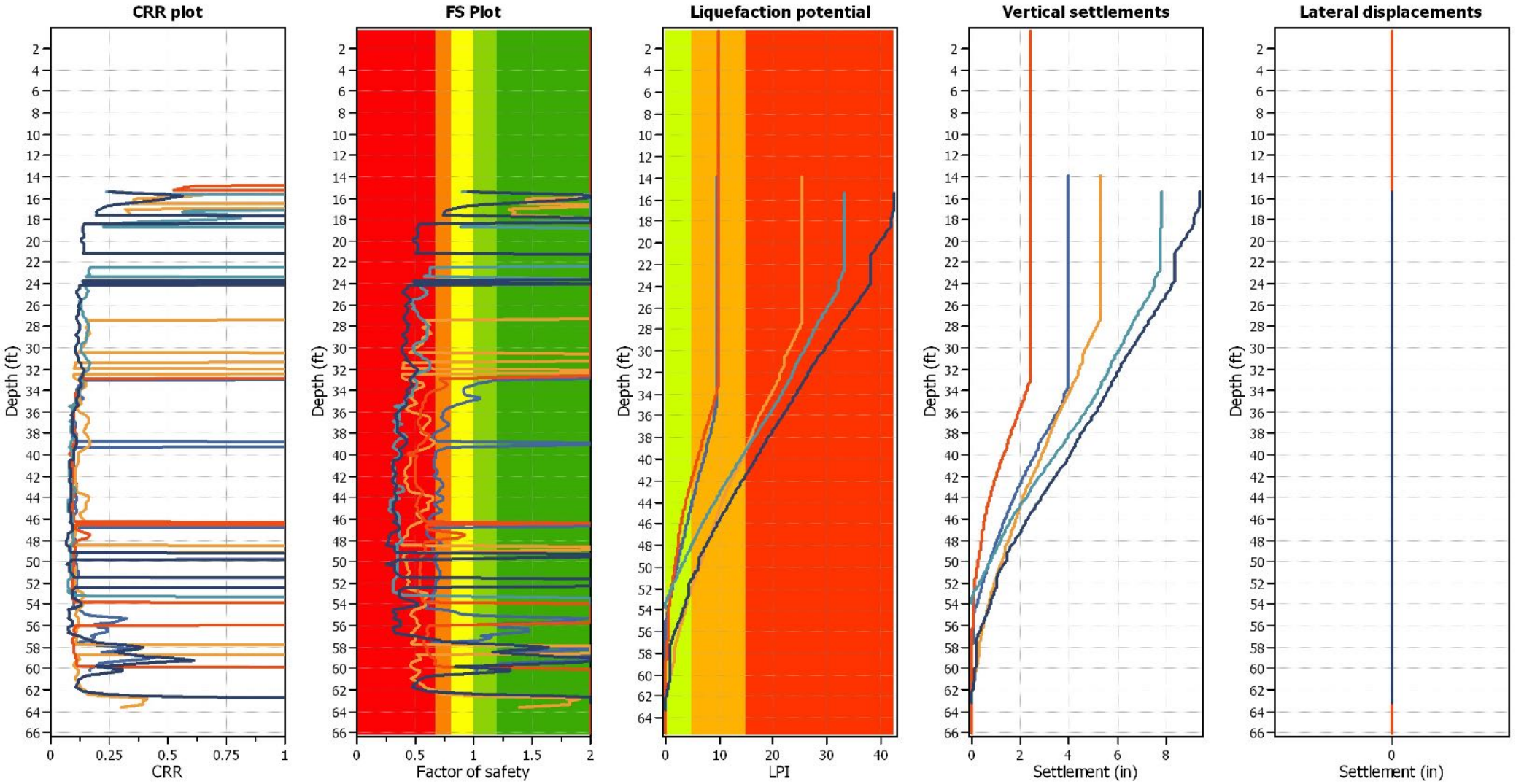
Project: Truxel Road Bridge at American River

Overlay Intermediate Results



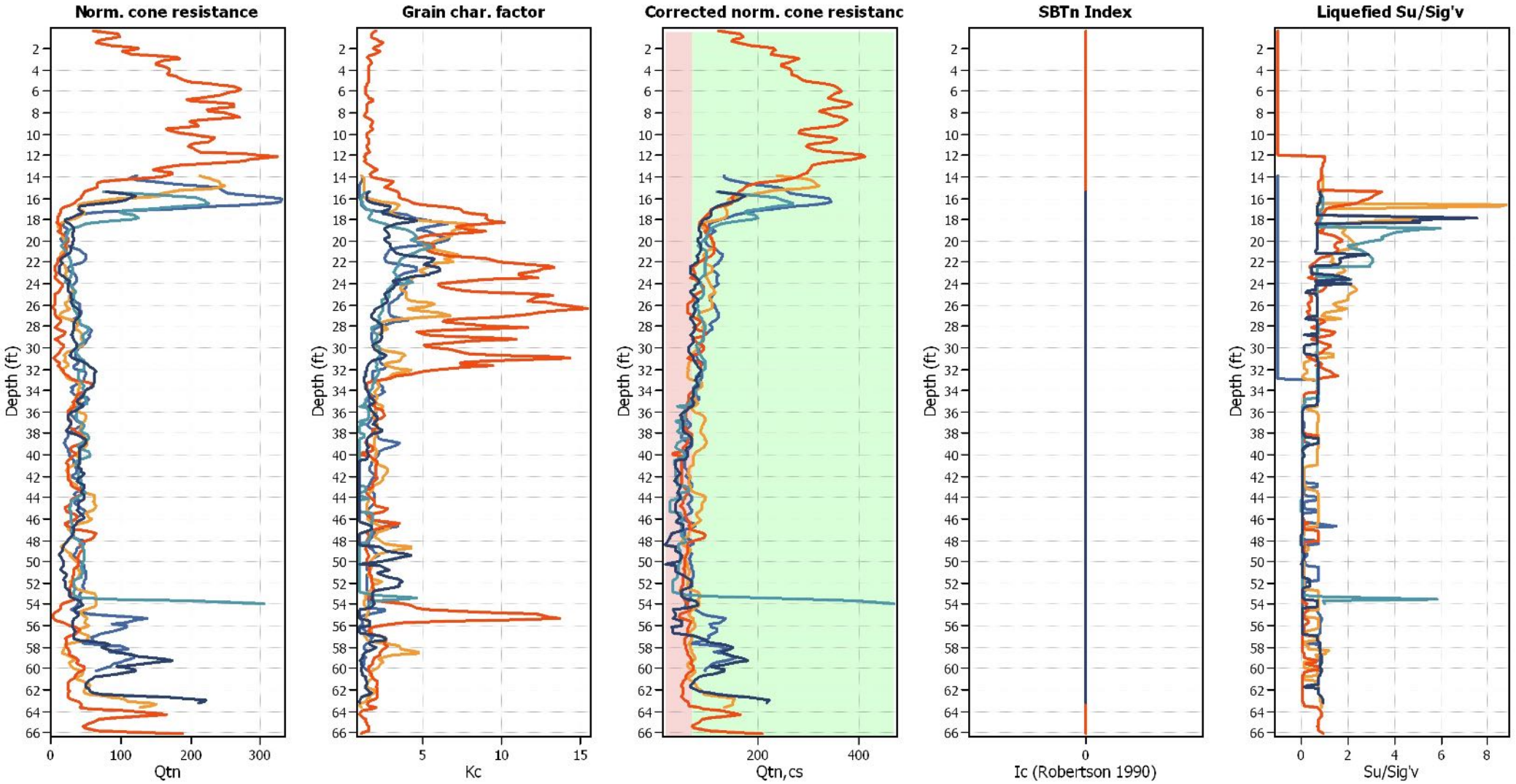
Project: Truxel Road Bridge at American River

Overlay Cyclic Liquefaction Plots



Project: Truxel Road Bridge at American River

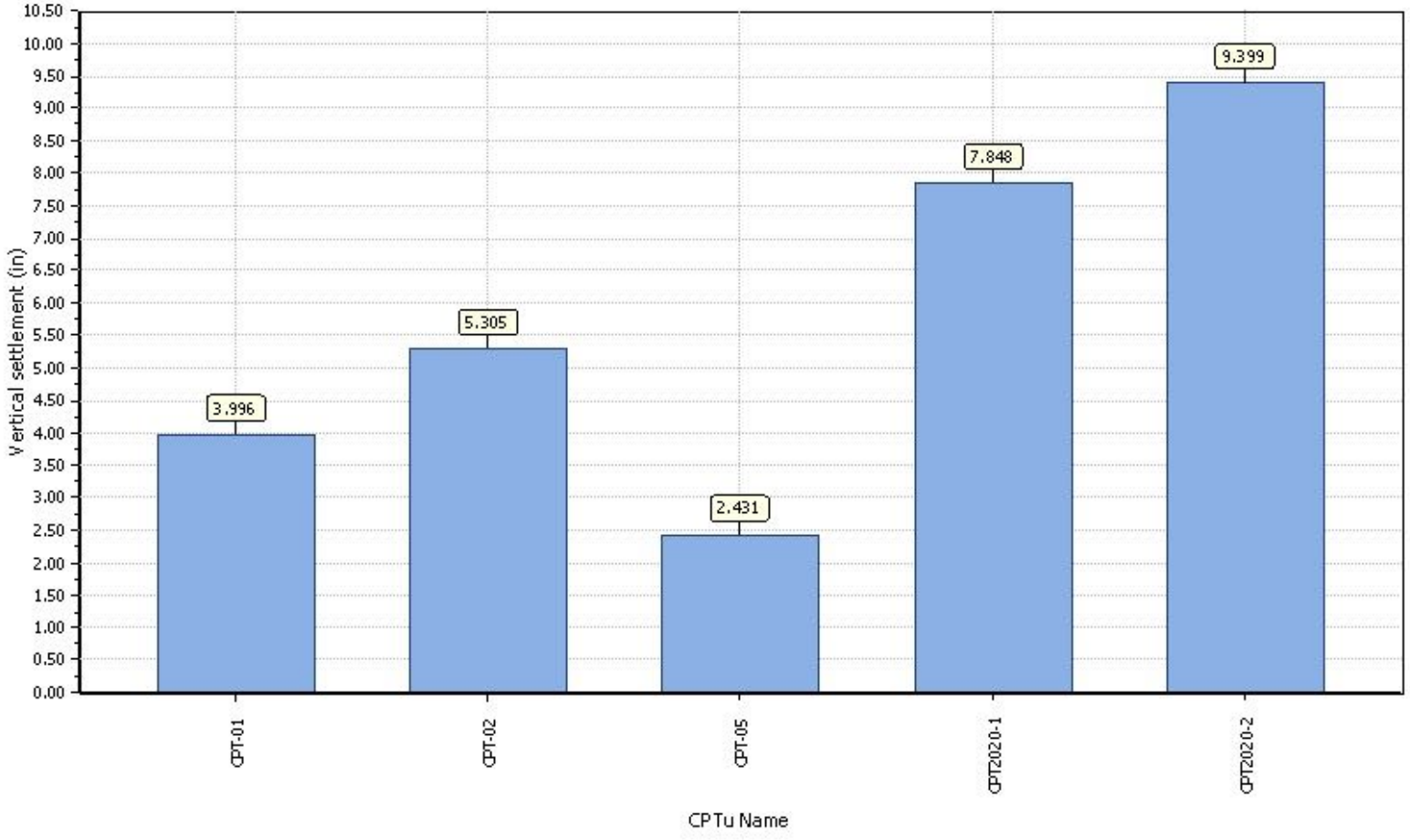
Overlay Strength Loss Plots

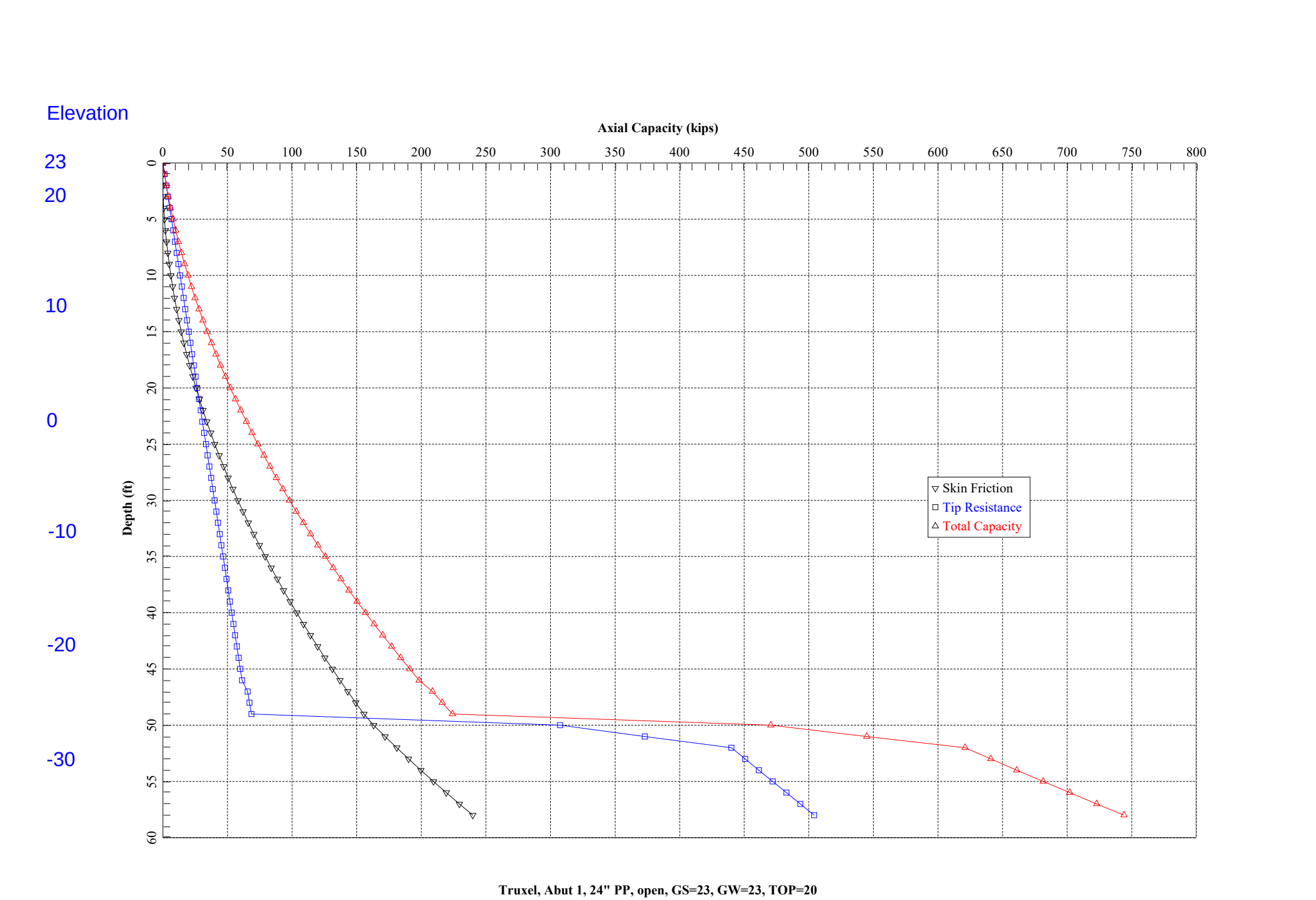


Project title : Truxel Road Bridge at American River

Location : Sacramento, CA

Overall vertical settlements report




Elevation
23
20
10
0
-10
-20
-30
Axial Capacity (kips)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Skin Friction
Tip Resistance
Total Capacity
Truxel, Abut 1, 24" PP, open, GS=23, GW=23, TOP=20

```
     ==========================================================================

                      APILE for Windows, Version 2015.7.3

                       Serial Number :  136156632

                       A Program for Analyzing the Axial Capacity
                       and Short-term Settlement of Driven Piles
                                 under Axial Loading.
                     (c) Copyright ENSOFT, Inc., 1987-2015
                           All Rights Reserved

     ==========================================================================


     This program is licensed to :

     Geocon Consultants, Inc.
     Rancho Cordova, CA

     Path to file locations      : R:\GEOCON WORKING FILES\S2800-S2849\S2815-05-01
Truxel Road Bridge\Analysis\Piles\APILE\
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     Name of output file         : PRELIM Abut 1.ap7o
     Name of plot output file    : PRELIM Abut 1.ap7p

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                          Time and Date of Analysis
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               Date:  July 18, 2024     Time:  07:58:52



1
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          * INPUT INFORMATION *
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          Truxel, Abut 1, 24" PP, open, GS=23, GW=23, TOP=20

          DESIGNER   : REL

          JOB NUMBER : S2815-05-01
```

METHOD FOR UNIT LOAD TRANSFERS :

- API RP 2A (American Petroleum Institute)
  Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- API RP 2A (American Petroleum Institute)

TYPE OF LOADING :
- COMPRESSION

PILE TYPE :

Steel pipe pile or non-tapered portion of monotube pile
- Open-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 452.19 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 24.00 IN.
- INTERNAL DIAMETER, ID = 0.50 IN.
- TOTAL PILE LENGTH, TL = 58.00 FT.
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 3.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED
  END SECTION = 58.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION = 0.50 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.80	53.00	31.00	8.00
49.00	SAND	0.80	53.00	31.00	8.00
49.00	SAND	0.80	68.00	38.00	50.00
83.00	SAND	0.80	68.00	38.00	50.00
83.00	CLAY	0.00	68.00	0.00	0.00
108.00	CLAY	0.00	68.00	0.00	0.00
108.00	SAND	0.80	68.00	38.00	50.00
114.50	SAND	0.80	68.00	38.00	50.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	2.50	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	2.50	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
49.00	1.000	1.000
49.00	1.000	1.000

83.00	1.000	1.000
83.00	1.000	1.000
108.00	1.000	1.000
108.00	1.000	1.000
114.50	1.000	1.000

DEPTH FT.	PLASTIC INDEX PI %	YIELD STRESS RATIO	Qc FROM CPT KSF
0.00	0.00	0.00	0.000E+00
49.00	0.00	0.00	0.000E+00
49.00	0.00	0.00	0.000E+00
83.00	0.00	0.00	0.000E+00
83.00	0.00	0.00	0.000E+00
108.00	0.00	0.00	0.000E+00
108.00	0.00	0.00	0.000E+00
114.50	0.00	0.00	0.000E+00

1

****
* COMPUTATION RESULT *
****

****
* API RP-2A (1994) *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0*	0.0
1.00	0.0	1.3*	1.3
2.00	0.0	2.7	2.7
3.00	0.2	3.9	4.1
4.00	0.6	5.3	6.0
5.00	1.2	6.7	7.9
6.00	1.9	8.0	9.9
7.00	2.8	9.3	12.1
8.00	3.8	10.7	14.4

9.00	4.9	12.0	16.9
10.00	6.1	13.3	19.4
11.00	7.5	14.7	22.1
12.00	9.0	16.0	24.9
13.00	10.6	17.3	27.9
14.00	12.3	18.6	31.0
15.00	14.2	20.0	34.2
16.00	16.2	21.3	37.6
17.00	18.4	22.6	41.0
18.00	20.7	24.0	44.6
19.00	23.1	25.3	48.4
20.00	25.6	26.6	52.2
21.00	28.3	28.0	56.2
22.00	31.1	29.3	60.4
23.00	34.0	30.6	64.6
24.00	37.0	32.0	69.0
25.00	40.2	33.3	73.5
26.00	43.5	34.6	78.2
27.00	47.0	36.0	82.9
28.00	50.5	37.3	87.8
29.00	54.2	38.6	92.9
30.00	58.1	40.0	98.0
31.00	62.0	41.3	103.3
32.00	66.1	42.6	108.8
33.00	70.4	44.0	114.3
34.00	74.7	45.3	120.0
35.00	79.2	46.6	125.8
36.00	83.8	48.0	131.8
37.00	88.6	49.3	137.8
38.00	93.4	50.6	144.0
39.00	98.4	51.9	150.4
40.00	103.6	53.3	156.8
41.00	108.8	54.6	163.4
42.00	114.2	55.9	170.2
43.00	119.7	57.3	177.0
44.00	125.4	58.6	184.0
45.00	131.2	59.9	191.1
46.00	137.1	61.3	198.4
47.00	143.1	65.6*	208.7
48.00	149.3	67.0*	216.3
49.00	155.6	68.5*	224.1
50.00	163.1	307.5	470.6
51.00	171.9	373.0	544.9
52.00	181.0	440.0	621.0
53.00	190.2	450.7	640.9
54.00	199.7	461.3	661.0
55.00	209.4	472.0	681.4

56.00	219.3	482.7	702.0
57.00	229.5	493.4	722.9
58.00	239.8	504.1	743.9

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.1000E-01
			0.0000E+00	0.2000E-01
			0.0000E+00	0.4000E-01
			0.0000E+00	0.6000E-01
			0.0000E+00	0.8000E-01
			0.0000E+00	0.9000E-01
			0.0000E+00	0.1000E+00
			0.0000E+00	0.5000E+00
			0.0000E+00	0.2000E+01
2	10	0.2453E+02		
			0.0000E+00	0.0000E+00
			0.3590E+00	0.1000E-01
			0.7180E+00	0.2000E-01
			0.1436E+01	0.4000E-01
			0.2154E+01	0.6000E-01
			0.2872E+01	0.8000E-01
			0.3231E+01	0.9000E-01
			0.3590E+01	0.1000E+00
			0.3590E+01	0.5000E+00
			0.3590E+01	0.2000E+01
3	10	0.4896E+02		
			0.0000E+00	0.0000E+00
			0.7645E+00	0.1000E-01
			0.1529E+01	0.2000E-01

			0.3058E+01	0.4000E-01
			0.4587E+01	0.6000E-01
			0.6116E+01	0.8000E-01
			0.6881E+01	0.9000E-01
			0.7645E+01	0.1000E+00
			0.7645E+01	0.5000E+00
			0.7645E+01	0.2000E+01
4	10	0.4900E+02		
			0.0000E+00	0.0000E+00
			0.9032E+00	0.1000E-01
			0.1806E+01	0.2000E-01
			0.3613E+01	0.4000E-01
			0.5419E+01	0.6000E-01
			0.7225E+01	0.8000E-01
			0.8128E+01	0.9000E-01
			0.9032E+01	0.1000E+00
			0.9032E+01	0.5000E+00
			0.9032E+01	0.2000E+01
5	10	0.6603E+02		
			0.0000E+00	0.0000E+00
			0.1145E+01	0.1000E-01
			0.2291E+01	0.2000E-01
			0.4582E+01	0.4000E-01
			0.6873E+01	0.6000E-01
			0.9164E+01	0.8000E-01
			0.1031E+02	0.9000E-01
			0.1145E+02	0.1000E+00
			0.1145E+02	0.5000E+00
			0.1145E+02	0.2000E+01
6	10	0.8296E+02		
			0.0000E+00	0.0000E+00
			0.1145E+01	0.1000E-01
			0.2291E+01	0.2000E-01
			0.4582E+01	0.4000E-01
			0.6873E+01	0.6000E-01
			0.9164E+01	0.8000E-01
			0.1031E+02	0.9000E-01
			0.1145E+02	0.1000E+00
			0.1145E+02	0.5000E+00
			0.1145E+02	0.2000E+01
7	10	0.8300E+02		
			0.0000E+00	0.0000E+00
			0.3436E+01	0.3840E-01
			0.5727E+01	0.7440E-01
			0.8591E+01	0.1368E+00
			0.1031E+02	0.1920E+00
			0.1145E+02	0.2400E+00

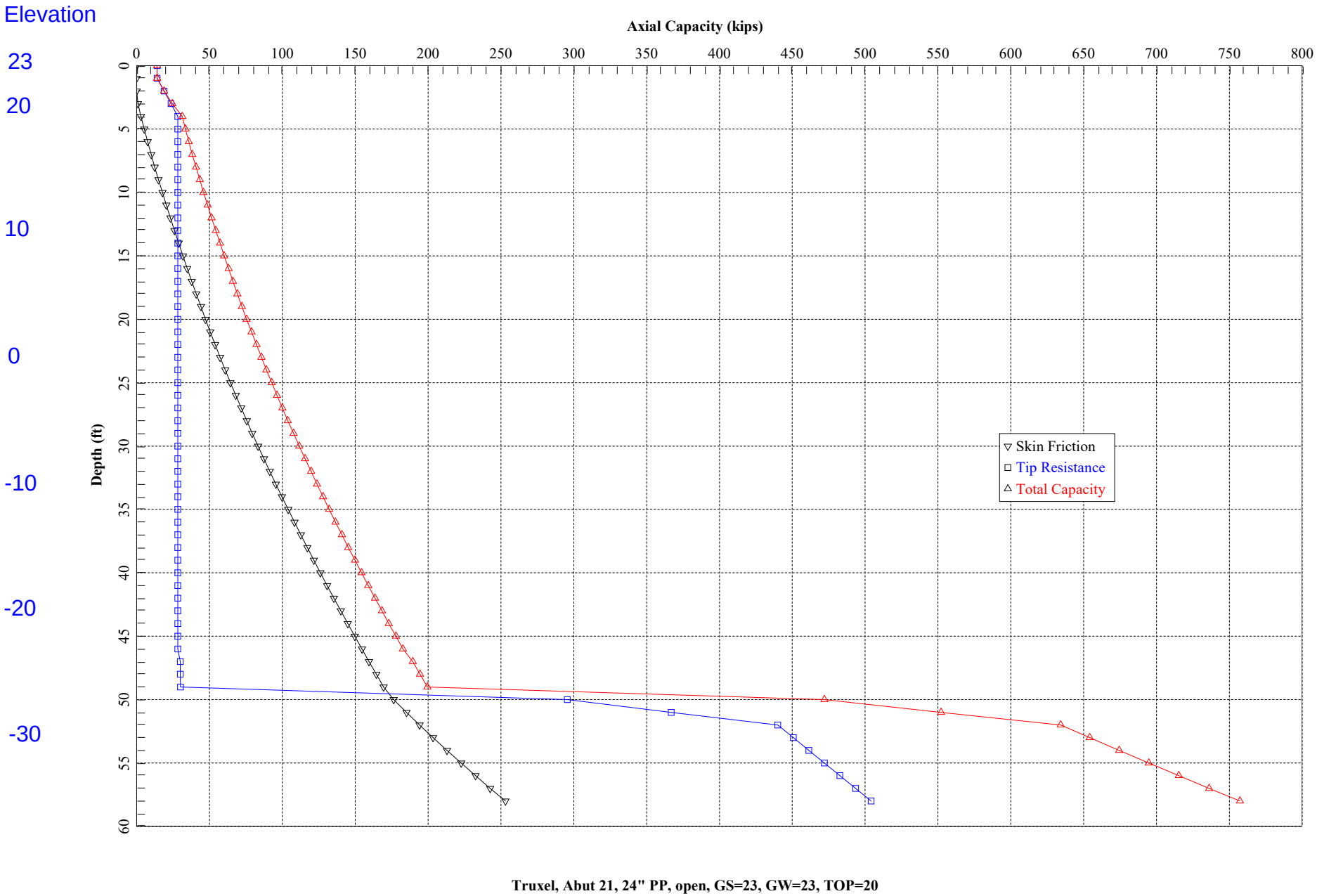
			0.1031E+02	0.4800E+00
			0.1031E+02	0.7200E+00
			0.1031E+02	0.1200E+01
			0.1031E+02	0.4800E+01
8	10	0.9553E+02		
			0.0000E+00	0.0000E+00
			0.3436E+01	0.3840E-01
			0.5727E+01	0.7440E-01
			0.8591E+01	0.1368E+00
			0.1031E+02	0.1920E+00
			0.1145E+02	0.2400E+00
			0.1031E+02	0.4800E+00
			0.1031E+02	0.7200E+00
			0.1031E+02	0.1200E+01
			0.1031E+02	0.4800E+01
9	10	0.1080E+03		
			0.0000E+00	0.0000E+00
			0.3436E+01	0.3840E-01
			0.5727E+01	0.7440E-01
			0.8591E+01	0.1368E+00
			0.1031E+02	0.1920E+00
			0.1145E+02	0.2400E+00
			0.1031E+02	0.4800E+00
			0.1031E+02	0.7200E+00
			0.1031E+02	0.1200E+01
			0.1031E+02	0.4800E+01
10	10	0.1080E+03		
			0.0000E+00	0.0000E+00
			0.1145E+01	0.1000E-01
			0.2291E+01	0.2000E-01
			0.4582E+01	0.4000E-01
			0.6873E+01	0.6000E-01
			0.9164E+01	0.8000E-01
			0.1031E+02	0.9000E-01
			0.1145E+02	0.1000E+00
			0.1145E+02	0.5000E+00
			0.1145E+02	0.2000E+01
11	10	0.1113E+03		
			0.0000E+00	0.0000E+00
			0.1145E+01	0.1000E-01
			0.2291E+01	0.2000E-01
			0.4582E+01	0.4000E-01
			0.6873E+01	0.6000E-01
			0.9164E+01	0.8000E-01
			0.1031E+02	0.9000E-01
			0.1145E+02	0.1000E+00
			0.1145E+02	0.5000E+00

```
                                        0.1145E+02      0.2000E+01
   12         10      0.1145E+03
                                        0.0000E+00      0.0000E+00
                                        0.1145E+01      0.1000E-01
                                        0.2291E+01      0.2000E-01
                                        0.4582E+01      0.4000E-01
                                        0.6873E+01      0.6000E-01
                                        0.9164E+01      0.8000E-01
                                        0.1031E+02      0.9000E-01
                                        0.1145E+02      0.1000E+00
                                        0.1145E+02      0.5000E+00
                                        0.1145E+02      0.2000E+01
```

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.3150E+02	0.1200E-01
0.6301E+02	0.2400E-01
0.1260E+03	0.4800E-01
0.2520E+03	0.3120E+00
0.3781E+03	0.1008E+01
0.4537E+03	0.1752E+01
0.5041E+03	0.2400E+01
0.5041E+03	0.3600E+01
0.5041E+03	0.4800E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.5200E+00	0.1231E-03	0.2625E+00	0.1000E-03
0.5200E+01	0.1231E-02	0.2625E+01	0.1000E-02
0.2600E+02	0.6156E-02	0.1313E+02	0.5000E-02
0.5200E+02	0.1231E-01	0.2625E+02	0.1000E-01
0.2556E+03	0.6132E-01	0.1270E+03	0.5000E-01
0.3937E+03	0.1168E+00	0.1508E+03	0.1000E+00
0.5290E+03	0.5240E+00	0.2861E+03	0.5000E+00
0.6195E+03	0.1029E+01	0.3766E+03	0.1000E+01
0.7158E+03	0.2034E+01	0.4730E+03	0.2000E+01



Truxel, Abut 21, 24" PP, open, GS=23, GW=23, TOP=20

```
     ============================================================================

                      APILE for Windows, Version 2015.7.3

                       Serial Number :  136156632

                       A Program for Analyzing the Axial Capacity
                       and Short-term Settlement of Driven Piles
                                 under Axial Loading.
                     (c) Copyright ENSOFT, Inc., 1987-2015
                           All Rights Reserved

     ============================================================================


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     Rancho Cordova, CA

     Path to file locations      : R:\GEOCON WORKING FILES\S2800-S2849\S2815-05-01
Truxel Road Bridge\Analysis\Piles\APILE\
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     Name of output file         : PRELIM Abut 21.ap7o
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               Date:  July 18, 2024     Time:  07:52:28



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          Truxel, Abut 21, 24" PP, open, GS=23, GW=23, TOP=20

          DESIGNER   : REL

          JOB NUMBER : S2815-05-01
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49.00	CLAY	0.00	53.00	0.00	0.00
49.00	SAND	0.80	68.00	38.00	50.00
83.00	SAND	0.80	68.00	38.00	50.00
83.00	CLAY	0.00	68.00	0.00	0.00
108.00	CLAY	0.00	68.00	0.00	0.00
108.00	SAND	0.80	68.00	38.00	50.00
114.50	SAND	0.80	68.00	38.00	50.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	1.00	0.50	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.00	0.50	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	2.50	0.00	0.00	0.00
0.10E+08*	0.10E+08*	5.00	2.50	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
49.00	1.000	1.000
49.00	1.000	1.000

83.00	1.000	1.000
83.00	1.000	1.000
108.00	1.000	1.000
108.00	1.000	1.000
114.50	1.000	1.000

DEPTH FT.	PLASTIC INDEX PI %	YIELD STRESS RATIO	Qc FROM CPT KSF
0.00	0.00	0.00	0.000E+00
49.00	0.00	0.00	0.000E+00
49.00	0.00	0.00	0.000E+00
83.00	0.00	0.00	0.000E+00
83.00	0.00	0.00	0.000E+00
108.00	0.00	0.00	0.000E+00
108.00	0.00	0.00	0.000E+00
114.50	0.00	0.00	0.000E+00

1

****
* COMPUTATION RESULT *
****

****
* API RP-2A (1994) *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	14.1	14.1
1.00	0.0	14.1	14.1
2.00	0.0	18.8	18.8
3.00	1.0	23.6	24.6
4.00	3.0	28.3	31.3
5.00	5.2	28.3	33.5
6.00	7.5	28.3	35.8
7.00	10.0	28.3	38.2
8.00	12.4	28.3	40.7

9.00	15.0	28.3	43.3
10.00	17.7	28.3	45.9
11.00	20.4	28.3	48.7
12.00	23.2	28.3	51.4
13.00	26.0	28.3	54.3
14.00	28.9	28.3	57.2
15.00	31.8	28.3	60.1
16.00	34.8	28.3	63.1
17.00	37.8	28.3	66.1
18.00	40.9	28.3	69.2
19.00	44.1	28.3	72.3
20.00	47.3	28.3	75.5
21.00	50.5	28.3	78.8
22.00	53.9	28.3	82.2
23.00	57.3	28.3	85.6
24.00	60.8	28.3	89.1
25.00	64.4	28.3	92.7
26.00	68.0	28.3	96.3
27.00	71.8	28.3	100.0
28.00	75.6	28.3	103.8
29.00	79.4	28.3	107.7
30.00	83.4	28.3	111.6
31.00	87.3	28.3	115.6
32.00	91.4	28.3	119.7
33.00	95.5	28.3	123.8
34.00	99.7	28.3	128.0
35.00	104.0	28.3	132.2
36.00	108.3	28.3	136.5
37.00	112.6	28.3	140.9
38.00	117.1	28.3	145.3
39.00	121.6	28.3	149.8
40.00	126.1	28.3	154.4
41.00	130.7	28.3	159.0
42.00	135.4	28.3	163.6
43.00	140.1	28.3	168.4
44.00	144.9	28.3	173.1
45.00	149.7	28.3	177.9
46.00	154.6	28.3	182.8
47.00	159.5	30.0*	189.5
48.00	164.5	30.0*	194.5
49.00	169.5	30.1*	199.6
50.00	176.4	295.6	472.0
51.00	185.2	366.9	552.1
52.00	194.2	440.0	634.2
53.00	203.5	450.7	654.1
54.00	213.0	461.3	674.3
55.00	222.7	472.0	694.7

56.00	232.6	482.7	715.3
57.00	242.7	493.4	736.1
58.00	253.1	504.1	757.2

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.3840E-01
			0.0000E+00	0.7440E-01
			0.0000E+00	0.1368E+00
			0.0000E+00	0.1920E+00
			0.0000E+00	0.2400E+00
			0.0000E+00	0.4800E+00
			0.0000E+00	0.7200E+00
			0.0000E+00	0.1200E+01
			0.0000E+00	0.4800E+01
2	10	0.2453E+02		
			0.0000E+00	0.0000E+00
			0.1199E+01	0.3840E-01
			0.1998E+01	0.7440E-01
			0.2997E+01	0.1368E+00
			0.3597E+01	0.1920E+00
			0.3996E+01	0.2400E+00
			0.3597E+01	0.4800E+00
			0.3597E+01	0.7200E+00
			0.3597E+01	0.1200E+01
			0.3597E+01	0.4800E+01
3	10	0.4896E+02		
			0.0000E+00	0.0000E+00
			0.1976E+01	0.3840E-01
			0.3293E+01	0.7440E-01

			0.4940E+01	0.1368E+00
			0.5927E+01	0.1920E+00
			0.6586E+01	0.2400E+00
			0.5927E+01	0.4800E+00
			0.5927E+01	0.7200E+00
			0.5927E+01	0.1200E+01
			0.5927E+01	0.4800E+01
4	10	0.4900E+02		
			0.0000E+00	0.0000E+00
			0.8671E+00	0.1000E-01
			0.1734E+01	0.2000E-01
			0.3469E+01	0.4000E-01
			0.5203E+01	0.6000E-01
			0.6937E+01	0.8000E-01
			0.7804E+01	0.9000E-01
			0.8671E+01	0.1000E+00
			0.8671E+01	0.5000E+00
			0.8671E+01	0.2000E+01
5	10	0.6603E+02		
			0.0000E+00	0.0000E+00
			0.1145E+01	0.1000E-01
			0.2291E+01	0.2000E-01
			0.4582E+01	0.4000E-01
			0.6873E+01	0.6000E-01
			0.9164E+01	0.8000E-01
			0.1031E+02	0.9000E-01
			0.1145E+02	0.1000E+00
			0.1145E+02	0.5000E+00
			0.1145E+02	0.2000E+01
6	10	0.8296E+02		
			0.0000E+00	0.0000E+00
			0.1145E+01	0.1000E-01
			0.2291E+01	0.2000E-01
			0.4582E+01	0.4000E-01
			0.6873E+01	0.6000E-01
			0.9164E+01	0.8000E-01
			0.1031E+02	0.9000E-01
			0.1145E+02	0.1000E+00
			0.1145E+02	0.5000E+00
			0.1145E+02	0.2000E+01
7	10	0.8300E+02		
			0.0000E+00	0.0000E+00
			0.3436E+01	0.3840E-01
			0.5727E+01	0.7440E-01
			0.8591E+01	0.1368E+00
			0.1031E+02	0.1920E+00
			0.1145E+02	0.2400E+00

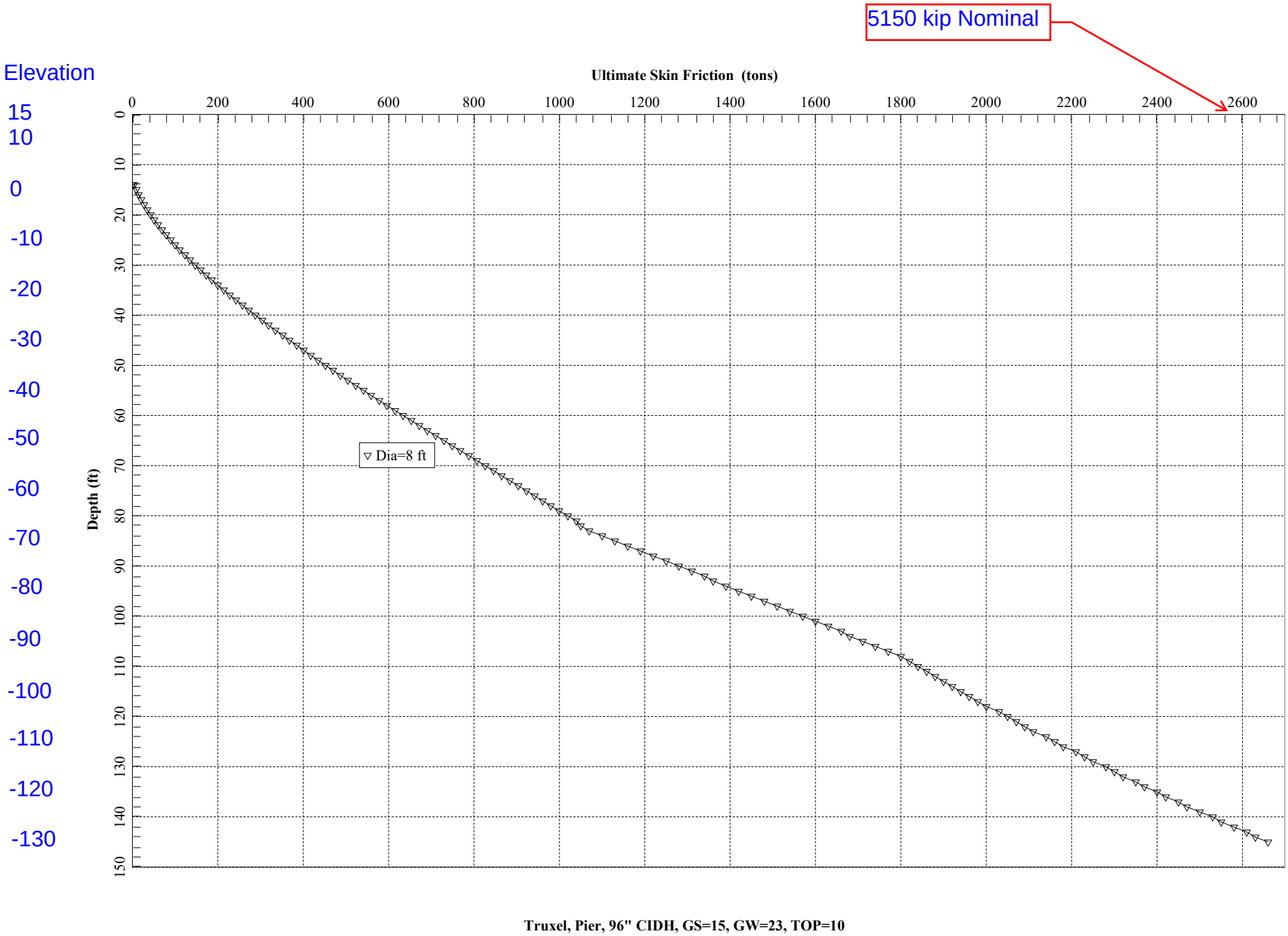
			0.1031E+02	0.4800E+00
			0.1031E+02	0.7200E+00
			0.1031E+02	0.1200E+01
			0.1031E+02	0.4800E+01
8	10	0.9553E+02		
			0.0000E+00	0.0000E+00
			0.3436E+01	0.3840E-01
			0.5727E+01	0.7440E-01
			0.8591E+01	0.1368E+00
			0.1031E+02	0.1920E+00
			0.1145E+02	0.2400E+00
			0.1031E+02	0.4800E+00
			0.1031E+02	0.7200E+00
			0.1031E+02	0.1200E+01
			0.1031E+02	0.4800E+01
9	10	0.1080E+03		
			0.0000E+00	0.0000E+00
			0.3436E+01	0.3840E-01
			0.5727E+01	0.7440E-01
			0.8591E+01	0.1368E+00
			0.1031E+02	0.1920E+00
			0.1145E+02	0.2400E+00
			0.1031E+02	0.4800E+00
			0.1031E+02	0.7200E+00
			0.1031E+02	0.1200E+01
			0.1031E+02	0.4800E+01
10	10	0.1080E+03		
			0.0000E+00	0.0000E+00
			0.1145E+01	0.1000E-01
			0.2291E+01	0.2000E-01
			0.4582E+01	0.4000E-01
			0.6873E+01	0.6000E-01
			0.9164E+01	0.8000E-01
			0.1031E+02	0.9000E-01
			0.1145E+02	0.1000E+00
			0.1145E+02	0.5000E+00
			0.1145E+02	0.2000E+01
11	10	0.1113E+03		
			0.0000E+00	0.0000E+00
			0.1145E+01	0.1000E-01
			0.2291E+01	0.2000E-01
			0.4582E+01	0.4000E-01
			0.6873E+01	0.6000E-01
			0.9164E+01	0.8000E-01
			0.1031E+02	0.9000E-01
			0.1145E+02	0.1000E+00
			0.1145E+02	0.5000E+00

			0.1145E+02	0.2000E+01
12	10	0.1145E+03		
			0.0000E+00	0.0000E+00
			0.1145E+01	0.1000E-01
			0.2291E+01	0.2000E-01
			0.4582E+01	0.4000E-01
			0.6873E+01	0.6000E-01
			0.9164E+01	0.8000E-01
			0.1031E+02	0.9000E-01
			0.1145E+02	0.1000E+00
			0.1145E+02	0.5000E+00
			0.1145E+02	0.2000E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.3150E+02	0.1200E-01
0.6301E+02	0.2400E-01
0.1260E+03	0.4800E-01
0.2520E+03	0.3120E+00
0.3781E+03	0.1008E+01
0.4537E+03	0.1752E+01
0.5041E+03	0.2400E+01
0.5041E+03	0.3600E+01
0.5041E+03	0.4800E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.4763E+00	0.1216E-03	0.2625E+00	0.1000E-03
0.4763E+01	0.1216E-02	0.2625E+01	0.1000E-02
0.2381E+02	0.6082E-02	0.1313E+02	0.5000E-02
0.4763E+02	0.1216E-01	0.2625E+02	0.1000E-01
0.2279E+03	0.6043E-01	0.1270E+03	0.5000E-01
0.3279E+03	0.1147E+00	0.1508E+03	0.1000E+00
0.5077E+03	0.5232E+00	0.2861E+03	0.5000E+00
0.5982E+03	0.1028E+01	0.3766E+03	0.1000E+01
0.6946E+03	0.2033E+01	0.4730E+03	0.2000E+01



Truxel, Pier, 96" CIDH, GS=15, GW=23, TOP=10

```
    ==========================================================================

                     SHAFT for Windows, Version 2017.8.10

                      Serial Number :  500126445

                   VERTICALLY LOADED DRILLED SHAFT ANALYSIS
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                          All Rights Reserved

    ==========================================================================


    Path to file locations      : R:\GEOCON WORKING FILES\S2800-S2849\S2815-05-01 Truxel Road
Bridge\Analysis\Piles\SHAFT\
    Name of input data file     : PRELIM Pier.sf8d
    Name of output file         : PRELIM Pier.sf8o
    Name of plot output file    : PRELIM Pier.sf8p
    Name of runtime file        : PRELIM Pier.sf8r


    --------------------------------------------------------------------------
                         Time and Date of Analysis
    --------------------------------------------------------------------------

              Date:  July 18, 2024     Time:  09:07:22

    Truxel, Pier, 96" CIDH, GS=15, GW=23, TOP=10


    PROPOSED DEPTH =     145.0 FT
    ----------------


    NUMBER OF LAYERS =    4
    ------------------
```

WATER TABLE DEPTH =   0.0 FT.

FACTOR OF SAFETY APPLIED TO THE ULTIMATE SIDE FRICTION CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA = 0.120E+01 (*)
  INTERNAL FRICTION ANGLE, DEG. = 0.310E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.400E+04
  DEPTH, FT = 0.000E+00

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA = 0.636E+00 (*)
  INTERNAL FRICTION ANGLE, DEG. = 0.310E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.400E+04

```
  DEPTH, FT                                          = 0.410E+02

LAYER NO  2----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                    = 0.636E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                      = 0.380E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.400E+04
  DEPTH, FT                                          = 0.410E+02

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                    = 0.331E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                      = 0.380E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.400E+04
  DEPTH, FT                                          = 0.750E+02

LAYER NO  3----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.464E+00  (*)
  END BEARING COEFFICIENT-Nc                         = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.500E+04
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.550E+04
  DEPTH, FT                                          = 0.750E+02
```

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.464E+00	(*)
END BEARING COEFFICIENT-Nc	= 0.900E+01	(*)
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.500E+04	
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00	
SOIL UNIT WEIGHT, LB/CU FT	= 0.130E+03	
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.550E+04	
DEPTH, FT	= 0.100E+03	

LAYER NO 4----SAND

AT THE TOP

SIDE FRICTION PROCEDURE, BETA METHOD		
SKIN FRICTION COEFFICIENT- BETA	= 0.250E+00	(*)
INTERNAL FRICTION ANGLE, DEG.	= 0.380E+02	
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00	
SOIL UNIT WEIGHT, LB/CU FT	= 0.130E+03	
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.400E+04	
DEPTH, FT	= 0.100E+03	

AT THE BOTTOM

SIDE FRICTION PROCEDURE, BETA METHOD		
SKIN FRICTION COEFFICIENT- BETA	= 0.250E+00	(*)
INTERNAL FRICTION ANGLE, DEG.	= 0.380E+02	
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00	
SOIL UNIT WEIGHT, LB/CU FT	= 0.130E+03	
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.400E+04	
DEPTH, FT	= 0.165E+03	

(*) ESTIMATED BY THE PROGRAM BASED ON OTHER PARAMETERS

INPUT DRILLED SHAFT INFORMATION

 MINIMUM SHAFT DIAMETER   =   8.000 FT.
 MAXIMUM SHAFT DIAMETER   =   8.000 FT.
 RATIO BASE/SHAFT DIAMETER =   0.000 FT.
 ANGLE OF BELL   =   0.000 DEG.
 IGNORED TOP PORTION   =   5.000 FT.
 IGNORED BOTTOM PORTION   =   8.000 FT.
 ELASTIC MODULUS, Ec   = 0.300E+07 LB/SQ IN

COMPUTATION RESULTS

- CASE ANALYZED   :   1
  VARIATION LENGTH   :   1
  VARIATION DIAMETER :   1

DRILLED SHAFT INFORMATION

 DIAMETER OF STEM   =   8.000 FT.
 DIAMETER OF BASE   =   8.000 FT.

```
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    5.000  FT.
 IGNORED BOTTOM PORTION    =    8.000  FT.
 AREA OF ONE PERCENT STEEL =   72.392  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.300E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.
 SHAFT LENGTH              =  145.000  FT.
```

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY
APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY
APPLIED TO THE ULTIMATE SIDE RESISTANCE AND
THE ULTIMATE BASE RESISTANCE.

LENGTH (FT)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
14.0	26.07	4.25	21.06	25.31	25.31	25.31	0.97
15.0	27.93	9.16	21.93	31.10	31.10	31.10	1.11
16.0	29.79	14.71	22.81	37.51	37.51	37.51	1.26
17.0	31.65	20.86	23.68	44.54	44.54	44.54	1.41
18.0	33.51	27.60	24.55	52.15	52.15	52.15	1.56
19.0	35.38	34.90	25.43	60.33	60.33	60.33	1.71
20.0	37.24	42.75	26.30	69.05	69.05	69.05	1.85
21.0	39.10	51.12	27.17	78.30	78.30	78.30	2.00
22.0	40.96	60.00	28.05	88.05	88.05	88.05	2.15
23.0	42.82	69.37	28.92	98.29	98.29	98.29	2.30

24.0	44.69	79.21	29.79	109.00	109.00	109.00	2.44
25.0	46.55	89.50	30.66	120.16	120.16	120.16	2.58
26.0	48.41	100.22	49.38	149.60	149.60	149.60	3.09
27.0	50.27	111.37	69.56	180.94	180.94	180.94	3.60
28.0	52.13	122.93	91.25	214.18	214.18	214.18	4.11
29.0	54.00	134.87	114.46	249.33	249.33	249.33	4.62
30.0	55.86	147.19	139.22	286.41	286.41	286.41	5.13
31.0	57.72	159.87	165.56	325.43	325.43	325.43	5.64
32.0	59.58	172.90	193.49	366.39	366.39	366.39	6.15
33.0	61.44	186.26	223.05	409.31	409.31	409.31	6.66
34.0	63.31	199.94	250.05	450.00	450.00	450.00	7.11
35.0	65.17	213.93	274.44	488.37	488.37	488.37	7.49
36.0	67.03	228.21	296.13	524.34	524.34	524.34	7.82
37.0	68.89	242.78	315.04	557.82	557.82	557.82	8.10
38.0	70.75	257.61	331.10	588.71	588.71	588.71	8.32
39.0	72.62	272.70	344.24	616.94	616.94	616.94	8.50
40.0	74.48	288.03	354.39	642.42	642.42	642.42	8.63
41.0	76.34	303.60	361.46	665.06	665.06	665.06	8.71
42.0	78.20	319.38	368.53	687.91	687.91	687.91	8.80
43.0	80.06	335.38	375.60	710.98	710.98	710.98	8.88
44.0	81.92	351.57	382.67	734.24	734.24	734.24	8.96
45.0	83.79	367.95	389.73	757.69	757.69	757.69	9.04
46.0	85.65	384.51	396.80	781.31	781.31	781.31	9.12
47.0	87.51	401.23	403.87	805.10	805.10	805.10	9.20
48.0	89.37	418.10	410.94	829.04	829.04	829.04	9.28
49.0	91.23	435.12	418.01	853.13	853.13	853.13	9.35
50.0	93.10	452.21	425.08	877.29	877.29	877.29	9.42
51.0	94.96	469.54	432.15	901.69	901.69	901.69	9.50
52.0	96.82	487.09	439.22	926.31	926.31	926.31	9.57
53.0	98.68	504.86	446.29	951.15	951.15	951.15	9.64
54.0	100.54	522.82	453.36	976.18	976.18	976.18	9.71
55.0	102.41	540.97	460.43	1001.40	1001.40	1001.40	9.78
56.0	104.27	559.29	467.50	1026.79	1026.79	1026.79	9.85
57.0	106.13	577.76	474.57	1052.33	1052.33	1052.33	9.92
58.0	107.99	596.38	481.64	1078.02	1078.02	1078.02	9.98
59.0	109.85	615.13	488.71	1103.84	1103.84	1103.84	10.05

60.0	111.72	634.00	507.95	1141.95	1141.95	1141.95	10.22
61.0	113.58	652.97	527.43	1180.40	1180.40	1180.40	10.39
62.0	115.44	672.04	547.11	1219.14	1219.14	1219.14	10.56
63.0	117.30	691.18	566.96	1258.14	1258.14	1258.14	10.73
64.0	119.16	710.40	586.96	1297.36	1297.36	1297.36	10.89
65.0	121.03	729.67	607.08	1336.75	1336.75	1336.75	11.05
66.0	122.89	748.99	627.28	1376.27	1376.27	1376.27	11.20
67.0	124.75	768.33	647.55	1415.88	1415.88	1415.88	11.35
68.0	126.61	787.70	664.98	1452.68	1452.68	1452.68	11.47
69.0	128.47	807.08	679.67	1486.75	1486.75	1486.75	11.57
70.0	130.33	826.45	691.69	1518.15	1518.15	1518.15	11.65
71.0	132.20	845.81	701.14	1546.96	1546.96	1546.96	11.70
72.0	134.06	865.15	708.10	1573.25	1573.25	1573.25	11.74
73.0	135.92	884.44	712.66	1597.10	1597.10	1597.10	11.75
74.0	137.78	903.69	714.89	1618.58	1618.58	1618.58	11.75
75.0	139.64	922.88	714.89	1637.77	1637.77	1637.77	11.73
76.0	141.51	941.99	714.89	1656.88	1656.88	1656.88	11.71
77.0	143.37	961.03	714.89	1675.92	1675.92	1675.92	11.69
78.0	145.23	979.97	714.89	1694.86	1694.86	1694.86	11.67
79.0	147.09	998.82	714.89	1713.70	1713.70	1713.70	11.65
80.0	148.95	1017.54	714.89	1732.43	1732.43	1732.43	11.63
81.0	150.82	1036.15	714.89	1751.03	1751.03	1751.03	11.61
82.0	152.68	1054.61	714.89	1769.50	1769.50	1769.50	11.59
83.0	154.54	1072.94	714.89	1787.82	1787.82	1787.82	11.57
84.0	156.40	1102.08	714.89	1816.97	1816.97	1816.97	11.62
85.0	158.26	1131.22	704.65	1835.88	1835.88	1835.88	11.60
86.0	160.13	1160.37	693.81	1854.18	1854.18	1854.18	11.58
87.0	161.99	1189.51	682.37	1871.89	1871.89	1871.89	11.56
88.0	163.85	1218.66	670.33	1888.99	1888.99	1888.99	11.53
89.0	165.71	1247.80	657.69	1905.49	1905.49	1905.49	11.50
90.0	167.57	1276.95	644.44	1921.39	1921.39	1921.39	11.47
91.0	169.44	1306.09	630.59	1936.68	1936.68	1936.68	11.43
92.0	171.30	1335.24	616.14	1951.38	1951.38	1951.38	11.39
93.0	173.16	1364.38	603.49	1967.88	1967.88	1967.88	11.36
94.0	175.02	1393.53	592.66	1986.19	1986.19	1986.19	11.35
95.0	176.88	1422.67	583.62	2006.30	2006.30	2006.30	11.34

96.0	178.74	1451.82	576.40	2028.22	2028.22	2028.22	11.35
97.0	180.61	1480.96	570.98	2051.94	2051.94	2051.94	11.36
98.0	182.47	1510.11	567.37	2077.48	2077.48	2077.48	11.39
99.0	184.33	1539.25	565.56	2104.81	2104.81	2104.81	11.42
100.0	186.19	1568.40	565.56	2133.96	2133.96	2133.96	11.46
101.0	188.05	1597.54	565.56	2163.10	2163.10	2163.10	11.50
102.0	189.92	1626.69	565.56	2192.25	2192.25	2192.25	11.54
103.0	191.78	1655.83	565.56	2221.39	2221.39	2221.39	11.58
104.0	193.64	1684.98	565.56	2250.54	2250.54	2250.54	11.62
105.0	195.50	1714.12	565.56	2279.68	2279.68	2279.68	11.66
106.0	197.36	1743.27	565.56	2308.83	2308.83	2308.83	11.70
107.0	199.23	1772.41	565.56	2337.97	2337.97	2337.97	11.74
108.0	201.09	1801.56	565.56	2367.12	2367.12	2367.12	11.77
109.0	202.95	1820.92	565.56	2386.48	2386.48	2386.48	11.76
110.0	204.81	1840.50	565.56	2406.06	2406.06	2406.06	11.75
111.0	206.67	1860.29	565.56	2425.85	2425.85	2425.85	11.74
112.0	208.54	1880.30	565.56	2445.86	2445.86	2445.86	11.73
113.0	210.40	1900.52	565.56	2466.08	2466.08	2466.08	11.72
114.0	212.26	1920.94	565.56	2486.50	2486.50	2486.50	11.71
115.0	214.12	1941.58	565.56	2507.15	2507.15	2507.15	11.71
116.0	215.98	1962.44	565.56	2528.00	2528.00	2528.00	11.70
117.0	217.85	1983.50	565.56	2549.06	2549.06	2549.06	11.70
118.0	219.71	2004.78	565.56	2570.34	2570.34	2570.34	11.70
119.0	221.57	2026.27	565.56	2591.83	2591.83	2591.83	11.70
120.0	223.43	2047.98	565.56	2613.54	2613.54	2613.54	11.70
121.0	225.29	2069.89	565.56	2635.45	2635.45	2635.45	11.70
122.0	227.15	2092.02	565.56	2657.58	2657.58	2657.58	11.70
123.0	229.02	2114.36	565.56	2679.92	2679.92	2679.92	11.70
124.0	230.88	2136.91	565.56	2702.47	2702.47	2702.47	11.71
125.0	232.74	2159.68	565.56	2725.24	2725.24	2725.24	11.71
126.0	234.60	2182.66	565.56	2748.22	2748.22	2748.22	11.71
127.0	236.46	2205.85	565.56	2771.41	2771.41	2771.41	11.72
128.0	238.33	2229.25	565.56	2794.81	2794.81	2794.81	11.73
129.0	240.19	2252.86	565.56	2818.42	2818.42	2818.42	11.73
130.0	242.05	2276.69	565.56	2842.25	2842.25	2842.25	11.74
131.0	243.91	2300.73	565.56	2866.29	2866.29	2866.29	11.75

132.0	245.77	2324.98	565.56	2890.54	2890.54	2890.54	11.76
133.0	247.64	2349.45	565.56	2915.01	2915.01	2915.01	11.77
134.0	249.50	2374.12	565.56	2939.68	2939.68	2939.68	11.78
135.0	251.36	2399.01	565.56	2964.57	2964.57	2964.57	11.79
136.0	253.22	2424.11	565.56	2989.67	2989.67	2989.67	11.81
137.0	255.08	2449.43	565.56	3014.99	3014.99	3014.99	11.82
138.0	256.95	2474.95	565.56	3040.51	3040.51	3040.51	11.83
139.0	258.81	2500.69	565.56	3066.25	3066.25	3066.25	11.85
140.0	260.67	2526.64	565.56	3092.20	3092.20	3092.20	11.86
141.0	262.53	2552.81	565.56	3118.37	3118.37	3118.37	11.88
142.0	264.39	2579.18	565.56	3144.74	3144.74	3144.74	11.89
143.0	266.26	2605.77	565.56	3171.33	3171.33	3171.33	11.91
144.0	268.12	2632.57	565.56	3198.13	3198.13	3198.13	11.93
145.0	269.98	2659.58	565.56	3225.14	3225.14	3225.14	11.95

AXIAL LOAD VS SETTLEMENT CURVES

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD TON	TOP MOVEMENT IN.	TIP LOAD TON	TIP MOVEMENT IN.
0.1320E+00	0.2212E-04	0.2062E-02	0.1000E-04
0.6600E+00	0.1106E-03	0.1031E-01	0.5000E-04
0.1320E+01	0.2212E-03	0.2062E-01	0.1000E-03
0.6618E+02	0.1107E-01	0.1031E+01	0.5000E-02
0.9930E+02	0.1661E-01	0.1546E+01	0.7500E-02
0.1324E+03	0.2215E-01	0.2062E+01	0.1000E-01
0.3310E+03	0.5538E-01	0.5155E+01	0.2500E-01
0.6618E+03	0.1107E+00	0.1031E+02	0.5000E-01
0.9738E+03	0.1654E+00	0.1546E+02	0.7500E-01
0.1212E+04	0.2135E+00	0.2062E+02	0.1000E+00

0.2066E+04	0.4508E+00	0.5155E+02	0.2500E+00
0.2514E+04	0.7500E+00	0.1030E+03	0.5000E+00
0.2734E+04	0.1239E+01	0.1951E+03	0.9600E+00
0.2833E+04	0.2699E+01	0.3620E+03	0.2400E+01
0.3039E+04	0.5133E+01	0.5740E+03	0.4800E+01

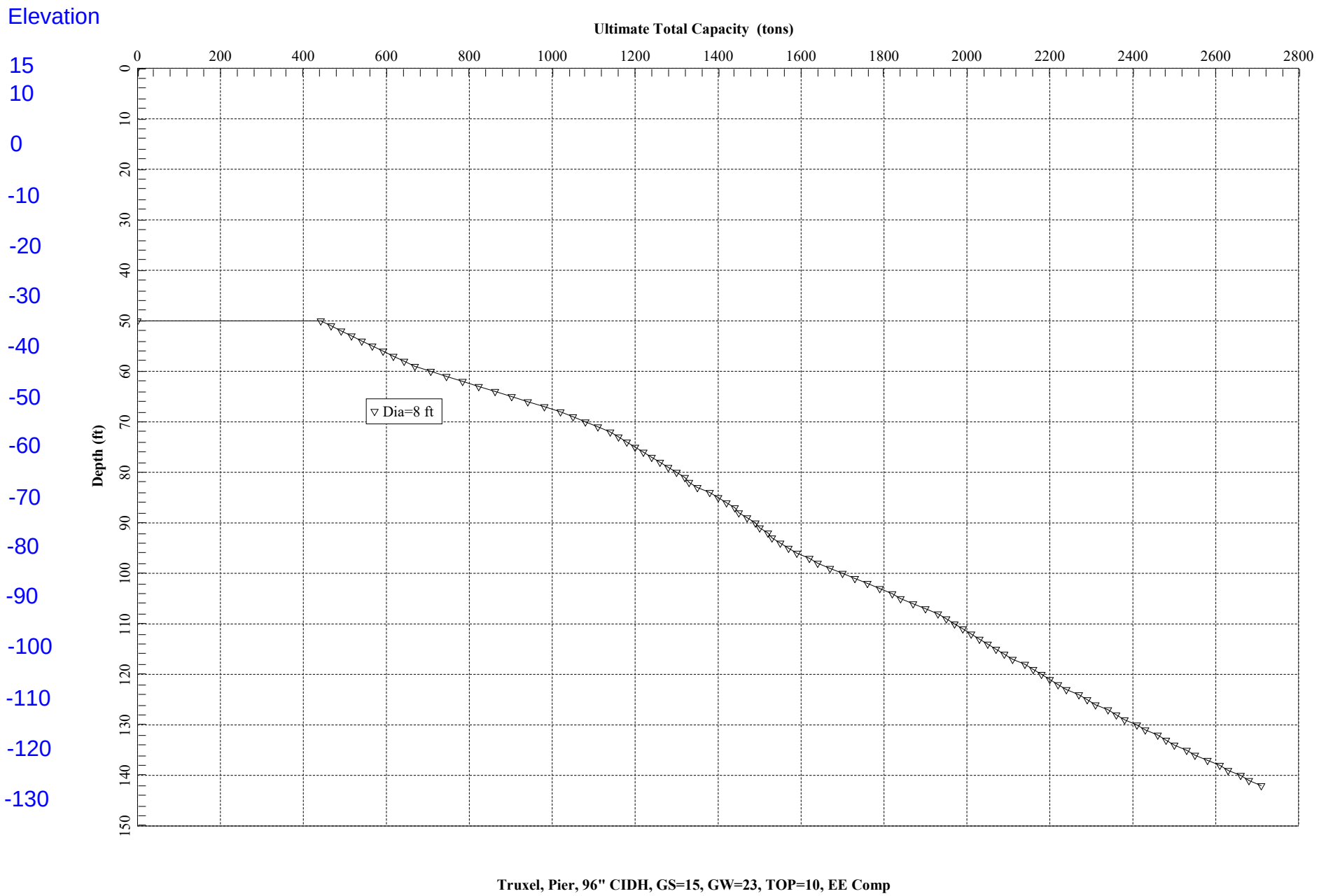
RESULT FROM UPPER-BOUND LINE

TOP LOAD TON	TOP MOVEMENT IN.	TIP LOAD TON	TIP MOVEMENT IN.
0.1960E+00	0.2759E-04	0.2946E-02	0.1000E-04
0.9802E+00	0.1380E-03	0.1473E-01	0.5000E-04
0.1960E+01	0.2759E-03	0.2946E-01	0.1000E-03
0.9843E+02	0.1382E-01	0.1473E+01	0.5000E-02
0.1477E+03	0.2074E-01	0.2209E+01	0.7500E-02
0.1969E+03	0.2765E-01	0.2946E+01	0.1000E-01
0.4923E+03	0.6914E-01	0.7364E+01	0.2500E-01
0.9787E+03	0.1381E+00	0.1473E+02	0.5000E-01
0.1417E+04	0.2047E+00	0.2209E+02	0.7500E-01
0.1705E+04	0.2581E+00	0.2946E+02	0.1000E+00
0.2500E+04	0.4952E+00	0.7364E+02	0.2500E+00
0.2803E+04	0.7825E+00	0.1468E+03	0.5000E+00
0.2936E+04	0.1264E+01	0.2715E+03	0.9600E+00
0.3039E+04	0.2724E+01	0.4298E+03	0.2400E+01
0.3220E+04	0.5153E+01	0.6108E+03	0.4800E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD TON	TOP MOVEMENT IN.	TIP LOAD TON	TIP MOVEMENT IN.
0.7676E-01	0.1721E-04	0.1178E-02	0.1000E-04
0.3838E+00	0.8607E-04	0.5891E-02	0.5000E-04
0.7676E+00	0.1721E-03	0.1178E-01	0.1000E-03
0.3844E+02	0.8611E-02	0.5891E+00	0.5000E-02

0.5767E+02	0.1292E-01	0.8837E+00	0.7500E-02
0.7690E+02	0.1723E-01	0.1178E+01	0.1000E-01
0.1923E+03	0.4307E-01	0.2946E+01	0.2500E-01
0.3846E+03	0.8613E-01	0.5891E+01	0.5000E-01
0.5743E+03	0.1291E+00	0.8837E+01	0.7500E-01
0.7439E+03	0.1705E+00	0.1178E+02	0.1000E+00
0.1531E+04	0.3975E+00	0.2946E+02	0.2500E+00
0.2214E+04	0.7168E+00	0.5915E+02	0.5000E+00
0.2531E+04	0.1214E+01	0.1188E+03	0.9600E+00
0.2628E+04	0.2675E+01	0.2941E+03	0.2400E+01
0.2859E+04	0.5113E+01	0.5373E+03	0.4800E+01



Truxel, Pier, 96" CIDH, GS=15, GW=23, TOP=10, EE Comp

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    ============================================================================

                     SHAFT for Windows, Version 2017.8.10

                      Serial Number :  500126445

                   VERTICALLY LOADED DRILLED SHAFT ANALYSIS
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    Path to file locations      : R:\GEOCON WORKING FILES\S2800-S2849\S2815-05-01 Truxel Road
Bridge\Analysis\Piles\SHAFT\
    Name of input data file     : PRELIM Pier EE Comp.sf8d
    Name of output file         : PRELIM Pier EE Comp.sf8o
    Name of plot output file    : PRELIM Pier EE Comp.sf8p
    Name of runtime file        : PRELIM Pier EE Comp.sf8r


    ----------------------------------------------------------------------------
                          Time and Date of Analysis
    ----------------------------------------------------------------------------

              Date:  July 18, 2024     Time:  10:13:39

    Truxel, Pier, 96" CIDH, GS=15, GW=23, TOP=10, EE Comp


    PROPOSED DEPTH =     142.0 FT
    ----------------


    NUMBER OF LAYERS =    4
    ------------------
```

WATER TABLE DEPTH =   0.0 FT.

FACTOR OF SAFETY APPLIED TO THE ULTIMATE SIDE FRICTION CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
  END BEARING COEFFICIENT-Nc = 0.600E+01 (*)
  UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.240E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.550E+04
  DEPTH, FT = 0.000E+00

  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
  END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
  UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.240E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT = 0.115E+03

```
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.550E+04
  DEPTH, FT                                         = 0.410E+02


LAYER NO  2----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.636E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.380E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.400E+04
  DEPTH, FT                                         = 0.410E+02

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.331E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.380E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.400E+04
  DEPTH, FT                                         = 0.750E+02

LAYER NO  3----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.464E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.500E+04
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.550E+04
```

DEPTH, FT = 0.750E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.464E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.500E+04
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.550E+04
DEPTH, FT = 0.100E+03

LAYER NO 4----SAND

AT THE TOP

SIDE FRICTION PROCEDURE, BETA METHOD
SKIN FRICTION COEFFICIENT- BETA = 0.250E+00 (*)
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.400E+04
DEPTH, FT = 0.100E+03

AT THE BOTTOM

SIDE FRICTION PROCEDURE, BETA METHOD
SKIN FRICTION COEFFICIENT- BETA = 0.250E+00 (*)
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.400E+04
DEPTH, FT = 0.165E+03

(*) ESTIMATED BY THE PROGRAM BASED ON OTHER PARAMETERS

INPUT DRILLED SHAFT INFORMATION

MINIMUM SHAFT DIAMETER	=	8.000	FT.
MAXIMUM SHAFT DIAMETER	=	8.000	FT.
RATIO BASE/SHAFT DIAMETER	=	0.000	FT.
ANGLE OF BELL	=	0.000	DEG.
IGNORED TOP PORTION	=	41.000	FT.
IGNORED BOTTOM PORTION	=	8.000	FT.
ELASTIC MODULUS, Ec	=	0.300E+07	LB/SQ IN

COMPUTATION RESULTS

- CASE ANALYZED : 1
  VARIATION LENGTH : 1
  VARIATION DIAMETER : 1

DRILLED SHAFT INFORMATION

```
 DIAMETER OF STEM          =    8.000  FT.
 DIAMETER OF BASE          =    8.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =   41.000  FT.
 IGNORED BOTTOM PORTION    =    8.000  FT.
 AREA OF ONE PERCENT STEEL =   72.392  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.300E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.
 SHAFT LENGTH              =  142.000  FT.
```

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY
APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY
APPLIED TO THE ULTIMATE SIDE RESISTANCE AND
THE ULTIMATE BASE RESISTANCE.

LENGTH (FT)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
50.0	93.10	17.09	425.08	442.17	442.17	442.17	4.75
51.0	94.96	34.42	432.15	466.57	466.57	466.57	4.91
52.0	96.82	51.97	439.22	491.20	491.20	491.20	5.07
53.0	98.68	69.74	446.29	516.03	516.03	516.03	5.23
54.0	100.54	87.70	453.36	541.06	541.06	541.06	5.38
55.0	102.41	105.85	460.43	566.28	566.28	566.28	5.53
56.0	104.27	124.17	467.50	591.67	591.67	591.67	5.67
57.0	106.13	142.64	474.57	617.21	617.21	617.21	5.82

58.0	107.99	161.26	481.64	642.90	642.90	642.90	5.95
59.0	109.85	180.01	488.71	668.72	668.72	668.72	6.09
60.0	111.72	198.88	507.95	706.83	706.83	706.83	6.33
61.0	113.58	217.85	527.43	745.28	745.28	745.28	6.56
62.0	115.44	236.92	547.11	784.03	784.03	784.03	6.79
63.0	117.30	256.07	566.96	823.03	823.03	823.03	7.02
64.0	119.16	275.28	586.96	862.24	862.24	862.24	7.24
65.0	121.03	294.55	607.08	901.63	901.63	901.63	7.45
66.0	122.89	313.87	627.28	941.15	941.15	941.15	7.66
67.0	124.75	333.22	647.55	980.77	980.77	980.77	7.86
68.0	126.61	352.58	664.98	1017.57	1017.57	1017.57	8.04
69.0	128.47	371.96	679.67	1051.63	1051.63	1051.63	8.19
70.0	130.33	391.33	691.69	1083.03	1083.03	1083.03	8.31
71.0	132.20	410.69	701.14	1111.84	1111.84	1111.84	8.41
72.0	134.06	430.03	708.10	1138.13	1138.13	1138.13	8.49
73.0	135.92	449.32	712.66	1161.98	1161.98	1161.98	8.55
74.0	137.78	468.57	714.89	1183.46	1183.46	1183.46	8.59
75.0	139.64	487.76	714.89	1202.65	1202.65	1202.65	8.61
76.0	141.51	506.88	714.89	1221.77	1221.77	1221.77	8.63
77.0	143.37	525.91	714.89	1240.80	1240.80	1240.80	8.65
78.0	145.23	544.86	714.89	1259.75	1259.75	1259.75	8.67
79.0	147.09	563.70	714.89	1278.59	1278.59	1278.59	8.69
80.0	148.95	582.42	714.89	1297.31	1297.31	1297.31	8.71
81.0	150.82	601.03	714.89	1315.92	1315.92	1315.92	8.73
82.0	152.68	619.49	714.89	1334.38	1334.38	1334.38	8.74
83.0	154.54	637.82	714.89	1352.71	1352.71	1352.71	8.75
84.0	156.40	666.96	714.89	1381.85	1381.85	1381.85	8.84
85.0	158.26	696.11	704.65	1400.76	1400.76	1400.76	8.85
86.0	160.13	725.25	693.81	1419.07	1419.07	1419.07	8.86
87.0	161.99	754.40	682.37	1436.77	1436.77	1436.77	8.87
88.0	163.85	783.54	670.33	1453.87	1453.87	1453.87	8.87
89.0	165.71	812.69	657.69	1470.37	1470.37	1470.37	8.87
90.0	167.57	841.83	644.44	1486.27	1486.27	1486.27	8.87
91.0	169.44	870.98	630.59	1501.57	1501.57	1501.57	8.86
92.0	171.30	900.12	616.14	1516.26	1516.26	1516.26	8.85
93.0	173.16	929.27	603.49	1532.76	1532.76	1532.76	8.85

94.0	175.02	958.41	592.66	1551.07	1551.07	1551.07	8.86
95.0	176.88	987.56	583.62	1571.18	1571.18	1571.18	8.88
96.0	178.74	1016.70	576.40	1593.10	1593.10	1593.10	8.91
97.0	180.61	1045.84	570.98	1616.82	1616.82	1616.82	8.95
98.0	182.47	1074.99	567.37	1642.36	1642.36	1642.36	9.00
99.0	184.33	1104.13	565.56	1669.69	1669.69	1669.69	9.06
100.0	186.19	1133.28	565.56	1698.84	1698.84	1698.84	9.12
101.0	188.05	1162.42	565.56	1727.98	1727.98	1727.98	9.19
102.0	189.92	1191.57	565.56	1757.13	1757.13	1757.13	9.25
103.0	191.78	1220.71	565.56	1786.27	1786.27	1786.27	9.31
104.0	193.64	1249.86	565.56	1815.42	1815.42	1815.42	9.38
105.0	195.50	1279.00	565.56	1844.56	1844.56	1844.56	9.44
106.0	197.36	1308.15	565.56	1873.71	1873.71	1873.71	9.49
107.0	199.23	1337.29	565.56	1902.85	1902.85	1902.85	9.55
108.0	201.09	1366.44	565.56	1932.00	1932.00	1932.00	9.61
109.0	202.95	1385.81	565.56	1951.37	1951.37	1951.37	9.62
110.0	204.81	1405.38	565.56	1970.94	1970.94	1970.94	9.62
111.0	206.67	1425.18	565.56	1990.74	1990.74	1990.74	9.63
112.0	208.54	1445.18	565.56	2010.74	2010.74	2010.74	9.64
113.0	210.40	1465.40	565.56	2030.96	2030.96	2030.96	9.65
114.0	212.26	1485.83	565.56	2051.39	2051.39	2051.39	9.66
115.0	214.12	1506.47	565.56	2072.03	2072.03	2072.03	9.68
116.0	215.98	1527.32	565.56	2092.88	2092.88	2092.88	9.69
117.0	217.85	1548.39	565.56	2113.95	2113.95	2113.95	9.70
118.0	219.71	1569.66	565.56	2135.22	2135.22	2135.22	9.72
119.0	221.57	1591.15	565.56	2156.71	2156.71	2156.71	9.73
120.0	223.43	1612.86	565.56	2178.42	2178.42	2178.42	9.75
121.0	225.29	1634.77	565.56	2200.33	2200.33	2200.33	9.77
122.0	227.15	1656.90	565.56	2222.46	2222.46	2222.46	9.78
123.0	229.02	1679.24	565.56	2244.80	2244.80	2244.80	9.80
124.0	230.88	1701.79	565.56	2267.35	2267.35	2267.35	9.82
125.0	232.74	1724.56	565.56	2290.12	2290.12	2290.12	9.84
126.0	234.60	1747.54	565.56	2313.10	2313.10	2313.10	9.86
127.0	236.46	1770.73	565.56	2336.29	2336.29	2336.29	9.88
128.0	238.33	1794.13	565.56	2359.69	2359.69	2359.69	9.90
129.0	240.19	1817.74	565.56	2383.30	2383.30	2383.30	9.92

130.0	242.05	1841.57	565.56	2407.13	2407.13	2407.13	9.94
131.0	243.91	1865.61	565.56	2431.17	2431.17	2431.17	9.97
132.0	245.77	1889.86	565.56	2455.42	2455.42	2455.42	9.99
133.0	247.64	1914.33	565.56	2479.89	2479.89	2479.89	10.01
134.0	249.50	1939.00	565.56	2504.56	2504.56	2504.56	10.04
135.0	251.36	1963.89	565.56	2529.45	2529.45	2529.45	10.06
136.0	253.22	1988.99	565.56	2554.55	2554.55	2554.55	10.09
137.0	255.08	2014.31	565.56	2579.87	2579.87	2579.87	10.11
138.0	256.95	2039.83	565.56	2605.39	2605.39	2605.39	10.14
139.0	258.81	2065.57	565.56	2631.13	2631.13	2631.13	10.17
140.0	260.67	2091.52	565.56	2657.08	2657.08	2657.08	10.19
141.0	262.53	2117.69	565.56	2683.25	2683.25	2683.25	10.22
142.0	264.39	2144.06	565.56	2709.62	2709.62	2709.62	10.25

AXIAL LOAD VS SETTLEMENT CURVES

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD TON	TOP MOVEMENT IN.	TIP LOAD TON	TIP MOVEMENT IN.
0.1072E+00	0.2090E-04	0.2062E-02	0.1000E-04
0.5358E+00	0.1045E-03	0.1031E-01	0.5000E-04
0.1072E+01	0.2090E-03	0.2062E-01	0.1000E-03
0.5377E+02	0.1047E-01	0.1031E+01	0.5000E-02
0.8066E+02	0.1570E-01	0.1546E+01	0.7500E-02
0.1076E+03	0.2094E-01	0.2062E+01	0.1000E-01
0.2689E+03	0.5235E-01	0.5155E+01	0.2500E-01
0.5378E+03	0.1047E+00	0.1031E+02	0.5000E-01
0.8010E+03	0.1567E+00	0.1546E+02	0.7500E-01
0.1000E+04	0.2029E+00	0.2062E+02	0.1000E+00
0.1746E+04	0.4334E+00	0.5155E+02	0.2500E+00

0.2136E+04	0.7287E+00	0.1030E+03	0.5000E+00
0.2340E+04	0.1216E+01	0.1951E+03	0.9600E+00
0.2441E+04	0.2676E+01	0.3620E+03	0.2400E+01
0.2648E+04	0.5109E+01	0.5740E+03	0.4800E+01

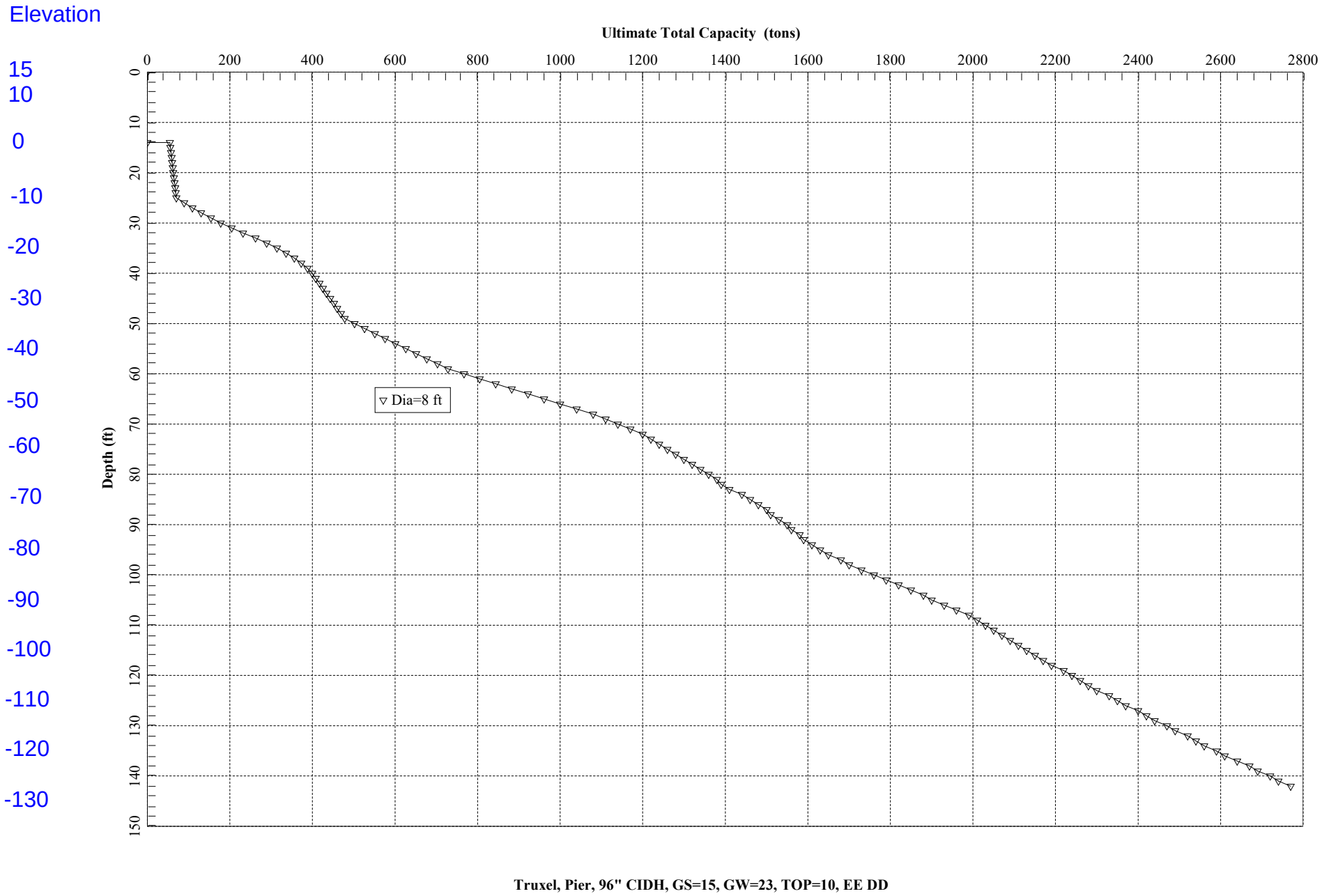
RESULT FROM UPPER-BOUND LINE

TOP LOAD TON	TOP MOVEMENT IN.	TIP LOAD TON	TIP MOVEMENT IN.
0.1564E+00	0.2572E-04	0.2946E-02	0.1000E-04
0.7822E+00	0.1286E-03	0.1473E-01	0.5000E-04
0.1564E+01	0.2572E-03	0.2946E-01	0.1000E-03
0.7862E+02	0.1289E-01	0.1473E+01	0.5000E-02
0.1179E+03	0.1934E-01	0.2209E+01	0.7500E-02
0.1573E+03	0.2579E-01	0.2946E+01	0.1000E-01
0.3932E+03	0.6448E-01	0.7364E+01	0.2500E-01
0.7864E+03	0.1290E+00	0.1473E+02	0.5000E-01
0.1157E+04	0.1920E+00	0.2209E+02	0.7500E-01
0.1401E+04	0.2431E+00	0.2946E+02	0.1000E+00
0.2114E+04	0.4738E+00	0.7364E+02	0.2500E+00
0.2395E+04	0.7590E+00	0.1468E+03	0.5000E+00
0.2527E+04	0.1240E+01	0.2715E+03	0.9600E+00
0.2629E+04	0.2699E+01	0.4298E+03	0.2400E+01
0.2810E+04	0.5127E+01	0.6108E+03	0.4800E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD TON	TOP MOVEMENT IN.	TIP LOAD TON	TIP MOVEMENT IN.
0.6322E-01	0.1652E-04	0.1178E-02	0.1000E-04
0.3161E+00	0.8261E-04	0.5891E-02	0.5000E-04
0.6322E+00	0.1652E-03	0.1178E-01	0.1000E-03
0.3167E+02	0.8266E-02	0.5891E+00	0.5000E-02
0.4752E+02	0.1240E-01	0.8837E+00	0.7500E-02

0.6336E+02	0.1653E-01	0.1178E+01	0.1000E-01
0.1584E+03	0.4134E-01	0.2946E+01	0.2500E-01
0.3168E+03	0.8268E-01	0.5891E+01	0.5000E-01
0.4750E+03	0.1240E+00	0.8837E+01	0.7500E-01
0.6176E+03	0.1640E+00	0.1178E+02	0.1000E+00
0.1288E+04	0.3844E+00	0.2946E+02	0.2500E+00
0.1871E+04	0.6979E+00	0.5915E+02	0.5000E+00
0.2152E+04	0.1192E+01	0.1188E+03	0.9600E+00
0.2252E+04	0.2653E+01	0.2941E+03	0.2400E+01
0.2486E+04	0.5090E+01	0.5373E+03	0.4800E+01



Truxel, Pier, 96" CIDH, GS=15, GW=23, TOP=10, EE DD

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    ============================================================================

                     SHAFT for Windows, Version 2017.8.10

                      Serial Number :  500126445

                   VERTICALLY LOADED DRILLED SHAFT ANALYSIS
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                          All Rights Reserved

    ============================================================================


    Path to file locations      : R:\GEOCON WORKING FILES\S2800-S2849\S2815-05-01 Truxel Road
Bridge\Analysis\Piles\SHAFT\
    Name of input data file     : PRELIM Pier EE DD.sf8d
    Name of output file         : PRELIM Pier EE DD.sf8o
    Name of plot output file    : PRELIM Pier EE DD.sf8p
    Name of runtime file        : PRELIM Pier EE DD.sf8r


    ----------------------------------------------------------------------------
                         Time and Date of Analysis
    ----------------------------------------------------------------------------

              Date:  July 18, 2024     Time:  11:53:04

    Truxel, Pier, 96" CIDH, GS=15, GW=23, TOP=10, EE DD


    PROPOSED DEPTH =     142.0 FT
    ----------------


    NUMBER OF LAYERS =    4
    ------------------
```

WATER TABLE DEPTH =   0.0 FT.

FACTOR OF SAFETY APPLIED TO THE ULTIMATE SIDE FRICTION CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
  END BEARING COEFFICIENT-Nc = 0.600E+01 (*)
  UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.240E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.550E+04
  DEPTH, FT = 0.000E+00

  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
  END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
  UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.240E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT = 0.115E+03

```
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.550E+04
  DEPTH, FT                                         = 0.410E+02


LAYER NO  2----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.636E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.380E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.400E+04
  DEPTH, FT                                         = 0.410E+02

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.331E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.380E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.400E+04
  DEPTH, FT                                         = 0.750E+02

LAYER NO  3----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.464E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.500E+04
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.550E+04
```

DEPTH, FT = 0.750E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.464E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.500E+04
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.550E+04
DEPTH, FT = 0.100E+03

LAYER NO 4----SAND

AT THE TOP

SIDE FRICTION PROCEDURE, BETA METHOD
SKIN FRICTION COEFFICIENT- BETA = 0.250E+00 (*)
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.400E+04
DEPTH, FT = 0.100E+03

AT THE BOTTOM

SIDE FRICTION PROCEDURE, BETA METHOD
SKIN FRICTION COEFFICIENT- BETA = 0.250E+00 (*)
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.400E+04
DEPTH, FT = 0.165E+03

(*) ESTIMATED BY THE PROGRAM BASED ON OTHER PARAMETERS

INPUT DRILLED SHAFT INFORMATION

MINIMUM SHAFT DIAMETER	=	8.000	FT.
MAXIMUM SHAFT DIAMETER	=	8.000	FT.
RATIO BASE/SHAFT DIAMETER	=	0.000	FT.
ANGLE OF BELL	=	0.000	DEG.
IGNORED TOP PORTION	=	5.000	FT.
IGNORED BOTTOM PORTION	=	8.000	FT.
ELASTIC MODULUS, Ec	=	0.300E+07	LB/SQ IN

COMPUTATION RESULTS

- CASE ANALYZED : 1
  VARIATION LENGTH : 1
  VARIATION DIAMETER : 1

DRILLED SHAFT INFORMATION

```
 DIAMETER OF STEM          =    8.000  FT.
 DIAMETER OF BASE          =    8.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    5.000  FT.
 IGNORED BOTTOM PORTION    =    8.000  FT.
 AREA OF ONE PERCENT STEEL =   72.392  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.300E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.
 SHAFT LENGTH              =  142.000  FT.
```

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY
APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY
APPLIED TO THE ULTIMATE SIDE RESISTANCE AND
THE ULTIMATE BASE RESISTANCE.

LENGTH (FT)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
14.0	26.07	1.66	52.80	54.46	54.46	54.46	2.09
15.0	27.93	3.32	52.59	55.91	55.91	55.91	2.00
16.0	29.79	4.98	52.33	57.30	57.30	57.30	1.92
17.0	31.65	6.64	52.04	58.67	58.67	58.67	1.85
18.0	33.51	8.29	51.74	60.03	60.03	60.03	1.79
19.0	35.38	9.95	51.45	61.41	61.41	61.41	1.74
20.0	37.24	11.61	51.20	62.81	62.81	62.81	1.69
21.0	39.10	13.27	50.98	64.25	64.25	64.25	1.64

22.0	40.96	14.93	50.81	65.74	65.74	65.74	1.60
23.0	42.82	16.59	50.68	67.27	67.27	67.27	1.57
24.0	44.69	18.25	50.58	68.83	68.83	68.83	1.54
25.0	46.55	19.91	50.52	70.43	70.43	70.43	1.51
26.0	48.41	21.57	67.38	88.95	88.95	88.95	1.84
27.0	50.27	23.23	85.73	108.96	108.96	108.96	2.17
28.0	52.13	24.88	105.61	130.49	130.49	130.49	2.50
29.0	54.00	26.54	127.02	153.56	153.56	153.56	2.84
30.0	55.86	28.20	150.00	178.20	178.20	178.20	3.19
31.0	57.72	29.86	174.57	204.43	204.43	204.43	3.54
32.0	59.58	31.52	200.76	232.28	232.28	232.28	3.90
33.0	61.44	33.18	228.61	261.79	261.79	261.79	4.26
34.0	63.31	34.84	254.15	288.99	288.99	288.99	4.56
35.0	65.17	36.50	277.31	313.81	313.81	313.81	4.82
36.0	67.03	38.16	298.01	336.16	336.16	336.16	5.02
37.0	68.89	39.82	316.15	355.96	355.96	355.96	5.17
38.0	70.75	41.47	331.65	373.12	373.12	373.12	5.27
39.0	72.62	43.13	344.42	387.56	387.56	387.56	5.34
40.0	74.48	44.79	354.39	399.18	399.18	399.18	5.36
41.0	76.34	46.45	361.46	407.91	407.91	407.91	5.34
42.0	78.20	48.11	368.53	416.64	416.64	416.64	5.33
43.0	80.06	49.77	375.60	425.37	425.37	425.37	5.31
44.0	81.92	51.43	382.67	434.09	434.09	434.09	5.30
45.0	83.79	53.09	389.73	442.82	442.82	442.82	5.29
46.0	85.65	54.75	396.80	451.55	451.55	451.55	5.27
47.0	87.51	56.41	403.87	460.28	460.28	460.28	5.26
48.0	89.37	58.06	410.94	469.01	469.01	469.01	5.25
49.0	91.23	59.72	418.01	477.74	477.74	477.74	5.24
50.0	93.10	76.81	425.08	501.90	501.90	501.90	5.39
51.0	94.96	94.14	432.15	526.29	526.29	526.29	5.54
52.0	96.82	111.70	439.22	550.92	550.92	550.92	5.69
53.0	98.68	129.46	446.29	575.75	575.75	575.75	5.83
54.0	100.54	147.43	453.36	600.79	600.79	600.79	5.98
55.0	102.41	165.57	460.43	626.00	626.00	626.00	6.11
56.0	104.27	183.89	467.50	651.39	651.39	651.39	6.25
57.0	106.13	202.37	474.57	676.94	676.94	676.94	6.38

58.0	107.99	220.99	481.64	702.62	702.62	702.62	6.51
59.0	109.85	239.73	488.71	728.44	728.44	728.44	6.63
60.0	111.72	258.60	507.95	766.55	766.55	766.55	6.86
61.0	113.58	277.58	527.43	805.00	805.00	805.00	7.09
62.0	115.44	296.64	547.11	843.75	843.75	843.75	7.31
63.0	117.30	315.79	566.96	882.75	882.75	882.75	7.53
64.0	119.16	335.01	586.96	921.96	921.96	921.96	7.74
65.0	121.03	354.28	607.08	961.35	961.35	961.35	7.94
66.0	122.89	373.59	627.28	1000.87	1000.87	1000.87	8.14
67.0	124.75	392.94	647.55	1040.49	1040.49	1040.49	8.34
68.0	126.61	412.31	664.98	1077.29	1077.29	1077.29	8.51
69.0	128.47	431.68	679.67	1111.35	1111.35	1111.35	8.65
70.0	130.33	451.06	691.69	1142.75	1142.75	1142.75	8.77
71.0	132.20	470.42	701.14	1171.56	1171.56	1171.56	8.86
72.0	134.06	489.75	708.10	1197.85	1197.85	1197.85	8.94
73.0	135.92	509.05	712.66	1221.70	1221.70	1221.70	8.99
74.0	137.78	528.29	714.89	1243.18	1243.18	1243.18	9.02
75.0	139.64	547.48	714.89	1262.37	1262.37	1262.37	9.04
76.0	141.51	566.60	714.89	1281.49	1281.49	1281.49	9.06
77.0	143.37	585.64	714.89	1300.53	1300.53	1300.53	9.07
78.0	145.23	604.58	714.89	1319.47	1319.47	1319.47	9.09
79.0	147.09	623.42	714.89	1338.31	1338.31	1338.31	9.10
80.0	148.95	642.15	714.89	1357.04	1357.04	1357.04	9.11
81.0	150.82	660.75	714.89	1375.64	1375.64	1375.64	9.12
82.0	152.68	679.22	714.89	1394.11	1394.11	1394.11	9.13
83.0	154.54	697.54	714.89	1412.43	1412.43	1412.43	9.14
84.0	156.40	726.69	714.89	1441.57	1441.57	1441.57	9.22
85.0	158.26	755.83	704.65	1460.48	1460.48	1460.48	9.23
86.0	160.13	784.97	693.81	1478.79	1478.79	1478.79	9.24
87.0	161.99	814.12	682.37	1496.49	1496.49	1496.49	9.24
88.0	163.85	843.26	670.33	1513.60	1513.60	1513.60	9.24
89.0	165.71	872.41	657.69	1530.10	1530.10	1530.10	9.23
90.0	167.57	901.55	644.44	1545.99	1545.99	1545.99	9.23
91.0	169.44	930.70	630.59	1561.29	1561.29	1561.29	9.21
92.0	171.30	959.84	616.14	1575.98	1575.98	1575.98	9.20
93.0	173.16	988.99	603.49	1592.48	1592.48	1592.48	9.20

94.0	175.02	1018.13	592.66	1610.79	1610.79	1610.79	9.20
95.0	176.88	1047.28	583.62	1630.90	1630.90	1630.90	9.22
96.0	178.74	1076.42	576.40	1652.82	1652.82	1652.82	9.25
97.0	180.61	1105.57	570.98	1676.55	1676.55	1676.55	9.28
98.0	182.47	1134.71	567.37	1702.08	1702.08	1702.08	9.33
99.0	184.33	1163.86	565.56	1729.42	1729.42	1729.42	9.38
100.0	186.19	1193.00	565.56	1758.56	1758.56	1758.56	9.44
101.0	188.05	1222.15	565.56	1787.71	1787.71	1787.71	9.51
102.0	189.92	1251.29	565.56	1816.85	1816.85	1816.85	9.57
103.0	191.78	1280.44	565.56	1846.00	1846.00	1846.00	9.63
104.0	193.64	1309.58	565.56	1875.14	1875.14	1875.14	9.68
105.0	195.50	1338.73	565.56	1904.29	1904.29	1904.29	9.74
106.0	197.36	1367.87	565.56	1933.43	1933.43	1933.43	9.80
107.0	199.23	1397.02	565.56	1962.58	1962.58	1962.58	9.85
108.0	201.09	1426.16	565.56	1991.72	1991.72	1991.72	9.90
109.0	202.95	1445.53	565.56	2011.09	2011.09	2011.09	9.91
110.0	204.81	1465.11	565.56	2030.67	2030.67	2030.67	9.91
111.0	206.67	1484.90	565.56	2050.46	2050.46	2050.46	9.92
112.0	208.54	1504.90	565.56	2070.46	2070.46	2070.46	9.93
113.0	210.40	1525.12	565.56	2090.68	2090.68	2090.68	9.94
114.0	212.26	1545.55	565.56	2111.11	2111.11	2111.11	9.95
115.0	214.12	1566.19	565.56	2131.75	2131.75	2131.75	9.96
116.0	215.98	1587.04	565.56	2152.60	2152.60	2152.60	9.97
117.0	217.85	1608.11	565.56	2173.67	2173.67	2173.67	9.98
118.0	219.71	1629.39	565.56	2194.95	2194.95	2194.95	9.99
119.0	221.57	1650.88	565.56	2216.44	2216.44	2216.44	10.00
120.0	223.43	1672.58	565.56	2238.14	2238.14	2238.14	10.02
121.0	225.29	1694.50	565.56	2260.06	2260.06	2260.06	10.03
122.0	227.15	1716.62	565.56	2282.18	2282.18	2282.18	10.05
123.0	229.02	1738.96	565.56	2304.52	2304.52	2304.52	10.06
124.0	230.88	1761.52	565.56	2327.08	2327.08	2327.08	10.08
125.0	232.74	1784.28	565.56	2349.84	2349.84	2349.84	10.10
126.0	234.60	1807.26	565.56	2372.82	2372.82	2372.82	10.11
127.0	236.46	1830.45	565.56	2396.01	2396.01	2396.01	10.13
128.0	238.33	1853.85	565.56	2419.41	2419.41	2419.41	10.15
129.0	240.19	1877.47	565.56	2443.03	2443.03	2443.03	10.17

130.0	242.05	1901.29	565.56	2466.85	2466.85	2466.85	10.19
131.0	243.91	1925.33	565.56	2490.89	2490.89	2490.89	10.21
132.0	245.77	1949.58	565.56	2515.14	2515.14	2515.14	10.23
133.0	247.64	1974.05	565.56	2539.61	2539.61	2539.61	10.26
134.0	249.50	1998.73	565.56	2564.29	2564.29	2564.29	10.28
135.0	251.36	2023.61	565.56	2589.17	2589.17	2589.17	10.30
136.0	253.22	2048.72	565.56	2614.28	2614.28	2614.28	10.32
137.0	255.08	2074.03	565.56	2639.59	2639.59	2639.59	10.35
138.0	256.95	2099.56	565.56	2665.12	2665.12	2665.12	10.37
139.0	258.81	2125.30	565.56	2690.86	2690.86	2690.86	10.40
140.0	260.67	2151.25	565.56	2716.81	2716.81	2716.81	10.42
141.0	262.53	2177.41	565.56	2742.97	2742.97	2742.97	10.45
142.0	264.39	2203.79	565.56	2769.35	2769.35	2769.35	10.47

AXIAL LOAD VS SETTLEMENT CURVES

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD TON	TOP MOVEMENT IN.	TIP LOAD TON	TIP MOVEMENT IN.
0.1060E+00	0.2070E-04	0.2062E-02	0.1000E-04
0.5298E+00	0.1035E-03	0.1031E-01	0.5000E-04
0.1060E+01	0.2070E-03	0.2062E-01	0.1000E-03
0.5310E+02	0.1036E-01	0.1031E+01	0.5000E-02
0.7967E+02	0.1555E-01	0.1546E+01	0.7500E-02
0.1062E+03	0.2073E-01	0.2062E+01	0.1000E-01
0.2656E+03	0.5182E-01	0.5155E+01	0.2500E-01
0.5312E+03	0.1036E+00	0.1031E+02	0.5000E-01
0.7868E+03	0.1551E+00	0.1546E+02	0.7500E-01
0.9801E+03	0.2008E+00	0.2062E+02	0.1000E+00
0.1705E+04	0.4300E+00	0.5155E+02	0.2500E+00

0.2080E+04	0.7244E+00	0.1030E+03	0.5000E+00
0.2278E+04	0.1212E+01	0.1951E+03	0.9600E+00
0.2375E+04	0.2671E+01	0.3620E+03	0.2400E+01
0.2582E+04	0.5104E+01	0.5740E+03	0.4800E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD TON	TOP MOVEMENT IN.	TIP LOAD TON	TIP MOVEMENT IN.
0.1556E+00	0.2544E-04	0.2946E-02	0.1000E-04
0.7778E+00	0.1272E-03	0.1473E-01	0.5000E-04
0.1556E+01	0.2544E-03	0.2946E-01	0.1000E-03
0.7805E+02	0.1274E-01	0.1473E+01	0.5000E-02
0.1171E+03	0.1911E-01	0.2209E+01	0.7500E-02
0.1561E+03	0.2549E-01	0.2946E+01	0.1000E-01
0.3904E+03	0.6372E-01	0.7364E+01	0.2500E-01
0.7774E+03	0.1274E+00	0.1473E+02	0.5000E-01
0.1135E+04	0.1896E+00	0.2209E+02	0.7500E-01
0.1368E+04	0.2400E+00	0.2946E+02	0.1000E+00
0.2058E+04	0.4695E+00	0.7364E+02	0.2500E+00
0.2333E+04	0.7543E+00	0.1468E+03	0.5000E+00
0.2464E+04	0.1235E+01	0.2715E+03	0.9600E+00
0.2563E+04	0.2694E+01	0.4298E+03	0.2400E+01
0.2744E+04	0.5123E+01	0.6108E+03	0.4800E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD TON	TOP MOVEMENT IN.	TIP LOAD TON	TIP MOVEMENT IN.
0.6205E-01	0.1640E-04	0.1178E-02	0.1000E-04
0.3102E+00	0.8199E-04	0.5891E-02	0.5000E-04
0.6205E+00	0.1640E-03	0.1178E-01	0.1000E-03
0.3106E+02	0.8202E-02	0.5891E+00	0.5000E-02
0.4660E+02	0.1230E-01	0.8837E+00	0.7500E-02

0.6214E+02	0.1641E-01	0.1178E+01	0.1000E-01
0.1554E+03	0.4102E-01	0.2946E+01	0.2500E-01
0.3108E+03	0.8204E-01	0.5891E+01	0.5000E-01
0.4656E+03	0.1230E+00	0.8837E+01	0.7500E-01
0.6055E+03	0.1627E+00	0.1178E+02	0.1000E+00
0.1260E+04	0.3819E+00	0.2946E+02	0.2500E+00
0.1820E+04	0.6940E+00	0.5915E+02	0.5000E+00
0.2090E+04	0.1188E+01	0.1188E+03	0.9600E+00
0.2186E+04	0.2648E+01	0.2941E+03	0.2400E+01
0.2421E+04	0.5086E+01	0.5373E+03	0.4800E+01

Liquefaction Induced Downdrag

Caltrans Geotechnical Manual, January 2020

Please refer to this manual when using this spreadsheet.

Project No.	S2815-05-01	
Project Name:	Truxel Road Bridge	
Support Location:	**Pier 9-20 PRELIMINARY**	
Boring/CPT:	Various	
Pile Type:	96" CIDH	
Pile diameter, inches:	96	
Top of Pile Elev., ft:	10.0	
Scour Ground Surface	15.0	After degradation/contraction scour only
Design Groundwater Elev., ft:	23.0	
Top of Liquefaction Zone Elev., ft:	15.0	
Bottom of Liquefaction Zone Elev., ft:	-26.0	
Approx. Depth of Middle of Liq. Zone, ft.:	20.5	or 6.2 meters
Pile Tip Elev., ft:	**-85.0**	For Extreme Event-I Limit State, Compression
Pile Length, ft:	95.0	
Pile Depth from Ground Surface, ft:	100.0	
Pile Weight / Foot, lb:	7288	
W'p, kips:	685.6	Pile Weight, effective
Permanent Load Per Support, kips:	1,800.0	Service-I Limit State Permanent Load
Number of Piles Per Support:	1	
$(Q_{EQ})_{Perm}$, kips:	1800.0	Permanent superstructure gravity load
Compression Load Per Pile, kips:	2,700.0	Extreme Event-I Limit State, Compression
$(Q_{EQ})_I$, kips:	900.0	
H_S, ft	0.0	Thickness of Surface Layer, see Figures 3 and 4
H_L, ft	41.0	Thickness of Liquefied Soil Layer, see Figures 3 and 4
a_{max}, g	0.26	PGA for 975-year return period
Is there potential for Surface Manifestation?	Yes	If yes, ignore pile nominal resistances from lowest liquefied layer and overlying layers in Extreme Event-I, Compression
$(N_1)_{60}$, average, in liquefiable soil:	8.0	
σ'_{vo}, average, in liquefiable soil, psf:	2,173	or 1.0 atmospheres (effective vertical stress)
S_r, psf:	240	Undrained residual shear strength of liquefied soil (average)

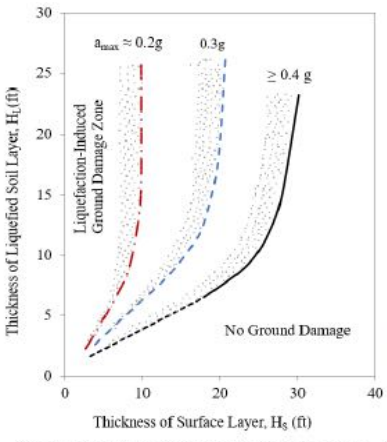


Figure 3. Boundaries for Surface Manifestation of Soil Liquefaction (Modified After Ishihara, 1985)

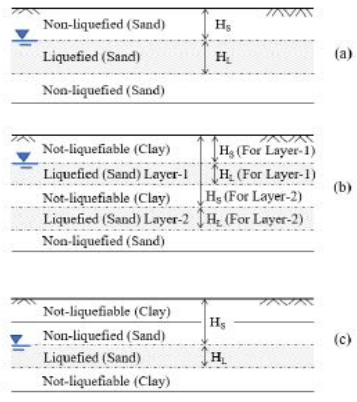


Figure 4. Definitions for Thickness of Surface Layer (H_s) and Thickness of Liquefiable Sand Layer (H_L) in Figure 3

Use SHAFT or APILE to determine the Design Tip Elevation for Extreme Event-I, Compression, ignoring soil layers above the bottom of the liquefied layer per the analysis above if/as required.

Q_{EQ} (Compression Load+W'p), kips:	3,385.6	
Round up to next 10 kip interval, kips:	3,390	
Actual calculated capacity, kips:	3,396	*Include full side friction and end bearing components.*
Length OK?	YES	If the pile length is too short, lower the Pile Tip Elev., above.
Pile embedment to pile diameter ratio:	7.4	Should be greater than 1.5 to allow full soil end-bearing nominal resistance.
Sufficient embedment for nominal end bearing?:	YES	If not, reduce nominal end bearing capacity in soils.

At this point, double check the design pile tip elevations for Service-I and Strength Limit States, lateral, and uplift. If any of these control, use the lower pile tip from those analyses.

Tip elev. used for Downdrag Load Analysis, ft:	**-127.0**	Start with the tip elev. from EE-I Compression load (or other pile tips if they control)

Using S , and the EE-I Compression soil model, calculate axial pile load vs. settlements for pile top and pile tip at the above tip elev.

$(Q_{EQ})_{Perm}$, kips:	1800.0	Permanent superstructure gravity load
Round up to next 10 kip interval, kips:	1800	

Plot the load vs. settlement curves from the SHAFT or APILE analysis printout. Use the above load to estimate top and corresponding tip settlements.

$(\delta_t)_{perm}$, Top Settlement, in.:	0.18	
$(\delta_b)_{perm}$, Tip Settlement, in.:	0.18	
Estimated settlement in liquefied layer, ft.:	0.483	or 5.80 in. From Idriss and Boulanger, 2008

Plot pile and ground settlement profiles (see manual, use elevation instead of depth). Calculate weighted average of z_{max}, per below and Table 1.

Clay thicknesses to top of liq. zone, ft.:	0	
Sand thicknesses to top of liq. zone, ft.:	41	
z_{max} / D from Table 1 for clay and pile type:	0.008	
z_{max} / D from Table 1 for sand and pile type:	0.01	
z_{max} / D:	0.01	or 1 percent
z_{max}, in.:	0.96	
δ_O, from plot, settlement at point "O", in.:	0.18	
$\delta_{c\text{-}Liq}$, in.:	1.14	

Table 1. Parameter z_{max} for Various Pile and Soil Types

Pile Type	Soil Type	$\frac{z_{max}}{D}$
Driven-Closed End	Sand or Clay	0.03
Driven – Open Ended	Clay	0.02
	Sand	0.03
Drilled Shafts	Clay	0.008
	Sand	0.01

Plot Point A on the ground settlement profile using the $\delta_{c\text{-}Liq}$ settlement value, above.

Depth of Point A from ground surface, ft:	33	
Elevation of Point A, ft:	-18.0	

Use Point A elevation (lowest downdrag elevation) to calculate downdrag on the pile, using residual shear strengths for liquefied soils.

DD_{max}, maximum (nominal) downdrag load, kips:	66.4	Account for adjustment to DD-related loads (existing pile DD on new foundations, alternate analysis methods from the designer, if applicable)
	66.4 kips DD plus	0 kips adjustment per structural engineer (if applicable)

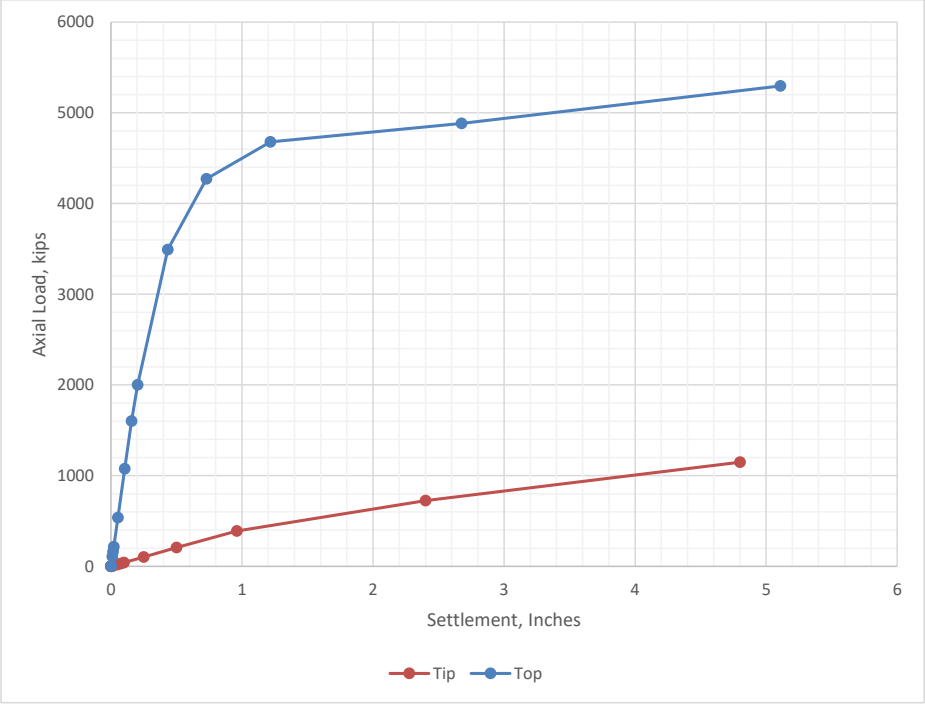
Pile capacity calculation below may be iterative based on pile length and capacity, with effective pile weight changing with pile length.

Pile Tip Depth from Ground Surface, ft:	73	
Pile Tip Elev., ft:	**-58.0**	For EE-I DD
Pile Length, ft:	68.0	
W'p, kips:	490.5	
Extreme Event Limit-I Downdrag load, kips:	2356.9	
Round up to next 10 kip interval, kips:	2,360	EE-I DD, equals permanent load + DD_{max} + W'p, to be generated below elevation of Point A
Pile Length Below Ground Surface for EE-I DD, ft:	73	
Pile Tip Elev. for EE-I DD load below Point A, ft:	-58.0	This needs to be at or above the Pile Tip Elev., above, for pile capacity calculation
Is EE-I DD pile tip elevation low enough?	YES	
Pile Tip Elev. (ft) for use:	**-127.0**	*Lowest tip elevation from Extreme Event-I Compression and Extreme Event-I Downdrag*
Design pile length, ft.:	**137.0**	*From top of pile elevation*

Pile Load-Settlement Curves

Data from SHAFT:

Top Load		Top Movement	Tip Load		Tip Movement
tons	kips	inch	tons	kips	inch
0.1072	0.2144	0.0000209	0.002062	0.004124	0.00001
0.5358	1.0716	0.0001045	0.01031	0.02062	0.00005
1.072	2.144	0.000209	0.02062	0.04124	0.0001
53.77	107.54	0.01047	1.031	2.062	0.005
80.66	161.32	0.0157	1.546	3.092	0.0075
107.6	215.2	0.02094	2.062	4.124	0.01
268.9	537.8	0.05235	5.155	10.31	0.025
537.8	1075.6	0.1047	10.31	20.62	0.05
801	1602	0.1567	15.46	30.92	0.075
1000	2000	0.2029	20.62	41.24	0.1
1746	3492	0.4334	51.55	103.1	0.25
2136	4272	0.7287	103	206	0.5
2340	4680	1.216	195.1	390.2	0.96
2441	4882	2.676	362	724	2.4
2648	5296	5.109	574	1148	4.8



Interpolating Linear Values

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High:	1000	0.2029
Desired:	900	0.18
	tons	inches

	Value 1	Value 2
Low:		
High:		
Desired:		#DIV/0!
	tons	inches

PROJECT NAME TRUXEL RD BR.

PRELIM PILE (96" ϕ CIDH)

PROJECT NO S2815-05-01

BY _____ DATE _____

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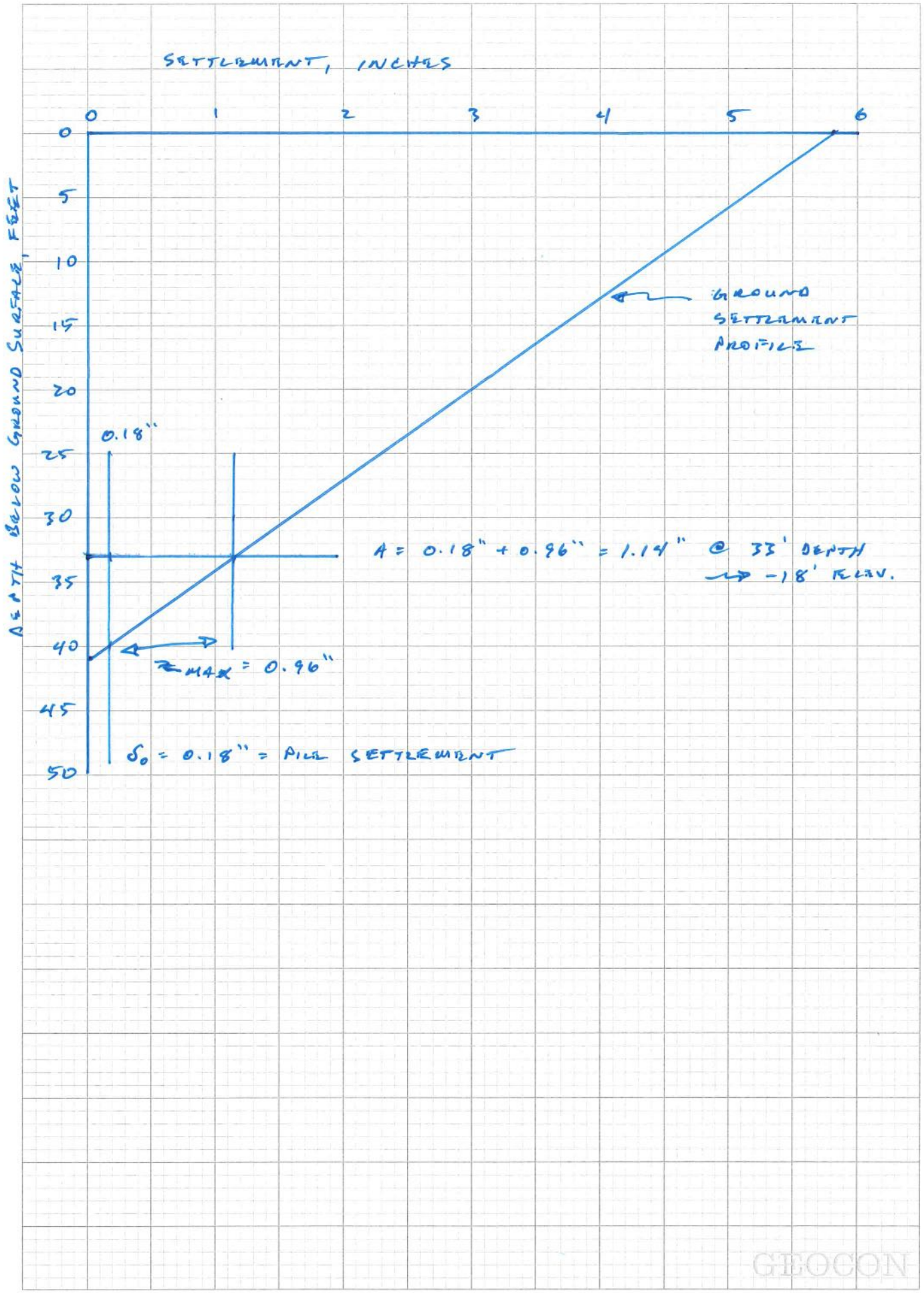
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GEOCON

Attachment O. Environmental Memo



Truxel Bridge Concept and Feasibility Study

Environmental Documentation Memorandum

Prepared by:

DOKKEN ENGINEERING

Prepared for:

City of SACRAMENTO

October 2024

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Appendices

Appendix A. UAIC Correspondence
Appendix B. Caltrans Preliminary Environment Study Form

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Executive Summary

The City of Sacramento (City) proposes to construct a multi-modal bridge connecting Truxel Road to Sequoia Pacific Boulevard across the American River as part of the Truxel Bridge Project (Project). The proposed Project would cross the Lower American River within the American River Parkway, which is an open space greenbelt that provides residents and visitors of the Sacramento Region various recreational opportunities. As such, this area contains numerous protected environmental resources. Due to the high environmental sensitivity in this area, it is imperative to fully understand the environmental constraints and how they can affect the Project cost and schedule early in the planning and design process. Through resource identification efforts and stakeholder outreach, potential environmental impacts, required technical studies, environmental documentation, and future coordination efforts were identified for this Feasibility Study.

Biological resources within the Project area include the Great Valley Riparian Forest habitat and the Lower American River. Database research and preliminary field surveys determined that both resources provide suitable habitat for the following special status species: Chinook salmon, Green sturgeon, California Central Valley (CCV) Steelhead, Swainson's Hawk, White-Tailed Kite, Western Pond Turtle, and valley elderberry longhorn beetle. Impacts to federally listed species require Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) during the Project Approval & Environmental Document (PA&ED) Phase. During the plans, specifications, and estimates (PS&E) Phase, regulatory permits from the U.S. Army Corps of Engineers (USACE), Central Valley Regional Water Quality Control Board (Water Board), California Department of Fish and Wildlife (CDFW), Central Valley Flood Protection Board (Flood Board), and the U.S. Coast Guard (USCG) are required for impacts to the American River, Great Valley Riparian Forest habitat, and adjacent jurisdictional water features. As mitigation is required for impacts to these habitats and protected species, the City team has initiated outreach to regulatory and wildlife agencies and the Sacramento County Department of Regional Parks to identify potentially suitable off-site mitigation options. Lastly, due to anticipated impacts to state listed species, an Incidental Take Permit (ITP) from CDFW is anticipated during the final design phase as well.

Due to the high cultural resource sensitivity, the City has initiated early consultation with the United Auburn Indian Community (UAIC), including ongoing email correspondence and a field visit with Tribal representatives in May 2024. As part of this early consultation, Indigenous resources known to the UAIC have been identified within and adjacent to the Project footprint, including the Delta Tribal Cultural Landscape (Delta TCL). During the PA&ED Phase, potential avoidance will be pursued but presence/absence of archaeological testing will likely be required to determine if any previously unknown resources are present within the Project footprint. Additionally, all cultural resource identified within the Project footprint will be evaluated to determine their eligibility for listing on either the National Register of Historic Places or California Register of Historical Resources. The Project will consult with the State Historic Preservation Officer (SHPO) to obtain concurrence on any cultural resources identified that require significance evaluations, determinations of effect, and/or a memorandum of agreement under Section 106 of the NHPA.

In an effort to accurately scope other environmental resources and sensitivities within the Project area, a California Department of Transportation (Caltrans) Preliminary Environment Study (PES) Form was completed. Environmental constraints identified through the PES Form (in addition to those discussed above) were related to Traffic, Noise, Air Quality, Hazardous Waste, Water Quality, Floodplains, Wild and Scenic Rivers, Parks, Visual Resources, and Community Impacts. Project impacts related to these resources will be evaluated during the PA&ED Phase.

Lastly, preparation of an Environmental Impact Report (EIR) under the California Environmental Quality Act (CEQA) is anticipated due to the high level of public involvement as well as potentially significant impacts to environmental resources. Under the National Environmental Policy Act (NEPA), the Project is anticipated to require the preparation of a Complex Environmental Assessment (EA) leading to a Finding of No Significant Impact (FONSI). All technical studies prepared for this Project will be used to support the CEQA/NEPA environmental document.

Chapter 1. Introduction

1.1 Background

The City of Sacramento proposes to construct a multi-modal bridge connecting Truxel Road to Sequoia Pacific Boulevard across the American River (**Figure 1. Project Vicinity** and **Figure 2. Project Location**). In 2013, the City prepared the American River Crossing Study to evaluate optional alignments to cross the American River. Eight alignments were prepared and studied, with Alignment 3 (the Truxel Road alignment) ultimately selected as the preferred alternative for a new crossing.

Dokken Engineering (Dokken) was selected to complete a Feasibility Study for the Truxel Road alignment and many different engineering and environmental constraints were evaluated (**Figure 3. Truxel Design Alternatives** and **Figure 4. Bridge Cross Section Alternatives**). This Environmental Documentation Memorandum is intended to scope all future environmental clearances, consultations, permits, and mitigation that will be required to deliver this Project through construction. It is understood that this Project will have a federal nexus, either through impacts to waters of the U.S. and/or due to federal funding. To ensure consistency throughout this document, it is assumed that federal funding would be obtained and that Caltrans Local Assistance would be the lead under NEPA. As such, this memorandum references Caltrans terminology for NEPA studies.

1.2 Project Purpose

The purpose of the proposed Project is to:

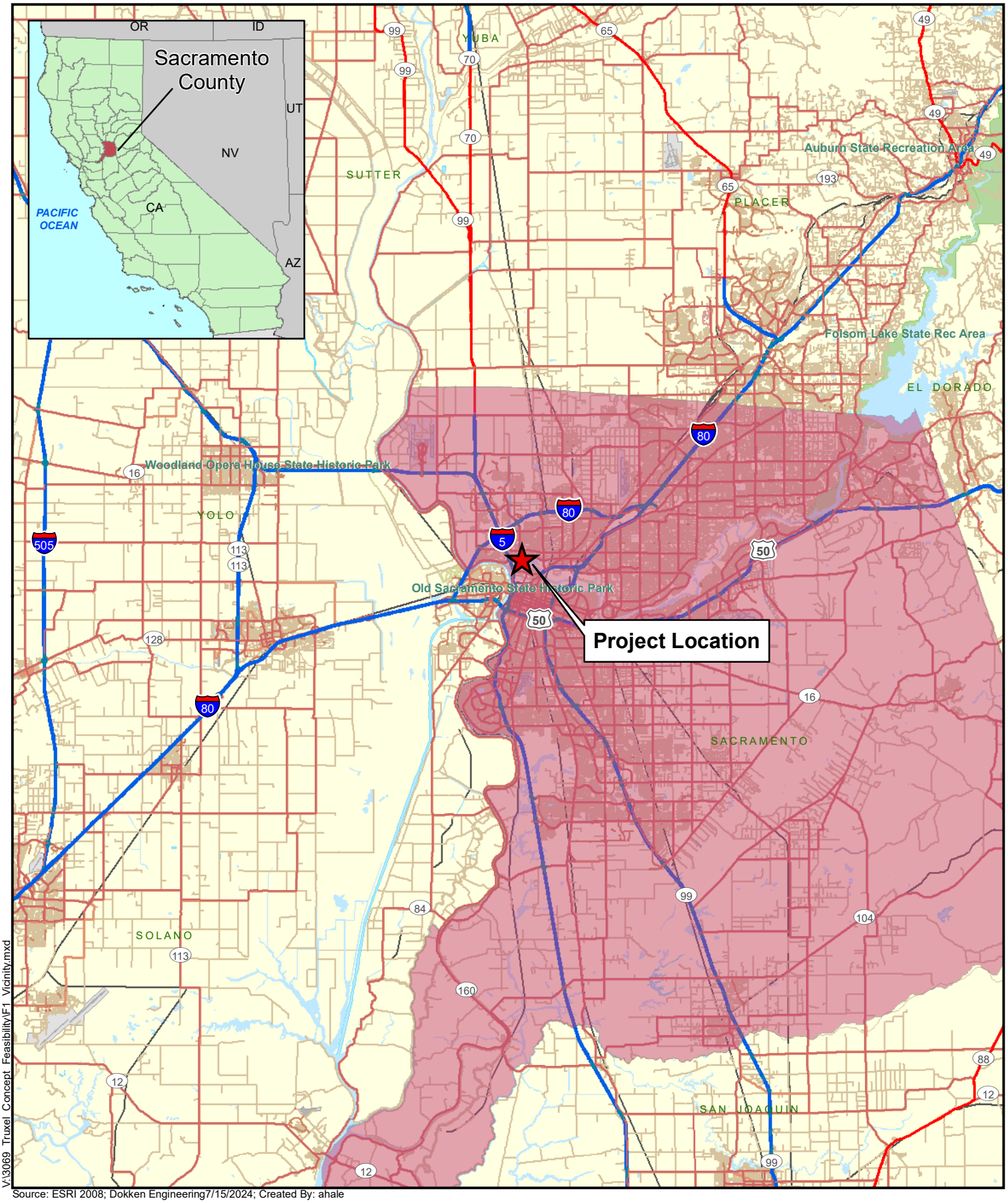
- Provide a crossing of the Lower American River for all modes of transportation which will increase the ability of the community to walk, bike, and utilize public transit as an alternative to driving while being in compliance with the City of Sacramento's Neighborhood Friendly Bridge Policy.
- Improve connectivity across the Lower American River between the Central City and South Natomas for all modes of travel in order to enhance accessibility to resources, jobs, commerce, and social exchanges.
- Increase evacuation and emergency/disaster response options for Central City and South Natomas residents and businesses.
- Enhance recreational access to the American River Parkway from both banks of the Lower American River for pedestrians and cyclists.

1.3 Project Need

The proposed Project addresses the following needs:

- The Lower American River creates a barrier to mobility that causes longer trip lengths for relatively close origins and destinations which discourages walking and bicycling, leads to a dependence on automobiles, and creates inefficient transit routing. These transportation system limitations lead to negative effects on public health.

- The Lower American River creates a barrier to economic activity, social exchanges, and job access between the Central City and South Natomas. In addition, lack of direct connection between the Central City and South Natomas diminishes the viability of development that has been planned and approved in the City of Sacramento's General Plan, the River District Specific Plan, and the Sacramento Railyards Specific Plan.
- Limited connectivity across the Lower American River contributes to longer emergency/disaster response times and limits evacuation alternatives.
- Limited options for access to recreational facilities reduces opportunities to utilize the Lower American River Parkway, especially for those walking and biking.



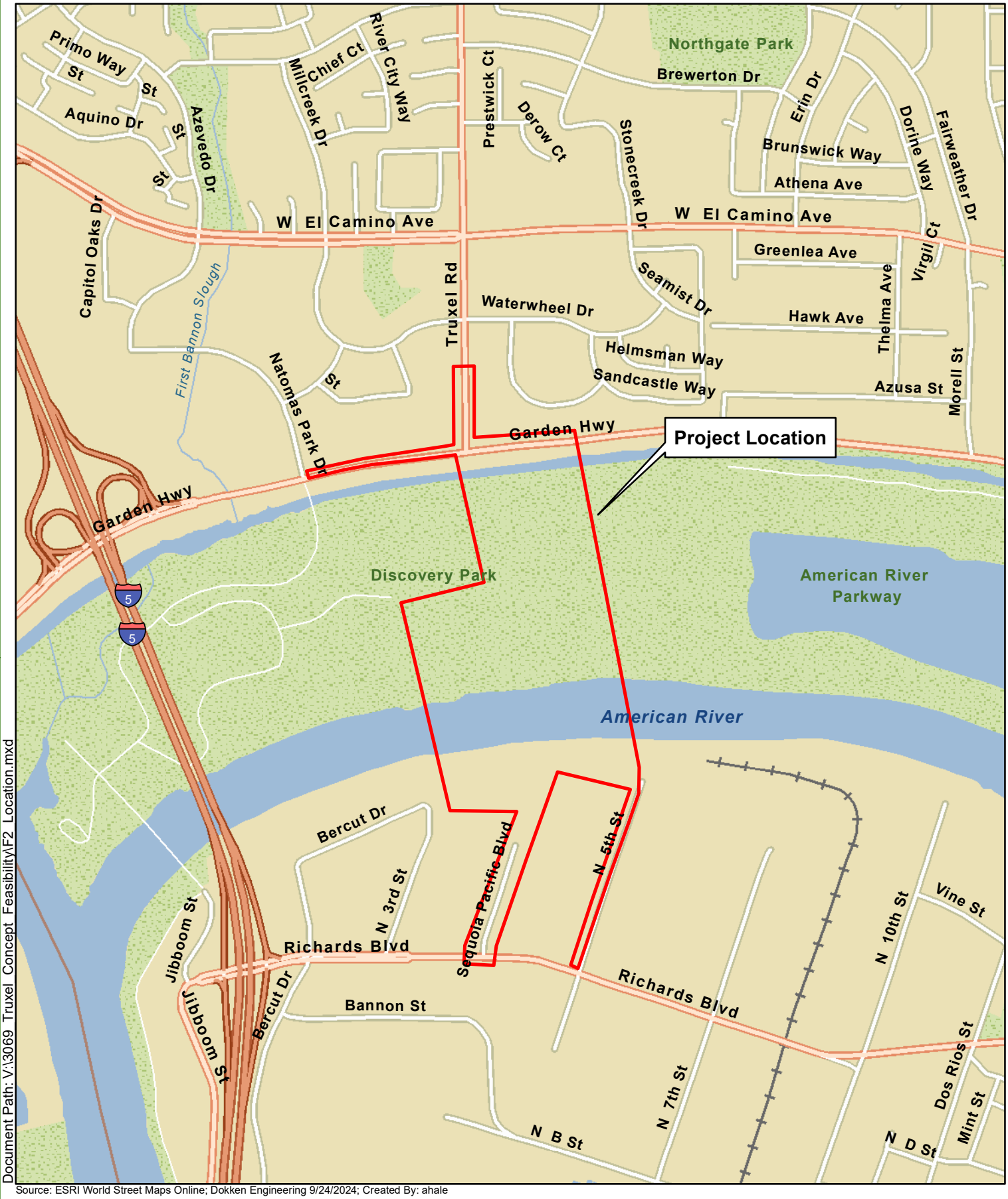
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Source: ESRI 2008; Dokken Engineering7/15/2024; Created By: ahale

0 5 10 15 Miles

FIGURE 1
Project Vicinity

Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California



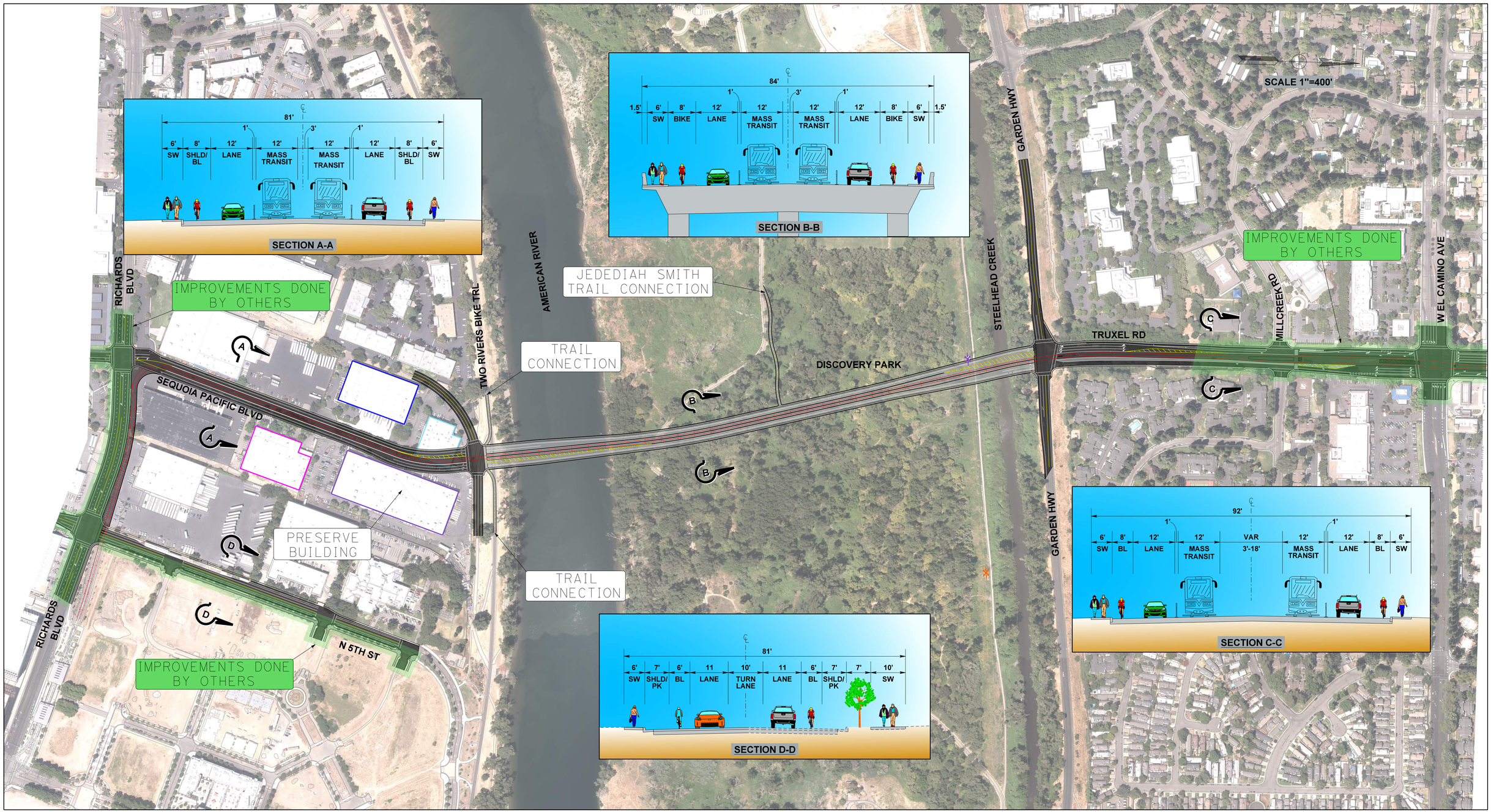
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Source: ESRI World Street Maps Online; Dokken Engineering 9/24/2024; Created By: ahale

0 800 1,600 2,400 3,200 Feet

FIGURE 2
Project Location

Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California

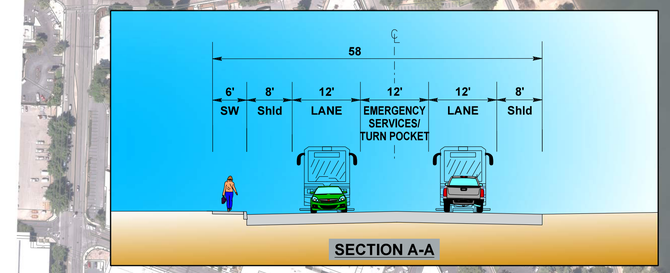


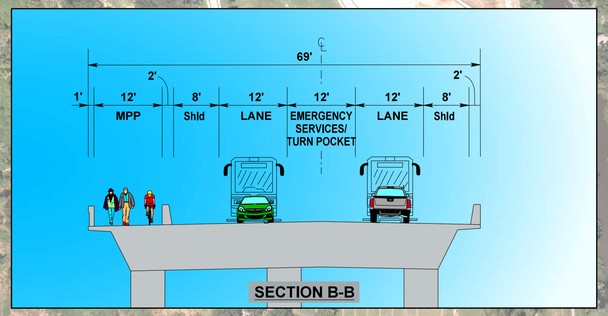
DOKKEN ENGINEERING
110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630
PH: 916-858-0642 FAX 916-858-0643

TRUXEL BRIDGE CONCEPT & FEASIBILITY STUDY

ALTERNATIVE 1

JUNE 2024





SCALE 1"=400'

IMPROVEMENTS DONE BY OTHERS

PRESERVE BUILDING

PRESERVE BUILDING

IMPROVEMENTS DONE BY OTHERS

JEDEDIAH SMITH TRAIL CONNECTION

TRAIL CONNECTION

TRAIL CONNECTION

PGE TOWER NOT IMPACTED

DISCOVERY PARK

IMPROVEMENTS DONE BY OTHERS

RICHARDS BLVD

RICHARDS BLVD

SEQUOIA PACIFIC BLVD

N 5TH ST

TWO RIVERS BIKE TRL

AMERICAN RIVER

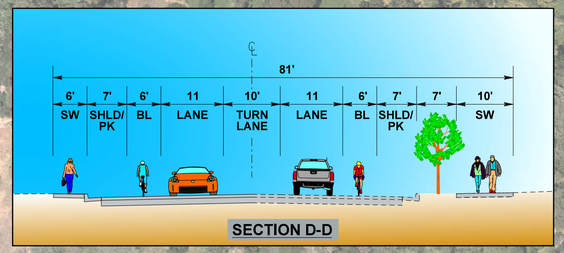
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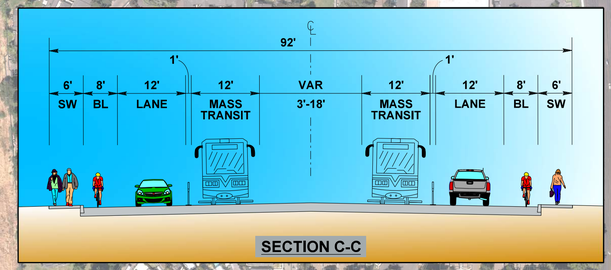
GARDEN HWY

TRUXEL RD

MILLCREEK RD

W EL CAMINO AVE



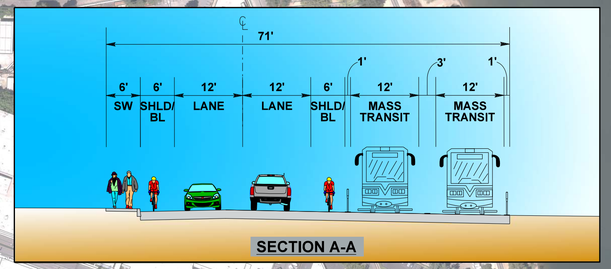


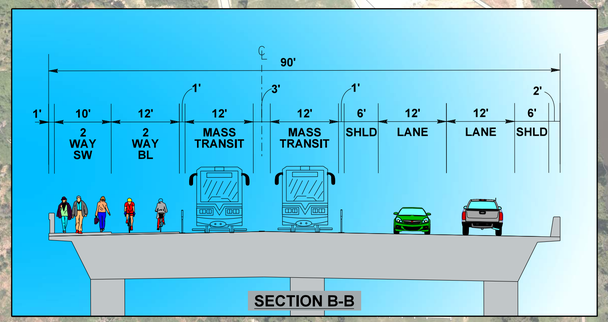
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PH: 916-858-0642 FAX:916-858-0643

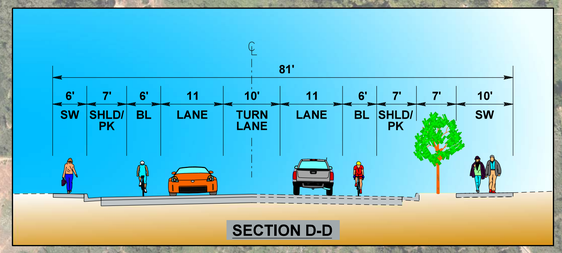
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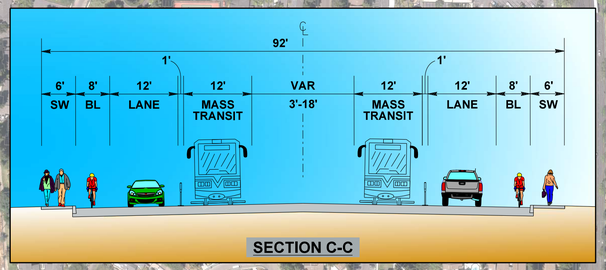
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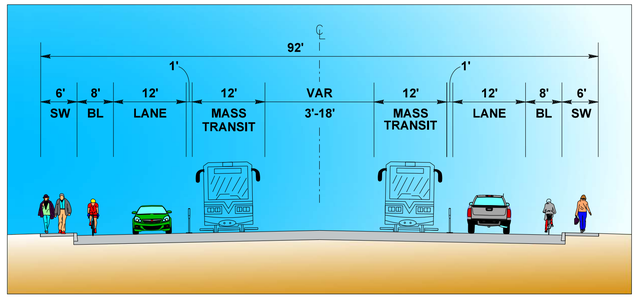


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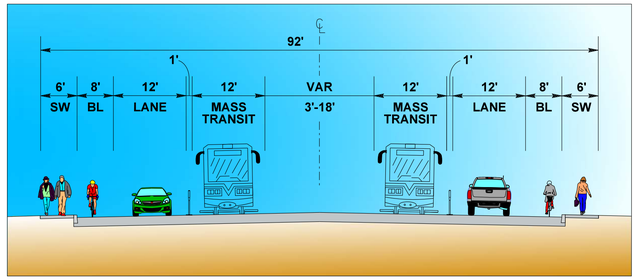
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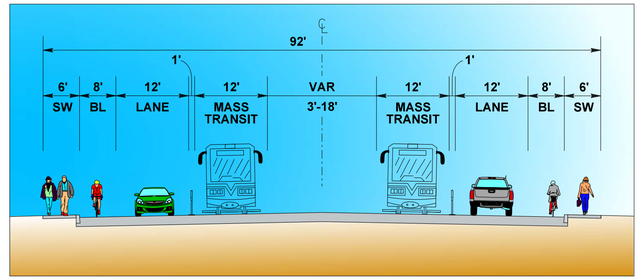
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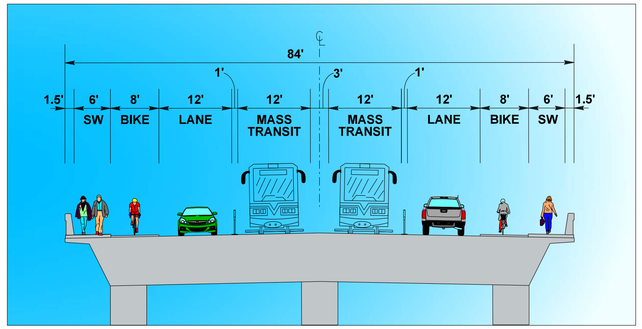
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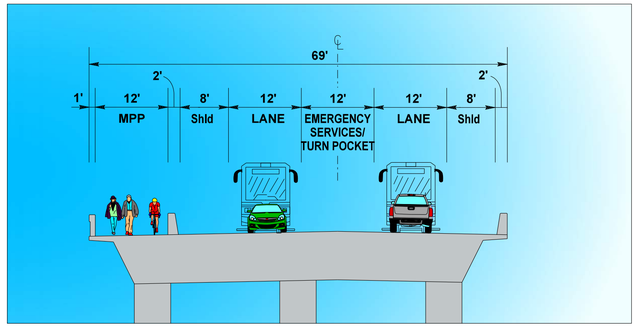
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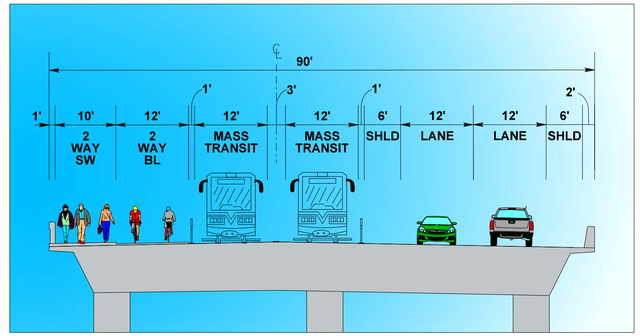
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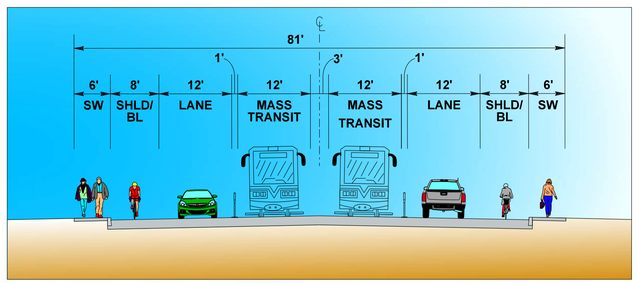
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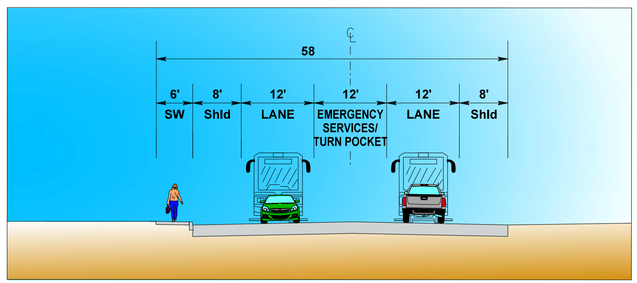
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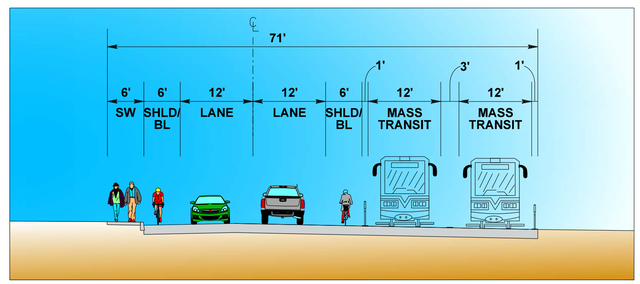
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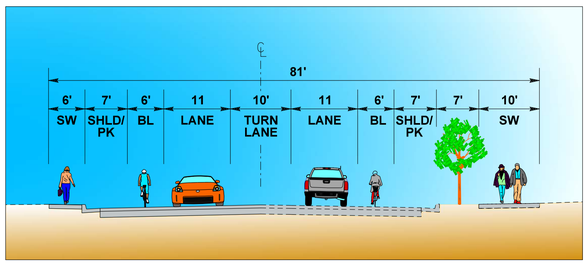
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ALT 2
SEQUOIA PACIFIC BLVD



ALT 3
SEQUOIA PACIFIC BLVD



N 5TH ST

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TRUXEL BRIDGE CONCEPT & FEASIBILITY STUDY

BRIDGE CROSS SECTION ALTERNATIVES FEASIBILITY STUDY

1.4 Project Setting

1.4.1 Lower American River

The Project would construct a new bridge across the Lower American River.

Wild and Scenic River

The Lower American River is designated as a “recreational” river within the Federal and State Wild and Scenic Rivers Systems. Sacramento County (County) has been designated to have the primary responsibility of managing this resource under both State and Federal laws. The National Park Service (NPS) has responsibility to ensure that the protections under Section 7(a) of the Federal Wild and Scenic Rivers Act (USC Title 16, Chapter 28) are consistently applied to the river.

American River Parkway Plan

Sacramento County has adopted the American River Parkway Plan (ARPP) as an element of its General Plan. The ARPP is a policy document that guides long term plans for development and preservation of the American River Parkway. Due to the Lower American River’s designation as a recreational Wild and Scenic River, the County’s ARPP focuses on the Parkway’s preservation, use, development, and administration. The County’s 2008 adopted ARPP was also adopted by the State legislature in 2010 under the Urban American River Parkway Preservation Act, Public Resources Code 5840. This State legislation requires that actions of state and local agencies, with regards to land use decisions, shall be consistent with the ARPP.

1.4.2 Biological Resources

Sensitive habitat communities within the Project area include the Lower American River, Steelhead Creek, and Great Valley Riparian Forest habitat. These natural habitat communities support various special status species including Chinook salmon, Green sturgeon, California CCV Steelhead, Swainson's Hawk, White-Tailed Kite, Western Pond Turtle, and valley elderberry longhorn beetle.

1.4.3 Cultural Resources

The Project is located within the Lower American River adjacent to the confluence with the Sacramento River which was an area of regional importance during both Indigenous and historic occupational periods. There are known Native American cultural resources present within the vicinity of the Project area, including the Delta TCL and the Lower American River Tribal Cultural Landscape (TCL). Historic-era resources within and adjacent to the Project area include the river levees, the Natomas East Main Drain, and commercial buildings.

Chapter 2. Environmental Constraints Analysis

This chapter discusses resource identification efforts and stakeholder outreach completed during the preparation of this Feasibility Study.

2.1 American River Parkway Plan

The Project is located within the American River Parkway and would cross the Lower American River, which is classified as a "recreational" river within the State and Federal Wild and Scenic River Systems. The ARPP acts as the management plan for the federal and state Wild and Scenic Rivers Acts. The ARPP is administered by Sacramento County, specifically the Regional Parks Department, and focuses on the Parkway's preservation, use, development, and administration. As such, Sacramento County Regional Parks is an important partner for the Project.

The ARPP's Discovery Park Area Plan identifies a new bridge crossing at the location of the proposed Project. The crossing is identified as the Downtown Natomas Airport (DNA-RT) light rail extension, which was included in the Discovery Park Area Plan in 2008 (**Figure 5. Discovery Park Area Plan Map**), and provided for the conveyance of transit, pedestrians, and bicyclists

Sacramento County Regional Parks and Planning Departments have acknowledged that the proposed Project, which is an all-modes facility and includes one lane for vehicles in each direction, would require a Discovery Park Area Plan Map Amendment to address the addition of vehicles on the crossing.

The City team has collaborated with Sacramento County Regional Parks throughout the Feasibility Study including:

- September 29, 2023: The City team met with Sacramento County Regional Parks to discuss the Project's purpose, scope, and proposed features; receive County input regarding resources located within the Project footprint and to obtain the County's recommendations regarding the Project; develop on and off-site mitigation concepts; and, to understand the County's position and process regarding an Area Plan Map Amendment to the ARPP.

- January 11, 2024: The City team and Sacramento County Regional Parks met with wildlife agencies to discuss the Project, environmental resources, permitting strategy, and mitigation concepts. The City and County met following the meeting to further discuss the Area Plan Map Amendment next steps.

- April 8, 2024: The City team had a focused meeting with staff from Sacramento County Regional Parks and Planning Departments to discuss the level of CEQA analysis and appropriate timing for the Area Plan Map Amendment.

- May 3, 2024: The City team provided a presentation to the American River Parkway Advisory Committee regarding the Project and the need for an ARPP map amendment.

- May 20, 2024: The City team provided a presentation to the County Recreation and Parks Commission regarding the Project and the need for an ARPP map amendment.

- June 4, 2024: City requested written clarification from the County of the required steps to amend the Discovery Area Plan.

- August 2, 2024: Sacramento County responded to the City's request for clarification.

- Throughout August and September 2024, conversations continued with the County. An agreement with the County and City that a CEQA analysis would be produced in the near term with the goal of seeking an Area Plan Amendment was made. The City intends to conduct this analysis throughout the winter of 2024.

During the May 2024 presentations, there were minimal comments or questions and no apparent public opposition despite concerns at several community meetings and online survey.

Continuous coordination with Sacramento County Regional Parks will be critical throughout the future project development phases to collaborate regarding the Project's design, temporary and permanent impacts to existing parkway/recreational features, environmental resource impacts, the ARPP map amendment, and environmental mitigation.

2.2 Biological Resources

2.2.1 Sensitive Habitat Communities

Great Valley Riparian Forest

The Project alignment crosses a dense stand of Great Valley Riparian Forest and will result in both permanent and temporary impact to this vegetation community. This forest type is characterized by a dense multistory tree canopy providing high quality habitat for many species of terrestrial and avian wildlife. Dominant overstory tree species in the Project area include cottonwoods (*Populus fremontii*) and valley oaks (*Quercus lobata*). Common mid-canopy and shrub species include box elder (*Acer negundo*), Oregon ash, blue elderberry, toyon, wild grape, poison oak, and Himalayan blackberry.

The Project alignment crosses through approximately 1,900 feet of Great Valley Riparian Forest between the north bank of the American River and the northern Project terminus at Truxel Road and an additional 100 feet along the south bank of the American River (**Figure 6. Habitat and Biological Resources**). Assuming the construction footprint will be approximately 150 feet wide (permanent bridge width plus temporary construction access), the Project will require the removal of approximately 7.5 acres of Great Valley Riparian Forest habitat and the removal of approximately 800 to 1,000 trees. As the Project is within the American River Parkway, all compensatory mitigation for habitat impacts (including tree loss) must be implemented within the parkway (*ARPP Mitigation of Project Impacts – pg. 225*).

Lower American River

The Lower American River is a tributary to the Sacramento River and is designated a Water of the United States, and a Water of the State (**Figure 6. Habitat and Biological Resources**). The channel provides important habitat for multiple species of special status fish including Spring and Winter Run Central Valley Chinook Salmon (*Oncorhynchus tshawytscha*), California Central Valley (CCV) Steelhead (*Oncorhynchus mykiss* ssp. *irideus*), and green sturgeon (*Acipenser medirostris*). In addition, the channel is final designated critical habitat for all three species and is also designed as an Essential Fish Habitat by NMFS.

The Project will involve adding both temporary and permanent structures to the main channel of the American River. The bridge is expected to be supported by a minimum of two sets of permanent concrete columns that will be drilled into the bed of the river. Construction will also

likely require assembly of a temporary wooden trestle over the river supported on temporary steel piles. Installation and removal of the temporary trestle piles will involve some level of impact pile driving which has the potential to result in harmful levels of underwater sound pressure. An analysis of underwater sound pressure will be required and included as part of the biological analysis completed for the Project. In addition, the permanent concrete columns that will support the new bridge will result in a slight permanent reduction in available stream channel habitat.

Proposed Rails

Downtown Natomas Airport Light Rail

Land Use Designation

Developed Recreation Area

Limited Recreation Area

Nature Study Area

Open Water

Protected Area

Millcreek Dr
Timberwood Ct
Apartment Rd
Apartment Rd
Truxel Rd
Mossy Bank Dr
Seamist Dr
Tide Ct
Sandcastle Way
Reiner Way
Brunswick Way
Athena Ave
Dorine Way
Fairweather Dr
Greenlea Ave
Virgil Ct
Morell St
Hawk Ave
Thelma Ave
Azusa St
W El Camino Ave
Norbert Way
Normington Dr
Northview Dr
Northglen St
Wilson Ave
Norcut Ct
Norgard Ct
Northgate Blvd
Wilson Ave
Peralta Ave
American Ave
Northey Dr
Cleveland Ave
Northfield Dr
Harding Ave
Northfield Dr
Garden Hwy
Arden Garden Connector
Garden Hwy
Jefferson Ave
Columbus Ave
E Levee Rd
Railroad Dr
Del Paso Blvd
160
5
River Plaza Dr
Garden Hwy
Levee Rd
GR 136
Bercut Dr
N 3rd St
Richards Blvd
Jibboom St
Bannon St
Sequoia Pacific Blvd
N 5th St
N 7th St
N 10th St
Dos Rios St
Vine St

V:\3069_Truxel_Concept_Feasibility\F5_Discovery_Park_Area_Plan_Map.mxd

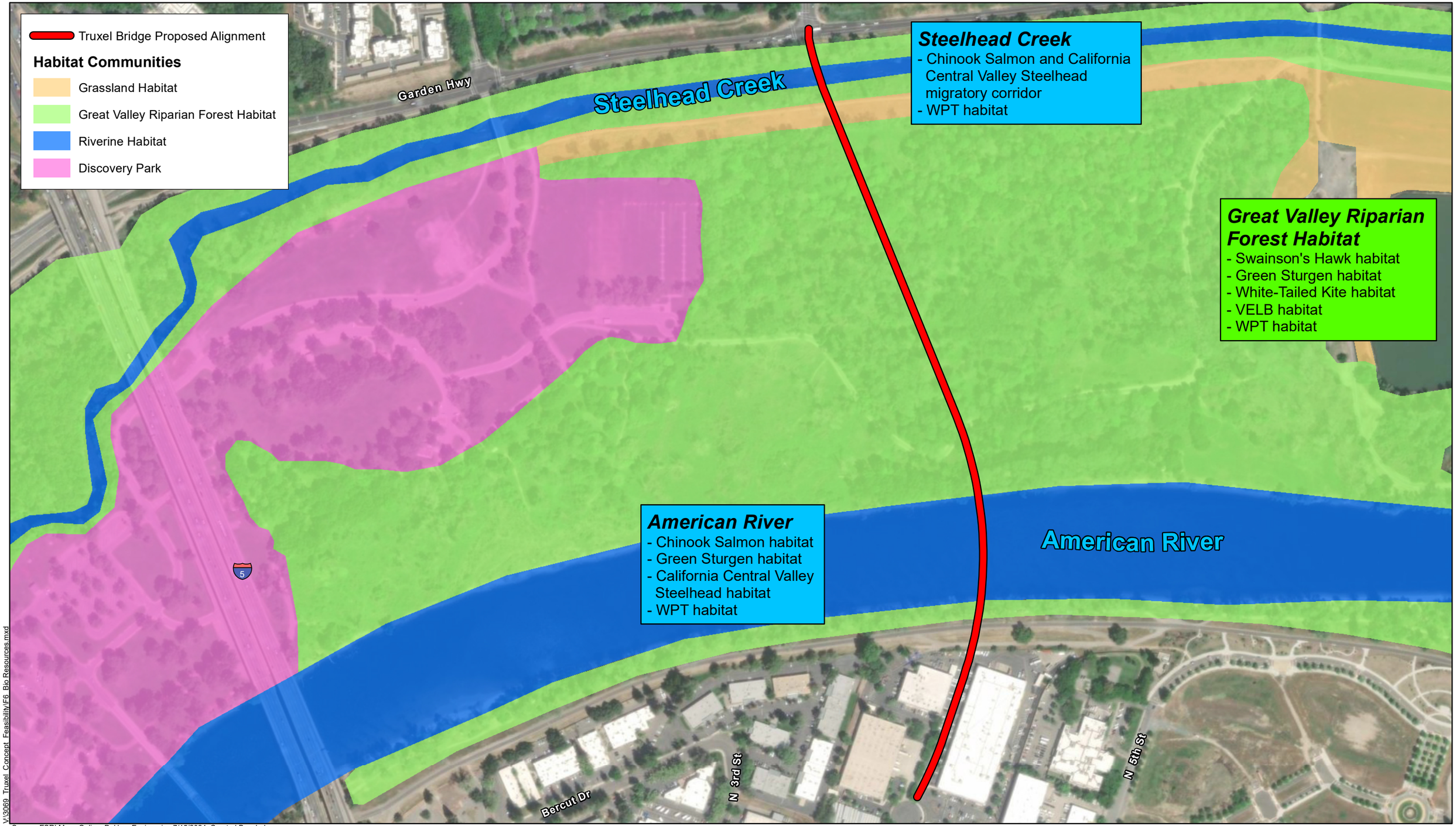
Source: ESRI Maps Online; Dokken Engineering 7/15/2024; Created By: ahale

1 inch = 800 feet

0 800 1,600 2,400 3,200 4,000 Feet

FIGURE 5
Discovery Park Area Plan Map

Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California



V:\3069_Truxel_Concept_Feasibility\F6_Bio Resources.mxd

Source: ESRI Maps Online; Dokken Engineering 7/15/2024; Created By: ahale

1 inch = 350 feet

0 350 700 1,050 1,400 1,750 Feet

FIGURE 6
Habitat and Biological Resources

Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California

Steelhead Creek

Steelhead Creek flows south from the Elverta and Rio Linda neighborhoods before turning west at Discovery Park and flowing parallel to Garden Highway before emptying directly into the Sacramento River. Steelhead Creek is fed by a number of urban tributaries including Arcade Creek and Dry Creek and carries perennial flow. Water quality and habitat values have been degraded by urban runoff, illegal dumping, and homeless encampments. The channel still provides a migratory corridor for small runs of anadromous fish including Chinook salmon and CCV Steelhead on their way to spawning habitat in Steelhead Creek.

The Project is expected to clear span over Steelhead Creek, meaning that no permanent bridge elements would be constructed within the channel; however, it's likely that a large abutment will need to be placed in the north bank of Steelhead Creek and riparian vegetation along both sides of Steelhead Creek would be temporarily impacted for construction access.

Previous Mitigation Projects

In the early 2000s, Sacramento County Parks undertook a salmonid floodplain rearing habitat enhancement project on the north bank of the American River, just east of the Project area. The project entailed downgrading a section of the stream bank to hydraulically connect it to the river during moderate flow events and revegetating with native trees and shrubs.

An elderberry and riparian forest habitat restoration project was completed immediately east of the Project area in the mid-2000s. The Project may require temporary or permanent encroachment into this restoration area depending on the final alignment and bridge design.

2.2.2 Special Status Species

A total of 7 special status species are either presumed to be present or have a high potential to be found within the Project area (**Figure 6. Habitat and Biological Resources**). Agency consultations and habitat mitigation for the species will be required.

Central Valley Chinook Salmon (Spring & Winter Run)

Chinook salmon (*Oncorhynchus tshawytscha*) is listed under both the Federal Endangered Species Act (FESA) and California Endangered Species Act (CESA). Two populations of the species use the Lower American River including a winter-run population and a spring-run population. The winter-run population is listed as endangered and the spring-run population is listed as threatened. In addition, the Lower American River is final designated Critical Habitat for the species.

Chinook salmon are anadromous, meaning they migrate between the ocean and fresh water to spawn and complete their life cycle. Depending on the population, adults migrate from marine habitats off the coast of California and move into freshwater river systems in either the winter or spring. The adults travel up the river systems, returning to their natal spawning grounds to breed before dying. When the eggs hatch, the young fish spend upwards of a year in freshwater before migrating out to the ocean where they will spend their entire adult life. Towards the end of their lives, the adults return to their natal streams to spawn and die, repeating the cycle.

Where the Project area crosses the American River, the water is too deep and the stream bed substrate too fine to support spawning habitat for the species; however, suitable spawning habitat is present further upstream, and the American River Fish Hatchery located just downstream of

the Nimbus Dam intercepts and artificially spawns thousands of Chinook salmon every year. The Project segment is part of a critical link along the species migration corridor, connecting the spawning grounds and fish hatchery to the ocean.

Green Sturgeon

Green sturgeon is listed as threatened under FESA and their conservation is under the purview of NMFS. The Southern Distinct Population Segment of Green sturgeon consists of populations utilizing coastal marine waters from Monterey Bay, California, north to Cape Flattery, Washington and inland freshwater channels including the Sacramento River, lower American River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; the lower Columbia River estuary; and certain coastal bays and estuaries in California, Oregon, and Washington.

Green sturgeon are anadromous marine dwelling species of estuaries, bays and oceanic waters. During the breeding season, mature Green sturgeon navigate upstream to freshwater riverine environments from February to July. Spawning is relatively infrequent and believed to occur once every 2 to 5 years, from March to July in cold, clean waters. Among the threats contributing to the Green sturgeon's decline are invasive species, inaccessibility to reaches within its native range, pollution, water development projects, insufficient water levels, fishing and habitat loss. In addition, the loss of shaded riparian corridors and alterations to natural flow regimes have contributed to harmful water temperatures during egg deposition (preferred 46-57 degrees Fahrenheit) and larval development (preferred 52°F -66°F).

The Project footprint is within final designated Critical Habitat for the species and this section of the Lower American River provides potential migration, spawning, and rearing habitat for the species. Adults could be present during the migration and spawning seasons (February – July), and smolt/fry may be present during any time of year.

California Central Valley Steelhead

CCV Steelhead is a distinct population of Steelhead listed as threatened under FESA. This distinct population is found in the Sacramento and San Joaquin River basins in the Central Valley. Steelhead are anadromous fish that spend part of their life cycle in freshwater and part in salt water. The species was once abundant in California coastal and central valley drainages; however, population numbers have significantly declined, especially in the tributaries of the Sacramento River. The species spawns in freshwater streams where the young remain for several years before migrating to the ocean where they spend most of their lives. After several years in the ocean, adults return to their natal streams to spawn. Unlike salmon, CCV Steelhead are capable of spawning more than once before they die.

The Lower American River provides vital habitat for the continued existence of CCV Steelhead and a sizable run of several thousand adults are counted at the American River Hatchery fish ladder several miles upstream each year. In addition, the Lower American River is final designated Critical Habitat for CCV Steelhead. Adults are present in the river during the fall/winter migration and spawning seasons and smolt/fry may be present any time of year.

Bald Eagle

Bald eagles have been delisted from the Federal Endangered Species Act but are still fully protected under the Bald and Golden Eagle Act of 1940. Bald eagles are large birds of prey and opportunistic feeders. They mainly eat fish but will also feed on carrion when available. The species builds large platform nests at the tops of large mature trees, usually in proximity to large

bodies of water. The Lower American River provides suitable nesting and foraging habitat for bald eagle and is known to support several pairs of nesting eagles.

Swainson's Hawk

Swainson's hawk (*Buteo swainsoni*) is listed as a threatened species under CESA. The species migrates annually from wintering areas in Central and South America to breeding locations in northwestern Canada, the western U.S., and Mexico. In California, Swainson's hawks nest throughout the Sacramento and San Joaquin Valley. The species is typically associated with mature riparian forest habitat, but individual pairs will also nest in large, isolated trees. The breeding season extends from late March through late August, with peak activity from late May through July (England et al. 1997). Swainson's hawks forage in large, open agricultural habitats, including alfalfa and hay fields. The breeding population in California has declined by an estimated 91% since 1900; this decline is attributed to the loss of riparian nesting habitats and the conversion of native grassland and woodland habitats to agriculture and urban development. Swainson's hawk are known to occur in the riparian forests of the Lower American River and the species is presumed to be present within or adjacent to the Project area.

White-Tailed Kite

White-tailed kite is a fully protected species under California Fish and Game Code Section 3511. This level of protection dictates that no individuals of this species may be impacted in any way. The species has a restricted distribution in the United States, occurring only in California and western Oregon and along the Texas coast (American Ornithologists' Union 1983). The species is fairly common in California's Central Valley margins with scattered oaks and river bottomlands. White-tailed kites nest in riparian and oak woodlands and forage in nearby grasslands, pastures, agricultural fields, and wetlands. They use nearby treetops for perching and nesting sites. Voles and mice are common prey species.

Riparian habitat within the Project area provides high quality habitat for the species and there are numerous documented occurrences of white-tailed kite within the Discovery Park area. The species is therefore considered to have a high potential to occur nearby and may be affected by the proposed Project. Additional conservation measures will need to be developed to ensure the species is "Fully Protected" throughout construction.

Western Pond Turtle

The western pond turtle is not currently a State or Federally listed species; however, the species is proposed for listing as a Threatened species under both FESA and CESA. The western pond turtle is a fully aquatic turtle, inhabiting ponds, marshes, rivers, streams and irrigation ditches with aquatic vegetation. The species requires suitable basking sites such as logs, rocks and exposed banks and associated upland habitat consisting of sandy banks or grassy open fields for reproduction. Nesting occurs mid-June through mid-July and egg incubation takes approximately 5 to 8 months before young emerge from the nest.

The Lower American River provides potentially suitable aquatic and upland habitat for western pond turtle and while the species is more strongly associated with ponds and smaller stream channels, there are several documented occurrences of the turtle further upstream along the Lower American River. Western pond turtle is therefore considered to have a high potential to occur within the Project area.

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle (VELB) has been federally listed as threatened since 1980. Elderberry shrubs (*Sambucus* sp.), which grow in riparian areas and foothill woodlands in California's Central Valley, are VELB's obligate host plant which they depend on for survival and reproduction. The beetle goes through four life stages: egg, larvae, pupa, and adult. Females lay their eggs on the bark of the elderberry shrub and the larvae hatch and burrow into the stems. Larvae are active within the stems year-round and take one to two years to emerge as adults. The adults are active from March to June. The beetle feeds exclusively on the elderberry shrub throughout all stages of its life (USFWS 2017). VELB's usage of elderberry shrubs can be detected by the presence of exit holes created by the beetle's larval stage in the stem of the shrubs. The VELB is threatened by habitat loss of California's Central Valley riparian areas mainly due to agriculture and urban development.

Sections of the American River riparian corridor have been designated as Critical habitat for the species, the closest of which is approximately 1.4 miles upstream of the Project. In addition, a portion of the riparian habitat within the project area was planted with elderberry shrubs as mitigation for a separate project. The beetle is presumed to be present within the project footprint and a large number of elderberry shrubs will need to be removed.

2.2.3 Mitigation

As mentioned in section 2.2.1, all compensatory mitigation for habitat impacts must be mitigated within the American River Parkway. A portion of the required habitat creation and enhancement will be able to be placed within the temporary impact footprint; however, permanent impacts resulting from the physical bridge structure and shade impacts will need to be mitigated by completing a habitat creation or enhancement project elsewhere within the American River Parkway.

The City team has completed initial outreach to various wildlife and regulatory agencies and the Sacramento County Parks Department and identified a potentially suitable site approximately 2 miles upstream in the Woodlake Plan Area. It is estimated that an off-site mitigation project will need to establish approximately 25 acres of enhanced/created habitat for the various protected biological resources. The Woodlake Plan Area is currently designated as a protected area and there are no plans to further develop recreational facilities or trails in this area. In the next phase of work, the City will need to work with County Regional Parks, regulatory agencies, and stakeholder groups to develop a conceptual mitigation design.

2.3 Cultural Resources

Cultural resource services are required for the Project to comply with Section 106 of the National Historic Preservation Act (NHPA) and CEQA. These services will include the identification and evaluation of any cultural resource within the Project footprint. Identification will consist of conducting a review of records on file at the North Central Information Center, consultation with Native American Tribal governments, archaeological field surveys, and archaeological presence/absence testing. Presence/absence testing is especially important to complete early in the planning process due to the dense vegetation that obscures the ground surface within the Project footprint.

Due to the high cultural resource sensitivity, the City has initiated early consultation with the UAIC, including a field visit with Tribal representatives in May 2024. As part of this early consultation, Indigenous resources known to the UAIC have been identified within and adjacent to the Project footprint, including the Delta TCL. The UAIC also provided recommendations for best practices to avoid, minimize, and/or mitigate potential impacts to Indigenous resources, which are included in **Appendix A**. Although potential avoidance will be pursued, presence/absence archaeological testing will likely be required to determine if any previously unknown resources are present within the Project footprint.

All cultural resources identified within the Project footprint will be evaluated to determine their eligibility for listing on either the National Register of Historic Places or California Register of Historical Resources. As the Project footprint encompasses a portion of the Delta TCL and a previously unrecorded portion of the Lower American River TCL, which are both considered significant resources eligible for listing on the California Register of Historical Resources, the Project may have an adverse effect to both resources under Section 106 of the NHPA and a potentially significant effect under CEQA. The UAIC provided recommendations for best practices to avoid, minimize, and/or mitigate potential impacts to cultural resources, which are included in **Appendix A**. The measures listed in **Appendix A** and other measures to mitigate impacts and reduce them to a less than significant level under CEQA will be developed in consultation with the UAIC, City, and potentially other tribes and stakeholders. Lastly, a late discovery and monitoring plan is also anticipated to allow for efficient and respectful treatment of cultural resources discovered during construction of the Project.

Additional resources known to be within the Project footprint include river levees, Natomas East Main Drain, and commercial buildings (**Figure 8. Environmental Constraints Overview**). Steps to address these resources will require possible recordation (if not previously recorded), evaluation, assessment of effects, and development of mitigation if adverse effects/significant impacts are anticipated. Consultation with SHPO regarding cultural resource identification, significance, effect determination, and proposed mitigation will be required.

Truxel Bridge Proposed Alignment

SB 535 Disadvantaged Communities

Sensitive Habitat Communities

Riparian Habitat

Riverine Habitat

Capital Park Dr

Creekside Oaks Dr

Natomas Park Dr

Truxel Rd

Garden Hwy

Azusa St

Thelma Ave

5

5

Noise Receivers
- American River Parkway
- Residents
- School and daycare center

Steelhead Creek
- Pacific salmonid migratory corridor

Riparian Habitat
- §1600 Permitting
- Listed Species Consultation
- Compensatory Mitigation

Tribal Resources
- Entire corridor has high tribal sensitivity

Jedediah Smith Trail

Cultural Resources
- River Levees
- Natomas East Main Drain
- Commercial Buildings

American River
- Permitting (§401, §404, §1600, USCG)
- Pacific salmonid habitat
- Compensatory mitigation
- Wild and Scenic River

Section 4(f) Resources
- Discovery Park
- Two Rivers Bike Trail
- Jedediah Smith Trail
- Entire American River Parkway

Two Rivers Bike Trail

Bercut Dr

N 3rd St

N 5th St

V:\13069_Truxel_Concept_Feasibility\F8_Constraints Overview.mxd

Source: ESRI Maps Online; Dokken Engineering 7/30/2024; Created By: ahale

1 inch = 425 feet

0 425 850 1,275 1,700 2,125 Feet

FIGURE 7
Environmental Constraints Overview

Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California

2.4 Community

The proposed Project crosses census tracts designated as Senate Bill 535 Disadvantaged Communities. These areas represent the 25% highest scoring census tracts in CalEnviroScreen 4.0, census tracts previously identified in the top 25% in CalEnviroScreen 3.0, and census tracts with high amounts of pollution and low populations (CalEPA, 2022). This indicates that the communities immediately adjacent to the proposed Project are the disadvantaged communities that will be most affected by the implementation of the proposed Project (**Figure 8. Environmental Constraints Map**).

Truxel Bridge location and features were vetted by the communities the Project will serve through the City's comprehensive engagement process that included utilizing online platforms, in-person workshops, and public presentations. During the Feasibility Study, outreach efforts provided both targeted, neighborhood-specific community engagement services to assure disadvantaged community members have an opportunity to share and provide the Project team with their travel needs, patterns and desires for improved connectivity. Community-wide engagement activities were also provided to understand the overall challenges and opportunities for providing an all-modes, community-friendly bridge.

2.5 Other Environmental Considerations

In an effort to accurately scope environmental resources and sensitivities within the Project area, a Caltrans PES Form was completed and is included as **Appendix B** of this document. The PES Form identifies the level of NEPA environmental technical studies that will be required should Caltrans Local Assistance be the NEPA lead. Other environmental considerations identified in the PES Form and during preparation of this report are discussed below.

2.5.1 Air Quality

Existing Air Quality

The City is within the jurisdictional boundaries of the Sacramento Metropolitan Air Quality Management District (SMAQMD). The SMAQMD is located in an area that is in non-attainment for Federal Particulate Matter 2.5 micrometers or less in diameter ($PM_{2.5}$) and ozone standards. The SMAQMD is in attainment or unclassified for other federal criteria pollutants. Lastly, the SMAQMD is located in an area that is in non-attainment for State ozone and PM_{10} standards. The SMAQMD is in attainment or unclassified for other state criteria pollutants. Table 1 lists the state and federal attainment status for SMAQMD.

Table 1. Attainment Status for SMAQMD

Pollutant	**Designation/Classification for SMAQMD**	
	Federal Standards	**State Standards**
Ozone	Non-attainment	Non-attainment
PM_{10}	Attainment-Maintenance Moderate	Non-attainment
$PM_{2.5}$	Non-attainment-Moderate	Attainment

Carbon Monoxide	Attainment	Attainment
Nitrogen Dioxide	Unclassified/Attainment	Attainment
Sulfur Dioxide	Unclassified/Attainment	Attainment
Lead	Attainment	Attainment
Source: SMAQMD, https://www.airquality.org/air-quality-health/air-quality-pollutants-and-standards		

Conformity Requirements

Conformity requirements apply only in Federal nonattainment and maintenance areas and do not apply for State standards regardless of the status of the area. Conformity analysis at the Project level includes verification that the Project is included in the regional conformity analysis and a "hot-spot" analysis if an area is in nonattainment or maintenance for CO and/or PM_{10} or $PM_{2.5}$. The Project, Truxel Bridge (SAC24539), is included in the Sacramento Area Council of Governments (SACOG) Metropolitan Transportation Plan/Sustainable Communities Strategy (MTP/SCS) and is thus included in the regional conformity analysis. However, since the Project is located in a Federal $PM_{2.5}$ nonattainment area and a Federal PM_{10} maintenance area, interagency consultation will be needed to determine if a "hot-spot" analysis is required.

2.5.2 Transportation

The purpose of the proposed Project is to construct a new multi-modal bridge connecting Truxel Road to Sequoia Pacific Boulevard across the American River, which will impact traffic patterns along Truxel Road, Garden Highway, Sequoia Pacific Boulevard, and other adjacent roads. Preliminary traffic studies have been prepared by Fehr and Peers. As the Project would construct a new bridge, potential impacts to regional transportation and traffic must be analyzed under CEQA guidelines through the vehicle miles travelled (VMT) framework. Since the City is the CEQA lead agency, this Project is required to comply with policies listed in the General Plan and the Climate Action & Adaption Plan (CAAP). The following threshold is listed in the City's General Plan:

- Transportation projects not included in the General Plan should be considered to have a significant impact if implementation of the project would result in any increase in Total Regional VMT.

As the Truxel Bridge Project is part of the City of Sacramento's 2040 General Plan, transportation impacts under CEQA are considered a less than significant. Only transportation projects not included in the General Plan would potentially be considered to have a significant impact; however, with inclusion of the Truxel Bridge Project in the General Plan, VMT impacts are not anticipated.

As part of this Feasibility Study, Fehr and Peers conducted a preliminary VMT analysis for the 2016 Base Year, No Project, and With Project scenarios with a regional SACOG boundary as the regional VMT estimates and a City of Sacramento boundary as the Project-level VMT estimates. Additionally, the No Project and With Project scenarios were analyzed for VMT in both the cumulative conditions and the supercumulative conditions.

For the 2016 Base Year, the Total Network VMT within the SACOG regional boundary was estimated to be 63,101,746, and within the City of Sacramento boundary was estimated to be 11,957,712.

Within the SACOG boundary, the Total Network VMT would slightly increase from 74,418,242 to 75,138,234 in the cumulative conditions with the Project, and in the supercumulative conditions, the Total Network VMT would decrease from 76,329,244 to 76,306,373. Within the City of Sacramento boundary, the Total Network VMT would increase from 14,704,781 to 14,802,541 in the cumulative conditions, and in the supercumulative conditions, the Total Network VMT would increase from 14,891,198 to 14,945,006.

Additionally, the Total Network VMT per capita for the 2016 Base Year within the SACOG regional boundary was estimated to be 26.55, and within the City of Sacramento boundary was estimated to be 25.30.

Within the SACOG boundary, the Total Network VMT per capita would slightly increase from 24.91 to 24.98 in the cumulative conditions with the Project; however, in the supercumulative conditions, the Total Network VMT per capita would decrease from 24.72 to 24.60. Within the City of Sacramento boundary, the Total Network VMT per capita would slight decrease from 23.80 to 23.19 in the cumulative conditions and in the supercumulative conditions, the Total Network VMT per capita would decrease from 23.95 to 23.50.

The analysis shows that within the SACOG regional boundary, Total Network VMT would slightly increase in the cumulative scenario, and decrease in the supercumulative scenario and within the City of Sacramento boundary, Total Network VMT would slightly increase with the proposed Project in both the cumulative and supersumulative scenarios compared to the No-Build scenario. For Total Network VMT per capita, the SACOG regional boundary cumulative scenario would increase; however, the SACOG regional boundary supercumulative scenario and both the City of Sacramento cumulative and supercumulative scenarios would decrease Total Network VMT per Capita with the Project compared to the No-Build scenario. Regardless, transportation impacts under CEQA are considered a less than significant.

2.5.3 Noise

There are multiple sensitive noise receptors along Truxel Road. Sensitive noise receptors include residential structures east of Truxel Road, Read Academy of Sacramento and Childtime of Sacramento west of Truxel Road, wildlife that inhabit the American River Parkway, and office buildings along Sequoia Pacific Boulevard. As the Project would construct a new multi-modal bridge across the American River, noise impacts on these sensitive receptors need to be evaluated. The Project would also need to comply with City General Plan noise policies and the City local noise ordinance. Since Caltrans is the assumed NEPA lead agency, the Project would also be subject to 23 Code of Regulations (CFR) 772 – Procedures for Abatement of Highway Traffic Noise and Construction Noise. The Project is considered a Type I project as defined in 23 CFR 772.5(h). Noise related impacts will need to be evaluated through the preparation of a Caltrans formatted Noise Study Report. See section 3.2.4 for more information regarding noise related technical studies required during the PA&ED phase.

2.5.4 Parks and Recreational Areas

The Project area is located within the American River Regional Parkway, a Sacramento County Regional Park. Additionally, Discovery Park, Two Rivers Bike Trail, and Jedediah Smith Trail are within the Project area. Public access to Discovery Park, American River Regional Parkway, Two Rivers Bike Trail, and Jedediah Smith Trail will be maintained during construction. In order to provide a safe and direct connection for bicyclists and pedestrians from Natomas to downtown Sacramento and the American River Regional Parkway, bike lanes and/or multi-purpose pathways will be included on the new bridge, and trail connections at the Two Rivers Bike Trail and Jedediah Smith Trail will be constructed as part of the Project. For the Two Rivers Bike Trail, design alternatives being pursued include providing a connection to the trail at the roadway intersection or constructing a ramp that connects to the trail, eliminating the need for a roadway intersection crossing. For the Jedediah Smith Trail, design alternatives include providing a connection to the trail on the west side of the bridge but an east side connection with a switchback is also being analyzed. See **Figure 3** for more information.

Project related impacts to these resources will be evaluated during the PA&ED phase of the Project. Since Caltrans is anticipated to be the NEPA lead, these resources would be treated as Section 4(f) and would go through the Section 4(f) evaluation process. This is discussed further in Section 3.2.10 and 4.4.

According to the Land and Water Conservation Fund (LWCF) project map, which tracks information on parcels/projects funded through LWCF over the program's history, there are multiple LWCF funded parcels/projects within the American River Parkway. After coordinating with the Director of Sacramento County Regional Parks, the closest LWCF funded parcel is outside of the Project vicinity. Thus, the Section 6(f) evaluation process is not anticipated.

2.5.5 Wild and Scenic River

The Lower American River, from Nimbus Dam to the Sacramento River confluence, is a state and nationally designated wild and scenic recreational river. The proposed Project is located in this segment of the American River. The ARPP is the policy document that guides decisions to preserve the scenic and recreational qualities of the river. Sacramento County Regional Parks is the implementing agency responsible for ensuring that management of the parkway is consistent with the ARPP.

Throughout the Feasibility Study, the City team has kept the goals and policies of the ARPP as a priority. Coordination with Sacramento County Regional Parks has been ongoing throughout the Feasibility Study (as discussed in Section 2.1).

Lastly, since the Lower American River is a nationally designated wild and scenic recreational river, it is subject to Section 7 of the Wild and Scenic Rivers Act. Section 7 directs federal agencies to protect the free-flowing condition and other values of designated rivers and congressionally authorized study rivers. Project related impacts to this resource will be evaluated during the PA&ED phase of the Project. This is discussed further in Section 3.2.8.

Chapter 3. Further Environmental Analysis

This chapter identifies environmental studies and environmental documents that will be required during the PA&ED phase of this Project.

3.1 Environmental Document

3.1.1 CEQA/NEPA

The proposed Project would require approval under both CEQA and NEPA during the environmental document phase. Preparation of an EIR under CEQA is anticipated due to the high level of public involvement as well as potentially significant impacts to environmental resources including, but not limited to cultural resources, tribal cultural resources, and biological resources. Additionally, approvals under NEPA are anticipated to be required due to federal funding and/or impacts to federal resources. Under NEPA, the Project is anticipated to require the preparation of a Complex EA leading to a FONSI. As it is anticipated that Caltrans would be the NEPA lead, acting on behalf of the Federal Highway Administration (FHWA), a Caltrans formatted joint EIR/EA would be prepared.

Prior to preparation of the EIR/EA, a Notice of Preparation (NOP) will be made available to the public and all interested stakeholders. The purpose of the NOP is to obtain early comments on the proposed Project, alternatives, and potential environmental impacts. Upon circulation of the NOP, the draft EIR/EA can be prepared and circulated to the public and all interested stakeholders, allowing the public to review and comment. Due to the level of impacts and anticipated significant public involvement, public engagement opportunities will be held throughout the overall environmental process. After circulation, all comments received will be responded to and included as an appendix to the final environmental document. During preparation of the final environmental document, findings of fact pursuant to State CEQA Guidelines Section 15091 for each of the significant effects identified in the Final EIR/EA will be prepared. The findings will describe the effect, cite one or more applicable findings under Section 15091, and describe the evidence that supports the selected findings. Additionally, a Statement of Overriding Considerations will be prepared to address any significant effects of the Project that are unavoidable, explaining the economic, legal, social, technological, or other benefits of the Project that outweigh its unavoidable environmental impacts. The objective of CEQA is to disclose to decision makers and the public the environmental effects of proposed activities. After considering the final EIR, the City, as the CEQA lead agency, may decide whether or how to approve or carry out the Project. If the City decides to approve the Project, a public hearing will be held regarding the potential adoption of the EIR/EA. Upon adoption of the CEQA document, Caltrans would consider moving forward with finalizing the NEPA portion of the EIR/EA with preparation and federal circulation of the FONSI.

3.1.2 Sacramento Regional Transit Previous Environmental Documentation

In 1989, Sacramento Regional Transit (SacRT) proposed a new bridge between Truxel Road and Sequoia Pacific Boulevard to serve the Green Line extension to the Sacramento International Airport. As a result of this effort, an Administrative Draft EIR/EA was prepared in 2019 that included an alternative with cars. However, this document was never publicly circulated and is thus not certified. In addition, there is currently no timeline identified for SacRT to complete this environmental document. To minimize delays, a standalone environmental document for the proposed Project is expected to be prepared rather than tiering off of a SacRT environmental document.

3.1.3 ARPP EIR Addendum

The ARPP identifies a new bridge crossing the Lower American River at the Truxel Road location. At the time of the ARPP adoption (2008), the development of this new bridge crossing was being led by SacRT and was known as the "Downtown-Natomas-Airport (DNA) light rail project alignment". This SacRT project is also referred to as the Green Line and at the time of adoption, provided for transit, pedestrian, and bicycles. SacRT is a partner on the City's Feasibility Study and supports the City moving forward with an all-modes bridge in this location, which would include vehicle lanes. While a new bridge in the proposed location is supported by the ARPP and is specifically referenced in numerous locations including the Discovery Park Area Plan, the Discovery Park Area Plan map identifies the crossing as a Light Rail DNA bridge, and Sacramento County Regional Parks has stated that an Area Plan Map Amendment will need to be processed and approved by the County in order to properly reflect the City's proposed all-modes bridge. Based on coordination with the County, it is anticipated that an Environmental Impact Report (EIR) Addendum to the previous ARPP Update EIR will be required before the County can approve this Area Plan Map Amendment. Public outreach will be conducted to ensure the public is involved before the EIR Addendum is approved. If Parkway-wide policies, associated text, or land use designations are to be changed, approval at the state level would be triggered. At this time, it is anticipated that is not needed.

3.2 Recommended Technical Studies

The technical studies listed below will be used to support the CEQA/NEPA environmental document prepared for this Project. It is anticipated that federal funding from FHWA will be secured for the Project and as such, the descriptions of technical studies below are consistent with Caltrans format documents.

3.2.1 Biological Technical Studies

Natural Environment Study

A Caltrans formatted Natural Environment Study (NES) will be needed to fully quantify the biological resources present onsite and potential project effects to those resources. The in-depth analysis included in the NES will be used to support the conclusions in the biological section of the CEQA/NEPA environmental document as well as guide the future preparation of Section 7 Endangered Species Consultation Materials.

Aquatic Resources Delineation Report

An Aquatic Resources Delineation Report (ARDR) is a standard required attachment for any permit application from USACE and will be required for this Project. A wetland delineation and ordinary high water mark identification and mapping effort will be completed as part of the biological investigations for the NES. Field investigations should be completed in the spring to maximize survey and mapping accuracy. Survey methodology must follow the standard practices specified in the Wetland Delineation Manual and Ordinary High Water Mark Delineation Manual published by USACE. The ARDR must be prepared in the template format provided by USACE. The ARDR will be prepared concurrently with the NES and does not need to receive separate Caltrans approval.

USFWS Biological Assessment

The Project may affect one federally listed (VELB) and one proposed threatened (western pond turtle) species that is under the conservation authority of USFWS. As the anticipated NEPA lead agency for the Project, Caltrans will be the Section 7 consultation lead with USFWS. A Biological Assessment (BA) will be needed to fully analyze and quantify potential impacts to these species. Caltrans will use the BA to initiate formal consultation with USFWS under Section 7 of the Endangered Species Act.

NMFS Biological Assessment

The Project may affect three fish species including Chinook salmon, Green sturgeon, and CCV Steelhead. In addition, the Project footprint contains final designated Critical Habitat for each of these species and Essential Fish Habitat. As such, formal consultation with the NMFS will be required to fully quantify, document, and mitigate potential effects to these species.

As the anticipated NEPA lead agency for this Project, Caltrans will be the Section 7 lead agency for consultation with NMFS. A BA will need to be prepared that assesses all potential direct and indirect effects to these species including habitat loss, potential hydroacoustic effects, and risk of entrapment. Caltrans will use the BA to initiate consultation with NMFS under Section 7 of the Endangered Species Act.

3.2.2 Water Quality

The proposed Project would construct a new crossing over the Lower American River, resulting in direct and indirect impacts to the Lower American River. A Water Quality Assessment Report will be prepared to evaluate potential impacts to water resources and water quality and identify best management practices to minimize and avoid water quality impacts.

3.2.3 Cultural

Cultural resource investigations will most likely include a pedestrian survey and Extended Phase I survey, due to the reduced visibility of the ground surface within the Project footprint. Should Indigenous resources extend into the areas of direct impact, a Phase II Testing Evaluation will be needed.

Technical studies, assuming Caltrans as the lead federal agency, include preparation of:

- Historic Property Survey Report,
- Archaeological Survey Report,
- Extended Phase I Proposal,
- Extended Phase I Report,
- Historical Resources Evaluation Report,
- Archaeological Evaluation Report,
- Finding of Effects Report,
- Monitoring and Environmentally Sensitive Area Action Plan,
- Memorandum of Agreement, and
- Late Discovery and Monitoring Plan

Consultation with SHPO will be required to consider potential impacts and effects to the resources identified through the investigation, consultation, and documentation processes.

3.2.4 Noise

The proposed Project will construct a new bridge across the Lower American River and is therefore a Type I project as defined in 23 CFR 772.5(h). There are multiple residences within 500 feet of the proposed bridge location. Additionally, the Lower American River contains habitat that supports wildlife and various special status species. Local residents, wildlife, and office workers may be impacted by increased noise levels; therefore, a Noise Study Report will be prepared to assess the Project's potential effects on future noise conditions and to evaluate temporary construction impacts and local noise ordinances.

Based on the Noise Study Report, if traffic noise impacts are predicted, noise abatement measures must be considered through the preparation of a Noise Abatement Decision Report (NADR). The NADR is prepared after the Noise Study Report is approved, during the PA&ED phase.

More specifically, the NADR evaluates the reasonableness and feasibility of constructing the noise abatement. The Caltrans Traffic Noise Analysis Protocol sets forth the criteria for determining when an abatement measure is reasonable and feasible. Feasibility of noise abatement is an engineering concern. A minimum 5-dBA reduction in the future noise level must be achieved for an abatement measure to be considered feasible. Other considerations include topography, access requirements, other noise sources, and safety considerations. The reasonableness determination is a cost-benefit analysis. Factors used in determining whether a proposed noise abatement measure is reasonable include the noise reduction design goal, residents' acceptance, and the cost per benefited residence. To meet the noise reduction design goal, a barrier must provide at least 7 dB of noise reduction at one or more benefited receptors. This design goal applies to any receptor and is not limited to affected receptors. In order to determine residents' acceptance, a letter and voting ballot will be sent to all property owners and non-owner occupants at benefited receptors, defined as receptors that are predicted to receive at least 5 dB of noise reduction from the proposed abatement, to solicit their viewpoints either to approve or oppose the proposed noise abatement. If more than 50% of the benefited receptors vote to oppose the abatement, then the abatement will not be considered reasonable. The results of the polling and the final reasonableness determination is included in the NEPA environmental document.

3.2.5 Air Quality

An Air Quality Report will be prepared to document potential Project impacts on air quality, potential avoidance, minimization, and/or mitigation measures, and project-level conformity documentation. Additionally, an Air Quality Conformity Analysis will be prepared and submitted to FHWA for their conformity determination.

Energy and Climate Change

Construction of a new bridge would potentially increase energy use via increased fuel consumption as well as greenhouse gas (GHG) emissions. Construction of the Project would result in short term energy use and GHG emission generation due to the use of construction equipment. A quantitative short-term and long-term energy use and greenhouse gas emissions analysis will be performed and summarized in the Air Quality Report and CEQA/NEPA environmental document. A discussion of compliance with the goals and policies of the City's CAAP will also be included in the CEQA/NEPA environmental document.

3.2.6 VMT

A Traffic Report, which includes a VMT analysis, would be prepared for the Project for public disclosure; however, only transportation projects not included in the General Plan would potentially be considered to have a significant impact under CEQA. The Truxel Bridge Project is part of the City of Sacramento's 2040 General Plan; therefore, VMT impacts under CEQA are considered a less than significant. Regardless, the results of the VMT analysis will be summarized in the CEQA environmental document.

3.2.7 Community

As the Project area crosses low-income and minority populations, a Community Impact Assessment will be conducted and will address community impact concerns, as well as identify minimization and mitigation measures to reduce impacts. The Project is striving to avoid any direct impacts to buildings; however, should the Project need relocations, a Relocation Impact Report will be prepared.

3.2.8 Visual/ Wild and Scenic Rivers

There are various visual and scenic resources within the Project area, such as the Lower American River, which is a state and nationally designated wild and scenic recreational river. Construction of the Project will introduce a new bridge across the Lower American River, requiring vegetation removal, and introducing new lighting in the area; therefore, impacts to the visual environment are anticipated. Viewer groups within the Project vicinity include residents, recreational users, commercial viewers, office workers, commuters, bicyclists, and pedestrians. To assess how these changes could impact viewer groups in the Project vicinity, a Visual Impact Assessment Advanced Report will be prepared. The Visual Impact Assessment Advanced Report will also evaluate if the construction or operation of the Project will affect this segment of the American River. Photo simulations are critical for understanding the proposed visual daytime and nighttime changes during and after construction of the Project. Because of the complexity of this Project, photorealistic simulations will be included in the Visual Impact Assessment Advanced Report. The new Truxel bridge will be designed to minimize negative impacts to the American River Parkway environment and aesthetic values and will follow policies listed in the ARPP. A Caltrans format Questionnaire to Determine Visual Impact Assessment Level (included in **Appendix B**) has been completed which resulted in a preliminary score of 39.

The ARPP has numerous policies related to the avoidance, minimization, and mitigation of visual impacts. As the Project progresses through future phases, the goals and policies of the ARPP will be at the forefront of Project decisions.

Last, since the Project is a nationally designated wild and scenic recreational river, it is subject to Section 7 of the Wild and Scenic Rivers Act and will need to be evaluated under the "direct and adverse effect" standard listed in the Technical Report of the Interagency Wild and Scenic Rivers Coordinating Council. This evaluation will be documented in a Wild and Scenic Rivers Study and will be prepared during the PA&ED phase of the Project.

3.2.9 Hazardous Waste

The Project would require removal and disposal of yellow traffic stripe paint and possible impacts to pole-mounted electrical transformers. Yellow traffic stripe paint made prior to 1995 has the potential to contain lead-based paint, and leaking electrical transformers are considered a

potential polychlorinated biphenyl hazard. There is also potential for aerially deposited lead (ADL) to be present in soils adjacent to Garden Highway and existing roadways. A Phase I Hazardous Waste Initial Site Assessment and Phase II Site Investigation will be required to assess potential hazardous waste sites for presence of hazardous materials in the Project area. The site assessments would include an evaluation of the Project area history through review of available reports and historic maps/aerial photographs etc., field reconnaissance to document the potential occurrence of and contamination by waste or hazardous materials in the Project area, and review of regulatory agency files and databases regarding the use, storage, unauthorized release and remediation of hazardous materials in the Project area. If any sites are confirmed to be present in the construction area, or where the City would be acquiring right-of way, additional testing will be required.

3.2.10 Section 4(f)

The Two Rivers Bike Trail, Jedediah Smith Trail, American River Parkway, and Discovery Park are located either within or immediately adjacent to the Project area. Additionally, the following historic sites, which qualify or may qualify as Section 4(f) resources, are located within the Project: Natomas East Main Drain / historic levees, commercial buildings, and Delta TCL. A Programmatic Section 4(f) Evaluation will be prepared and will appropriately document minimization effort to the Section 4(f) resources within or adjacent to the Project.

3.2.11 Floodplains

The proposed Project location occurs within Zone AE, which indicates floodway areas, and Zone A99, which indicates a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. The Project also occurs within Zone X, area with reduced flood risk due to levee. A Location Hydraulic Study, Floodplain Evaluation Report, and Summary Floodplain Encroachment Report will be prepared to analyze the impacts of the new bridge on the floodplain.

3.3 Habitat Mitigation Design

Once preliminary engineering has been completed and Project impacts to environmental and biological resources are more accurately calculated, a conceptual mitigation design must be prepared and shared with the County Parks Department, regulatory agencies, and stakeholder groups for input. Once a conceptual mitigation design is agreed upon, the next step will be to develop a Habitat Mitigation and Monitoring Plan (HMMP).

The HMMP will outline the impacts and mitigation from the proposed bridge Project, define a mitigation project to offset those impacts, and include post-mitigation success criteria to verify the mitigation project is progressing towards providing high quality habitat for target species. A conservation easement and endowment may be required.

Chapter 4. Future Agency & Stakeholder Consultations

This chapter discusses anticipated agency and stakeholder consultation that will occur during PA&ED, PS&E, and beyond.

4.1 Sacramento County Regional Parks and American River Parkway Plan

Frequent and regular coordination with Sacramento County Regional Parks will be a priority of the Project since they have the principal responsibility for administering the ARPP. The County Regional Parks' input on Project features and avoidance/minimization/mitigation measures will be extremely important. As discussed in previous sections, it is anticipated that the Project will need (at a minimum) one Area Plan Map Amendment for the inclusion of vehicles on the bridge, which will require an EIR Addendum followed by approval from the County Board of Supervisors. If Parkway-wide policies, associated text, or land use designations are to be changed, approval at the state level would be triggered. At this time, it is anticipated that is not needed. In addition, it is anticipated that future presentations will be necessary to the American River Parkway Advisory Committee and the County Recreation and Parks Commission.

4.2 Interagency Consultation for Air Quality Conformity

The City is in non-attainment for ozone and $PM_{2.5}$ and maintenance for PM_{10} under Federal regulations. As part of the Air Quality Report, a request for Interagency Consultation Review (ICR) will be prepared and presented to the SACOG Interagency Consultation Review Group. This Interagency Consultation process will determine if the Project is a Project of Air Quality Concern (POAQC) under U.S. EPA's regulations 40 CFR 93.123 (b) (1). The Project sponsor will submit a completed POAQC determination form to SACOG for review. SACOG then submits this form to the members of the SACOG ICR Group for 14 days. If it is determined to be a POAQC, the Project sponsor will need to perform a project-level PM hot spot analysis and bring it again to the SACOG ICR Group for review. Conformity documentation will be included in the joint CEQA/NEPA environmental document.

4.3 Wild and Scenic Rivers Interagency Coordination

As part of the Wild and Scenic Rivers Study, coordination with the River Managing Agencies (Sacramento County Regional Parks and California Resources Agency) for the Lower American River is required. It may be necessary to also consult with NPS. The purpose of this consultation is to determine whether the proposed Project could have an adverse effect on the free-flowing characteristics of the river and whether the action could have the potential to alter the river segment's ability to meet the criteria that classify it as wild, scenic, or recreational. The results of this consultation must be included in the Wild and Scenic Rivers Study and CEQA/NEPA environmental document. In order to avoid delays, it is recommended that coordination with all appropriate agencies occur early during the PA&ED phase of the Project.

4.4 Section 4(f) Programmatic Coordination

As part of the Programmatic Section 4(f) evaluation, interagency coordination is required with the agency having jurisdiction over the resource. For Two Rivers Bike Trail, Jedediah Smith Trail, American River Parkway, and Discovery Park, Sacramento County is the agency with jurisdiction. For the Natomas East Main Drain / historic levees and Delta TCL, SHPO is the agency with jurisdiction. Coordination with these jurisdictional agencies will consist of discussing the significance of the property, primary purpose of the land, proposed use and impacts, and

proposed measures to avoid and/or minimize harm. The official with jurisdiction must agree on the use evaluation and proposed measures to minimize harm in order for the Programmatic Section 4(f) evaluation to be approved.

4.5 State Historic Preservation Officer Consultation

The Project will consult with the SHPO to obtain concurrence on any cultural resources identified with require significance evaluations, determinations of effect, and/or a memorandum of agreement under Section 106 of the NHPA.

4.6 Endangered Species Consultations

4.6.1 U.S. Fish and Wildlife Service

The Project is anticipated to affect federally listed species protected by USFWS, including western pond turtle and VELB. As the anticipated NEPA lead agency for the Project, Caltrans will be the Section 7 consultation lead for both species. A BA will be needed to fully analyze and quantify potential impacts to these species. Caltrans will use the BA to initiate consultation with USFWS under Section 7 of the Endangered Species Act.

As the Project is likely to require removal or relocation of elderberry shrubs, formal consultation under Section 7 is anticipated.

4.6.2 National Marine Fisheries Service

The Project may affect three fish species including Chinook salmon, green sturgeon, and CCV Steelhead. In addition, the project footprint contains final designated Critical habitat for each of these species and Essential Fish Habitat. As such, formal consultation with the National Marine Fisheries Service will be required to fully quantify, document, and mitigate potential effects to these species.

As the anticipated NEPA lead agency for this Project, Caltrans will be the Section 7 lead agency for consultation with NMFS. A BA will need to be prepared that assesses all potential direct and indirect effects to these species including habitat loss, potential hydroacoustic effects, and risk of entrapment. Caltrans will use the BA to initiate consultation with NMFS under Section 7 of the Endangered Species Act.

4.6.3 California Department of Fish and Wildlife

The Project may result in incidental take of two species listed as threatened or endangered under CESA including Chinook salmon and Swainson’s hawk. Under California Fish and Game Code Section 2081, “take” of CESA listed species is prohibited without first obtaining an ITP from CDFW.

As the Project will likely involve impact pile driving that has the potential to result in harmful levels of underwater sound pressure that would result in direct take of CESA listed fish in close proximity to the construction area during trestle installation, an ITP for Chinook salmon is expected to be required.

CDFW has asserted that any Project activities within ¼ mile of an active Swainson’s hawk nest may result in nest abandonment or other forms of “take.” There are numerous documented

Swainson's hawk nests within ¼ mile of the proposed Project and there is a very good chance that Swainson's hawk will be nesting within ¼ mile of the Project during construction. As such, an ITP for Swainson's hawk is expected to be required to avoid potential delays during construction.

4.7 Regulatory Permitting

The regulatory permits listed below will need to be obtained during the PS&E phase, prior to construction of the Project. However, separate permits from the USACE, CDFW, and the Water Board will be required during PA&ED in order to proceed with geotechnical work or to initiate any cultural resource investigations that require excavation and vegetation removal.

4.7.1 U.S. Army Corps of Engineers

The USACE regulates discharges of dredged or fill material into Waters of the United States. These waters include rivers, streams, lakes, and the territorial seas that meet specific criteria, including a direct or indirect connection to navigation or interstate commerce. USACE's jurisdiction in these areas stems from two laws, Section 10 of the Rivers and Harbors Act, which regulates navigable water ways, and Section 404 of the Clean Water Act, which also includes smaller tributaries and adjacent wetlands. The American River is a traditionally navigable waterway and is a water of the United States. As such, any project on the river is subject to regulation under both Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act.

The proposed bridge is consistent with a linear transportation project described in Nationwide Permit 14 (NWP-14) which would cover the project for both Section 10 and Section 404 discharges. The City will be required to submit a pre-construction notification to the Sacramento District of the USACE to apply for coverage under NWP-14. In the Sacramento region, 404 Nationwide Permit Authorization take approximately 8-10 months to obtain.

4.7.2 Central Valley Regional Water Quality Control Board

The Water Board has jurisdiction under Section 401 of the Clean Water Act and regulates any activity which may result in a discharge to Waters of the United States. In addition, the Water Board also asserts authority over "waters of the State" under waste discharge requirements pursuant to the Porter-Cologne Water Quality Control Act.

The City will be required to submit an application to the Water Board for coverage under both Section 401 of the Clean Water Act and the Porter-Cologne Water Quality Control Act. The Water Board accepts a combined application and will issue a single Water Quality Certification that covers both State and Federal laws. In the Central Valley, 401 Water Quality Certifications take approximately 6-8 months to obtain.

4.7.3 Central Valley Flood Protection Board

The Flood Board regulates activities along designated floodways and regulated streams throughout the Central Valley. Any project in these areas must apply for a Flood Encroachment Permit from the Flood Board. In addition, if a project is located along or near a Federal Flood Control Project (e.g. federal levees, dams), the Flood Board must receive approval from the USACE Sacramento District Section 408 Program before issuing a Flood Encroachment Permit.

The American River at the Project area is a designated floodway and the City will need to apply for a Flood Encroachment permit from the Flood Board. In addition, Folsom Dam is a Federal Flood Control Facility and all portions of the Lower American River downstream of the dam are also considered part of the Federal Flood Control Facility. As such, the USACE Sacramento District Section 408 Program will need to review the project as part of the Encroachment Permit Process. Flood Encroachment permits with 408 review take approximately 18-24 months to obtain.

4.7.4 California Department of Fish and Wildlife

Under California Fish and Game Code Section 1600, public agencies are required to notify the CDFW and obtain a Streambed Alteration Agreement before undertaking any project that may substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake. In practice, CDFW jurisdiction under Section 1600 includes waterways (both natural and manmade) as well as associated wetland and riparian habitats. The Project is within CDFW Region 2, which is headquartered in Rancho Cordova.

The City will need to apply for a Streambed Alteration Agreement from CDFW for the proposed Project. Project notifications must be submitted to CDFW through their EPIMS online web portal. The typical timeline for obtaining a Streambed Alteration Agreement from CDFW in Region 2 is approximately 8-10 months.

4.7.5 U.S. Coast Guard

The USCG Bridge Program monitors and ensures that existing bridge crossings, bridge modifications, and new bridges over navigable waters do not obstruct navigation. The Lower American River is a navigable water and the bridge will need to be designed to meet navigational clearances. The proposed Project is within the jurisdiction of the 11th Coast Guard District in Alameda. The City will be required to contact the USCG Bridge Program and submit an application for a Bridge Permit. As part of their permit review, the USCG will complete their own separate public notification and comment process. The typical timeline for securing a USCG Bridge Permit is 12 months.

4.7.6 City Tree Permitting

The City of Sacramento Tree Ordinance protects all native trees with a trunk diameter of 12 inches or greater measured at standard height. In addition, all trees over 24 inches in diameter in undeveloped areas are protected by the City Tree Ordinance. As discussed in Section 2.2.1, construction of the proposed Project is estimated to require the removal of approximately 800 to 1,000 trees, many of which will be protected under the City tree ordinance. As such, an arborist survey is required and the City will have to coordinate with City Arborist and obtain a tree permit prior to the start of construction.

Chapter 5. Conclusions

5.1 Environmental Documentation and Technical Study Summary

The proposed Project will require approvals under CEQA and NEPA during the environmental document phase. The City of Sacramento will be the CEQA lead and it is assumed that Caltrans will be the NEPA lead. Due to the level of impacts to environmental resources and anticipated level of public interest, it is anticipated that the Project will require the preparation of an EIR under CEQA and a Complex EA under NEPA. To streamline the process, a joint EIR/EA will likely be prepared.

As Caltrans is the assumed NEPA lead and the Project is off the State Highway System, a PES Form will be required, which outlines the recommended federal environmental documentation, technical studies, surveys, approvals, agency coordination, and permits required for the Project. A PES Form has been prepared as part of this effort and is included in **Appendix B**. The following technical studies are expected to be required:

Table 2. Required Environmental Technical Studies

Resource Type	Environmental Technical Studies[1]	Coordination
Biological Resources	NES	Caltrans
	Biological Assessment (USFWS/NMFS)	Caltrans, USFWS, NMFS
	ARDR	Caltrans
Water Quality	WQAR	Caltrans
Cultural Resources	Historic Property Survey Report /Archaeological Survey Report	Caltrans, USACE, SHPO
	Extended Phase I Proposal/ Report	Caltrans, USACE, SHPO,
	Historical Resources Evaluation Report	Caltrans, USACE, SHPO
	Archaeological Evaluation Report	Caltrans, USACE, SHPO
	Finding of Effects Report	Caltrans, USACE, SHPO
	Monitoring and Environmentally Sensitive Area Action Plan	Caltrans, USACE

Resource Type	Environmental Technical Studies[1]	Coordination
	Memorandum of Agreement	Caltrans, USACE
	Late Discovery and Monitoring Plan	Caltrans, USACE
Noise	Noise Study Report	Caltrans
	NADR (Optional)	Caltrans
Air Quality	Air Quality Report	Caltrans
	Air Quality Conformity Analysis	Caltrans, SACOG ICR Group, FHWA
Traffic	Traffic Study	Caltrans
Community	Community Impact Assessment	Caltrans
	Relocation Impact Report (Optional)	Caltrans
Visual	Visual Impact Assessment - Advanced Report	Caltrans
Wild and Scenic Rivers	Wild and Scenic Rivers Study	Caltrans, Sacramento County, California Resource Agency, NPS
Hazardous Materials/Hazardous Waste	Hazardous Waste ISA	Caltrans
Section 4(f)	Section 4(f) Evaluation	Caltrans, Sacramento County, SHPO
Floodplain	Location Hydraulic Study	Caltrans
	Floodplain Evaluation Report	Caltrans
	Summary Floodplain Encroachment Report	Caltrans

Resource Type	Environmental Technical Studies[1]	Coordination
[1.] All technical studies listed are Caltrans specific since it is anticipated that Caltrans would be the NEPA lead agency		

5.1.1 American River Parkway Plan

The Project is located over the Lower American River which is classified as a recreation river within the State and Federal Wild and Scenic River Systems. In addition to being a Wild and Scenic River, the American River Parkway is an extremely valuable resource for the region. The ARPP is the guiding policy document for the Parkway and Sacramento County Regional Parks is responsible for administering the ARPP.

The ARPP sets goals, policies, and guidelines for activities within the Parkway. As the Project progresses, the City team will coordinate closely with Sacramento County Regional Parks and will obtain their input on the design features, temporary and permanent impacts to parkway natural and recreational resources, and mitigation. In addition, at least one Map Amendment to the Discover Park Area Plan will be necessary. Complying with the ARPP as well as avoiding, minimizing, and fully mitigating impacts to the Parkway/Lower American River will be a high priority of the Project.

5.1.2 Biological Resources

Special Status Species Consultations

As discussed in Section 4.4, the Project may affect species listed as either Threatened or Endangered under either FESA, or CESA.

For species listed under FESA, Caltrans is anticipated to serve as the Federal consultation lead for Section 7 Consultation with USFWS and NMFS. For species listed under CESA, the City will need to apply for an Incidental Take Permit under CFG Code Section 2081.

Due to the extended timelines necessary to complete federal and state consultations, it will be important for the Project schedule to begin the process as early as possible during the PA&ED phase of the Project, ideally shortly after biological technical studies have been prepared.

Regulatory Permitting

As discussed in Section 4.8, numerous permits, listed in Table 3 below, will be required during the PS&E Phase to construct the Project. Separate regulatory permits from the USACE, CDFW, and the Water Board will be required during PA&ED in order to perform geotechnical and cultural resource investigations that require excavation.

Table 3. Required Regulatory Permits

Permit Type	Regulatory Agency	Prerequisite	Approximate Timeline
§404 Nationwide Permit 14	USACE	NEPA	8-10 months
§401 Water Quality Certification	Water Board	NEPA & CEQA	6-8 months
Flood Encroachment Permit	Flood Board & USACE 408 Group	NEPA & CEQA	18–24 months

§1600 Streambed Alteration Agreement	CDFW	CEQA	8-10 months
Coast Guard Bridge Permit	USCG	NEPA	12 months
City Tree Permit	City of Sacramento	N/A	6 months

Habitat Mitigation

The Project alignment crosses a dense stand of Great Valley Riparian Forest, a sensitive vegetation community, and will result in both permanent and temporary impacts. Therefore, mitigation will be required. As the Project is within the American River Parkway, all compensatory mitigation for habitat impacts (including tree loss) must be implemented within the parkway. The City team has completed initial outreach to regulatory agencies and the Sacramento County Parks Department and identified a potentially suitable site approximately 2 miles upstream in the Woodlake Plan Area. In the next phase of work, the City will need to work with County Parks, Regulatory Agencies, and stakeholder groups to develop a conceptual mitigation design. Once a conceptual mitigation design is agreed upon, the next step will be to fully develop a mitigation plan and prepare a HMMP.

5.1.3 Cultural Resources

Due to the high cultural resource sensitivity of the Project area, Native American and permitting agency coordination is essential to begin investigations early in the planning process. Resources of concern include the Delta TCL and the Lower American River TCL as well as river levees, commercial buildings, and the Natomas East Main Drain. Overall, the Project may have an adverse effect under Section 106 of the NHPA and a potentially significant effect under CEQA requiring substantial attention to evaluation, assessment of effects, significance, development of mitigation, and consultation.

Appendix A. UAIC Correspondence

From: Melodi McAdams <mmcadams@auburnrancheria.com>
Date: August 30, 2024 at 5:02:56 PM PDT
To: Fedolia Harris <FHarris@cityofsacramento.org>, Rene Guerrero <rguerrero@auburnrancheria.com>
Cc: Jerome Encinas <jerome@encinasga.com>, Anna Starkey <astarkey@auburnrancheria.com>, Josef Fore <jfore@auburnrancheria.com>
Subject: RE: Truxel Bridge Crossing Site Visit

Hi Sparky,

Thank you for reaching out. Our team had the following recommendations for best practices:

- **Tribal Cultural Resource (TCR) Identification** – invite Tribes to identify TCRs within project areas and offer to conduct additional identification work (subsurface testing, canine survey, etc.) to further define boundaries.
    - Accept Tribal identifications of TCRs and document the sites (boundaries, significance & integrity) based on tribal recommendations.
- **Tribal Monitoring** – fully fund Tribal Monitoring during TCR identification, TCR treatment and construction.
- **TCR Treatment and Restoration** – follow Tribal recommendations for respectful treatment and restoration of TCRs.
    - **Design drawings** – provide copies of the design, so it's clear what types of ground disturbance will be occurring in which areas. This information helps to target areas for site identification and plan strategies for TCR protection.
    - **Engineers & Contracts** – ensure that engineers are present when treatment of TCRs is being discussed, so they can help determine feasible ways to avoid or reduce impacts to sites;
    - **Contract** – offer Tribes the ability to review construction contracts to ensure that the contract has funding and language for the protection of TCRs, include secure storage areas, stockpiling of cultural soils, reburial, identification of the role of Tribal Monitors, etc.
    - **Reburial** – offer timely and secure reburial of any cultural soils or cultural items at a location that is approved by Tribal representatives.
- **Archaeological Coordination** –Archaeological identification, evaluation and treatment will not be privileged over tribal identification, evaluation and treatment.
    - **Assistance** - Archaeologists should be tasked to support shared goals by assisting with documentation and treatment of Tribal Cultural Resources, upon Tribal request.

- **Competency** – since archaeologists often document or assist with treatment of tribal cultural resources, offer Tribal Representatives the opportunity to recommend archaeological consultants;
- **Enforcement** – include clauses for the removal and replacement of archaeological consultants if they lack the appropriate technical expertise, do not show up at the job site, cause damage to tribal cultural resources, or behave unprofessionally toward Tribal Representatives

- **Mitigation** – mitigate for impacts to TCRs in a way that is meaningful to Tribes.

Melodi McAdams

Tribal Heritage Manager

Tribal Historic Preservation Department

United Auburn Indian Community of the Auburn Rancheria

Mobile: 530-401-7470

Email: mmcadams@auburnrancheria.com

www.auburnrancheria.com

https://auburnrancheria.com/programs-services/tribal-preservation

10720 Indian Hill Road

Auburn, CA 95603

From: Fedolia Harris <FHarris@cityofsacramento.org>
Sent: Thursday, July 25, 2024 8:51 AM
To: Rene Guerrero <rguerrero@auburnrancheria.com>
Cc: 'Jerome Encinas' <jerome@encinasga.com>; Melodi McAdams <mmcadams@auburnrancheria.com>; Anna Starkey <astarkey@auburnrancheria.com>; Josef Fore <jfore@auburnrancheria.com>
Subject: Re: Truxel Bridge Crossing Site Visit

***** Caution - External Email:** The following email originated from outside the organization. Please exercise caution when opening attachments or links. ***

Good morning, Rene

My consultant team is busy pulling together cost estimates for the next phases of work to complete the Truxel Bridge. As we discussed, cultural analysis during the environmental phase and appropriate methods and mitigations are important for us to capture early so that we can budget accordingly. Hopefully your team has had an opportunity to discuss the project and can provide feedback soon. Thanks in advance.

Sparky

--

Fedolia “Sparky” Harris, Principal Planner

City of Sacramento, Public Works

(916) 808-2996

http://mypronouns.org/he

From: Rene Guerrero <rguerrero@auburnrancheria.com>
Date: Tuesday, June 4, 2024 at 5:15 PM
To: Fedolia Harris <FHarris@cityofsacramento.org>
Cc: 'Jerome Encinas' <jerome@encinasga.com>, Melodi McAdams <mmcadams@auburnrancheria.com>, Anna Starkey <astarkey@auburnrancheria.com>, Josef Fore <jfore@auburnrancheria.com>
Subject: RE: Truxel Bridge Crossing Site Visit

Thank you Sparky,

Talk soon,

From: Fedolia Harris <FHarris@cityofsacramento.org>
Sent: Tuesday, June 4, 2024 5:09 PM

To: Rene Guerrero <rguerrero@auburnrancheria.com>
Cc: 'Jerome Encinas' <jerome@encinasga.com>; Melodi McAdams <mmcadams@auburnrancheria.com>; Anna Starkey <astarkey@auburnrancheria.com>; Josef Fore <jfore@auburnrancheria.com>
Subject: Re: Truxel Bridge Crossing Site Visit

***** Caution - External Email:** The following email originated from outside the organization. Please exercise caution when opening attachments or links. ***

Thanks, Rene

Please follow this link for the information packet that I prepared for our meeting :

 Truxel Packet for UAIC Meeting.pdf

Don't hesitate to call if you have any questions.

--

Fedolia "Sparky" Harris, Principal Planner

City of Sacramento, Public Works

(916) 808-2996

http://mypronouns.org/he

From: Rene Guerrero <rguerrero@auburnrancheria.com>
Date: Tuesday, June 4, 2024 at 4:53 PM
To: Fedolia Harris <FHarris@cityofsacramento.org>
Cc: 'Jerome Encinas' <jerome@encinasga.com>, Melodi McAdams <mmcadams@auburnrancheria.com>, Anna Starkey <astarkey@auburnrancheria.com>, Josef Fore <jfore@auburnrancheria.com>
Subject: RE: Truxel Bridge Crossing Site Visit

Hello Sparky,

We will be discussing this project and hope to have input for you later this week or early next week.

If we haven't received them already, would you please send out the concept alternatives?

Thank you,

Rene

From: Fedolia Harris <FHarris@cityofsacramento.org>
Sent: Tuesday, June 4, 2024 10:59 AM
To: Rene Guerrero <rguerrero@auburnrancheria.com>
Cc: 'Jerome Encinas' <jerome@encinasga.com>; Melodi McAdams <mmcadams@auburnrancheria.com>; Anna Starkey <astarkey@auburnrancheria.com>; Josef Fore <jfore@auburnrancheria.com>
Subject: Re: Truxel Bridge Crossing Site Visit

***** Caution - External Email:** The following email originated from outside the organization. Please exercise caution when opening attachments or links. ***

Good morning, Rene

Thank you again for setting up the on-site meeting in Discovery Park to discuss the Truxel Bridge project. I am reaching out to let you know that our consultant team is finalizing the project concept alternatives and will soon begin preparing cost estimates. Your input regarding best practices to avoid and protect cultural resources is an important part of those estimates. As discussed at our meeting, please share any guidance that you have at your earliest convenience and don't hesitate to call if you have additional questions. Thank you in advance.

Sparky

--

Fedolia "Sparky" Harris, Principal Planner

City of Sacramento, Public Works

(916) 808-2996

http://mypronouns.org/he

From: rguerrero@auburnrancheria.com
When: 9:00 AM - 11:00 AM May 7, 2024
Subject: Truxel Bridge Crossing Site Visit
Location: Discovery Park, 291 Natomas Park Drive, Sacramento 95833

I set aside a couple of hours. If this date/time is not good, we can reschedule.

Site visit of the proposed crossing for the Truxel Bridge

City of Sacramento

Nothing in this e-mail is intended to constitute an electronic signature for purposes of the Electronic Signatures in Global and National Commerce Act (E-Sign Act), 15, U.S.C. §§ 7001 to 7006 or the Uniform Electronic Transactions Act of any state or the federal government unless a specific statement to the contrary is included in this e-mail.

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Nothing in this e-mail is intended to constitute an electronic signature for purposes of the Electronic Signatures in Global and National Commerce Act (E-Sign Act), 15, U.S.C. §§ 7001 to 7006 or the Uniform Electronic Transactions Act of any state or the federal government unless a specific statement to the contrary is included in this e-mail.

Appendix B. Caltrans PES Form

EXHIBIT 6-A PRELIMINARY ENVIRONMENTAL STUDY (PES)

Federal Project No.: *(Federal Program Prefix-Project No., Agreement No.)*

Final Design: *(Expected Start Date)*

To: Bomasur Banzon *(District Local Assistance Engineer)*
Caltrans District 3 *(District)*
703, B Street, Marysville, CA 95901 *(Address)*
bomasur.banzon@dot.ca.gov *(Email Address)*

From: City of Sacramento *(Local Agency)*
Fedolia "Sparky" Harris, (916) 808-2996 *(Project Manager's Name and Telephone No.)*
915 I Street, Room 2000 Sacramento, CA 95814 *(Address)*
fharris@cityofsacramento.org *(Email Address)*

Is this Project "ON" the State Highway System? ☐ Yes ☒ No **IF YES, STOP HERE** and contact the District Local Assistance Engineer regarding the completion of other environmental documentation.

Federal State Transportation Improvement Program (FSTIP)
https://dot.ca.gov/programs/financial-programming/office-of-federal-programming-data-management-ofpdm

2023 MTP/SCS *(Currently Adopted Plan Date)* 54 *(Page No.___ attach to this form)*

Programming for FSTIP:

Preliminary Engineering		Right of Way		Construction	
(Fiscal Year)	$ *(Dollars)*	*(Fiscal Year)*	$ *(Dollars)*	*(Fiscal Year)*	$ *(Dollars)*

Project Description as Shown in RTP and FSTIP: New all-modal Bridge: between downtown Sacramento and South Natomas across the Lower American River. Includes: Auto, transit, bicycle, and pedestrian facilities. Scale and features to be determined through need and purpose study anticipated to begin in 2012.

Detailed Project Description: *(Describe the following, as applicable: purpose and need, project location and limits, required right of way acquisition, proposed facilities, staging areas, disposal and borrow sites, construction activities, and construction access.)*
The City of Sacramento proposes to construct a multi-modal bridge connecting Truxel Road to Sequoia Pacific Boulevard across the American River.

(Continue description on "Notes" sheet, last page of this Exhibit, if necessary)

Preliminary Design Information:
Does the project involve any of the following? Please check the appropriate boxes and delineate on an attached map, plan, or layout including any additional pertinent information.

Yes	No		Yes	No		Yes	No	
☐	☒	Widen existing roadway	☒	☐	Ground disturbance	☒	☐	Easements
☒	☐	Increase number of through lanes	☒	☐	Road cut/fill	☒	☐	Equipment staging
☒	☐	New alignment	☒	☐	Excavation: anticipated maximum depth 120 feet	☒	☐	Temporary access road/detour
☒	☐	Capacity increasing—other (e.g., channelization)				☒	☐	Utility relocation
						☒	☐	Right of way acquisition (if yes, attach map with APN)
☐	☒	Realignment	☒	☐	Drainage/culverts			
☒	☐	Ramp or street closure	☒	☐	Flooding protection			
☒	☐	Bridge work	☒	☐	Stream channel work	☐	☒	Disposal/borrow sites
			☒	☐	Pile driving	☐	☒	Part of larger adjacent project
☒	☐	Vegetation removal						
☒	☐	Tree removal	☐	☒	Demolition	☐	☒	Railroad

Required Attachments:

☒ Regional map ☒ Project location map ☒ Project footprint map (existing/proposed right of way)

☒ Engineering drawings (existing and proposed cross sections), if available ☐ Borrow/disposal site location map, if applicable
(Note: all maps (except project location map and regional maps) should be consistent with the project description (minimum scale: 1" = 200').)

☒ GeoTracker Printout for Hazardous Materials (http://geotracker.waterboards.ca.gov/).

☒ Federal Threatened and Endangered Species List from USFWS (http://ecos.fws.gov/ipac/).

☒ Federal Threatened and Endangered Species List from NMFS (http://www.westcoast.fisheries.noaa.gov/maps/data/california species listtools.html).

☒ Current Photos of Project Site ☒ FEMA map ☒ VIA Questionnaire

Examine the project for potential effects on the environment, direct or indirect and answer the following questions. The "construction area," as specified below, includes all areas of ground disturbance associated with the project, including staging and stockpiling areas and temporary access roads.

Each answer must be briefly documented on the "Notes" pages at the end of the PES Form.

A. Potential Environmental Effects	Yes	To Be Determined	No
General			
1. Will the project require future construction to fully utilize the design capabilities included in the proposed project?	☐	☐	☒
2. Will the project generate public controversy?	☒	☐	☐
Noise			
3. Is the project a Type I project as defined in 23 CFR 772.5(h); "construction on new location or the physical alteration of an existing highway, which significantly changes either the horizontal or vertical alignment or increases the number of through-traffic lanes"?	☒	☐	☐
4. Does the project have the potential for adverse construction-related noise impact (such as related to pile driving)?	☒	☐	☐
Air Quality			
5. Is the project in a NAAQS non-attainment or maintenance area?	☒	☐	☐
6. Is the project exempt from the requirement that a conformity determination be made? (If "Yes," state which conformity exemption in 40 CFR 93.126, or 40 CFR 93.128 (check one box below and identify the project type if applicable): ☐40 CFR 93.126 ☐ 40 CFR 93.128 Project type: _____	☐	☐	☒
7. Is the project exempt from regional conformity? (If "Yes," state which conformity exemption in 40 CFR 93.127, Table 3 applies): _____	☐	☐	☒
8. If project is not exempt from regional conformity, (If "No" on Question #7)			
Is project in a metropolitan non-attainment/maintenance area?	☒	☐	☐
Is project in an isolated rural non-attainment area?	☐	☐	☒
Is project in a CO, PM10 and/or PM2.5 non-attainment/maintenance area?	☒	☐	☐
Hazardous Materials/Hazardous Waste			
9. Is there potential for hazardous materials (including underground or aboveground tanks, etc.) or hazardous waste (including oil/water separators, waste oil, asbestos-containing material, lead-based paint, ADL, etc.) within or immediately adjacent to the construction area?	☐	☒	☐
Water Quality/Resources			
10. Does the project have the potential to impact water resources (rivers, streams, bays, inlets, lakes, drainage sloughs) within or immediately adjacent to the project area?	☒	☐	☐

11. Is the project within a designated sole-source aquifer?	☐	☐	☒
Coastal Zone			
12. Is the project within the State Coastal Zone, San Francisco Bay, or Suisun Marsh?	☐	☐	☒
Floodplain			
13. Is the construction area located within a regulatory floodway or within the base floodplain (100-year) elevation of a watercourse or lake?	☒	☐	☐
Wild and Scenic Rivers			
14. Is the project within or immediately adjacent to a Wild and Scenic River System?	☒	☐	☐
Biological Resources			
15. Is there a potential for federally listed threatened or endangered species, or their critical habitat or essential fish habitat to occur within or adjacent to the construction area?	☒	☐	☐
16. Does the project have the potential to directly or indirectly affect migratory birds, or their nests or eggs (such as vegetation removal, box culvert replacement/repair, bridge work, etc.)?	☒	☐	☐
17. Is there a potential for wetlands to occur within or adjacent to the construction area?	☒	☐	☐
18. Is there a potential for agricultural wetlands to occur within or adjacent to the construction area?	☐	☐	☒
19. Is there a potential for the introduction or spread of invasive plant species?	☒	☐	☐
Sections 4(f) and 6(f)			
20. Are there any historic sites or publicly owned public parks, recreation areas, wildlife or waterfowl refuges (Section 4[f]) within or immediately adjacent to the construction area?	☒	☐	☐
21. Does the project have the potential to affect properties acquired or improved with Land and Water Conservation Fund Act (Section 6[f]) funds?	☐	☐	☒
Visual Resources			
22. Does the project have the potential to affect any visual or scenic resources?	☒	☐	☐
Relocation Impacts			
23. Will the project require the relocation of residential or business properties? (If the answer to questions 23-32 is "yes," then Title VI Implementation and outreach may be triggered)	☐	☒	☐
Land Use, Community, and Farmland Impacts			
24. Will the project require any right of way, including partial or full takes? Consider construction easements and utility relocations.	☒	☐	☐
25. Is the project inconsistent with plans and goals adopted by the community?	☐	☐	☒
26. Does the project have the potential to divide or disrupt neighborhoods/communities?	☐	☒	☐
27. Does the project have the potential to disproportionately affect low-income and minority populations?	☐	☒	☐
28. Will the project require the relocation of public utilities?	☐	☒	☐
29. Will the project affect access to properties or roadways?	☐	☒	☐
30. Will the project involve changes in access control to the State Highway System (SHS)?	☐	☐	☒
31. Will the project involve the use of a temporary road, detour, or ramp closure?	☐	☒	☐
32. Will the project reduce available parking?	☐	☐	☒
33. Will the project construction encroach on state or federal lands?	☐	☐	☒
34. Will the project convert any farmland to a different use or impact any farmlands?	☐	☐	☒
Cultural Resources			
35. Is there National Register listed, or potentially eligible historic properties, or archaeological resources within or immediately adjacent to the construction area? *(Note: Caltrans PQS answers question #35)*	☒	☐	☐
36. Is the project adjacent to, or would it encroach on Tribal land?	☐	☐	☒

For Sections B, C, and D, check appropriate box to indicate required technical studies, coordination, permits, or approvals.

B. Required Technical Studies and Analyses	C. Coordination	D. Anticipated Actions/Permits/Approvals
☒ **Traffic**		
Check one:		
☒ Traffic Study	☒ Caltrans	☒ Approval
☐ Technical Memorandum	☐ Caltrans	☐ Approval
☐ Discussion in ED Only	☐ Caltrans	☐ Approval
☒ **Noise**		
Check as applicable:		
☒ Traffic Related		
☒ Construction Related		
Check one:		
☒ Noise Study Report	☒ Caltrans	☒ Approval
☒ NADR	☒ Caltrans	☒ Approval
☐ Technical Memorandum	☐ Caltrans	☐ Approval
☐ Discussion in ED Only	☐ Caltrans	☐ Approval
☒ **Air Quality**		
Check as applicable:		
☒ Traffic Related		
☒ Construction Related		
Check one:		
☒ Air Quality Report	☒ Caltrans	☒ Approval
☐ Technical Memorandum	☐ Caltrans	☐ Approval
☐ Discussion in ED Only	☐ Caltrans	☐ Approval
	☒ FHWA	☒ Conformity Finding (23 USC 327 CEs, EAs, EISs)
	☐ Caltrans	☐ Conformity Finding (23 USC 326 CEs)
	☒ Regional Agency	☒ PM10/PM2.5 Interagency Consultation
☒ **Hazardous Materials/ Hazardous Waste**		
Check as applicable:		
☒ Initial Site Assessment (Phase 1)	☒ Caltrans	☒ Approval
☒ Preliminary Site Assessment (Phase 2)	☒ Caltrans	☒ Approval
☐ Discussion in ED Only	☐ Caltrans	☐ Approval
	☐ Cal EPA DTSC	☐ Review Database
	☐ Local Agency	☐ Review Database
☒ **Water Quality/Resources**		
Check as applicable:		
☒ Water Quality Assess. Report	☒ Caltrans	☒ Approval
☐ Technical Memorandum	☐ Caltrans	☐ Approval
☐ Discussion in ED Only	☐ Caltrans	☐ Approval
☐ **Sole-Source Aquifer (Districts 5, 6 and 11)**	☐ EPA (S.F. Regional Office)	☐ Approval of Analysis in ED
☐ **Coastal Zone**	☐ CCC	☐ Coastal Zone Consistency Determination

B. Required Technical Studies and Analyses	C. Coordination	D. Anticipated Actions/Permits/Approvals
☒ **Floodplain**		
Check as applicable:		
☒ Location Hydraulic Study	☒ Caltrans	☒ Approval
☒ Floodplain Evaluation Report	☒ Caltrans	☒ Approval
☒ Summary Floodplain Encroachment Report	☐ Caltrans	☐ Approval
	☐ Caltrans	☐ Only Practicable Alternative Finding
	☐ FHWA	☐ Approves significant encroachments and concurs in Only Practicable Alternative Findings
☒ **Wild and Scenic Rivers**	☒ River Managing Agency	☒ Wild and Scenic Rivers Determination
☒ **Biological Resources**		
Check as applicable:		
☐ NES, Minimal Impact	☐ Caltrans	☐ Approval
☒ NES		
☒ BA	☒ Caltrans	☒ Approves for Consultation
	☒ USFWS ☒ NOAA Fisheries	☒ Section 7 Informal/Formal Consultation
☒ EFH Evaluation	☒ NOAA Fisheries	☐ MSA Consultation
☒ Bio-Acoustic Evaluation	☒ NOAA Fisheries	☒ Approval
☐ Technical Memorandum	☐ Caltrans	☐ Approval
☒ **Wetlands**		
Check as applicable:		
☒ WD and Assessment	☒ Caltrans	☒ Approval
	☐ ACOE	☐ Wetland Verification
	☐ NRCS	☐ Agricultural Wetland Verification
	☐ Caltrans	☐ Wetlands Only Practicable Alternative Finding
☒ **Invasive Plants**		
☒ Discussion in ED Only	☒ Caltrans	☒ Approval
☒ **Section 4(f)**		
Check as applicable:		
	☐ Caltrans	☐ Determine Temporary Occupancy
☐ De minimis	☐ Caltrans	☐ De minimis finding
☒ Programmatic 4(f) Evaluation Type: _____	☒ Caltrans	☒ Approval
☐ Individual 4(f) Evaluation	☐ Caltrans	☐ Approval
	☐ Agency with Jurisdiction ☐ SHPO ☐ DOI ☐ HUD ☐ USDA	

B. Required Technical Studies and Analyses	C. Coordination	D. Anticipated Actions/Permits/Approvals

☐	**Section 6(f)**	☐ Agency with Jurisdiction ☐ NPS	☐ Determines Consistency with Long-Term Management Plan
		☐ NPS	☐ Approves Conversion
☒	**Visual Resources**		
	☐ Technical Memorandum	☐ Caltrans	☐ Approval
	☐ Minor VIA	☐ Caltrans	☐ Approval
	☐ Moderate VIA	☐ Caltrans	☐ Approval
	☒ Advance/Complex VIA	☒ Caltrans	☒ Approval
☒	**Relocation Impacts**		
	Check one:		
	☐ Relocation Impact Memo	☐ Caltrans	☐ Approval
	☐ Relocation Impact Study	☐ Caltrans	☐ Approval
	☒ Relocation Impact Report	☒ Caltrans	☒ Approval
☒	**Land Use and Community Impacts**		
	Check one:		
	☒ CIA	☒ Caltrans	☒ Approval
	☐ Technical Memorandum	☐ Caltrans	☐ Approval
	☐ Discussion in ED Only	☐ Caltrans	☐ Approval
☐	**Construction/Encroachment on State Lands**		
	Check as applicable:		
	☐ SLC Jurisdiction	☐ SLC	☐ SLC Lease
	☐ Caltrans Jurisdiction	☐ Caltrans	☐ Encroachment Permit
	☐ SP Jurisdiction	☐ SP	☐ Encroachment Permit
☐	**Construction/Encroachment on Federal Lands**	☐ Federal Agency with Jurisdiction	☐ Encroachment Permit
☐	**Construction/Encroachment On Indian Trust Lands**	☐ Bureau of Indian Affairs	☐ Right of Way Permit
☐	**Farmlands**		
	Check one:		
	☐ CIA	☐ Caltrans	☐ Approval
	☐ Technical Memorandum	☐ Caltrans	☐ Approval
	☐ Discussion in ED Only	☐ Caltrans	☐ Approval
	Check as applicable:		
	☐ Form AD 1006	☐ NRCS	☐ Approves Conversion
		☐ CDOC	☐ Approves Conversion
	☐ Conversion to Non-Agri Use	☐ ACOE	

B. Required Technical Studies and Analyses	C. Coordination	D. Anticipated Actions/Permits/ Approvals
☒ **Cultural Resources** (**PQS completes this section**)	☐ Caltrans PQS	☐ Screened Undertaking
☒ APE Map	☒ Caltrans PQS and DLAE	☒ Approves APE Map
	☒ Local Preservation Groups and/or Native American Tribes	☒ Provides Comments Regarding Concerns with Project
☒ HPSR ☒ ASR ☒ HRER	☒ Caltrans	☒ Approves for Consultation
☒ Finding of Effect Report	☒ Caltrans	☐ Concurs on No Effect, No Adverse Effect with Standard Conditions
	☒ SHPO	☐ Letter of Concurrence on Eligibility, No Adverse Effect without Standard
☒ MOA	☒ Caltrans	☒ Approves MOA
	☐ SHPO	☐ Approves MOA
	☐ ACHP (if requested)	☐ Approves MOA
☒ **Permits** Copies of permits and a list of mitigation commitments are mandatory submittals following NEPA approval.	☒ ACOE	☒ Section 404 Nationwide Permit
	☐ ACOE	☐ Section 404 Individual Permit
	☐ Caltrans/ACOE/EPA ☐ USFWS ☐ NOAA Fisheries	☐ NEPA/404 Integration MOU
	☒ ACOE	☒ Rivers and Harbors Act Section 10 Permit
	☒ USCG	☒ USCG Bridge Permit
	☒ RWQCB	☒ Section 401 Water Quality Certification
	☒ CDFW	☒ Section 1602 Streambed Alteration Agreement
	☒ RWQCB	☒ NPDES Permit
	☐ CCC ☐ Local Agency	☐ Coastal Zone Permit
	☐ BCDC	☐ BCDC Permit

Notes: Additional studies may be required for other federal agencies.

ACHP = Advisory Council on Historic Preservation
ACOE = U.S. Army Corps of Engineers
ADL = Aerially Deposited Lead
APE = Area of Potential Effect
APN = Assessor Parcel Number
ASR = Archaeological Survey Report
BA = Biological Assessment
BCDC = Bay Conservation and Development Commission
BE = Biological Evaluation
BO = Biological Opinion
Cal EPA = California Environmental Protection Agency
CCC = California Coastal Commission
CDFW = California Department of Fish and Wildlife
CDOC = California Department of Conservation
CE = Categorical Exclusion
CIA = Community Impact Assessment
CWA = Clean Water Act
DLAE = District Local Assistance Engineer
DOI = U.S. Department of Interior
DTSC = Department of Toxic Substances Control
EA = Environmental Assessment
ED = Environmental Document
EFH = Essential Fish Habitat
EIS = Environmental Impact Statement
EPA = U.S. Environmental Protection Agency
FEMA = Federal Emergency Management Agency
FHWA = Federal Highway Administration
FONSI = Finding of No Significant Impacted
FTIP = Federal Transportation Improvement Program
HPSR = Historic Property Survey Report
HRER = Historical Resources Evaluation Report
HUD = U.S. Housing and Urban Development
MOA = Memorandum of Agreement
MSA = Magnuson-Stevens Fishery Conservation and Management Act
NEPA = National Environmental Policy Act
NADR = Noise Abatement Decision Report
NES = Natural Environment Study
NHPA = National Historic Preservation Act
NOAA = National Oceanic and Atmospheric Administration
NMFS National Marine Fisheries Service
NPDES = National Pollutant Discharge Elimination System
NPS = National Park Service
NRCS = Natural Resources Conservation Service
PM10 = Particulate Matter 10 Microns in Diameter or Less
PM2.5 = Particulate Matter 2.5 Microns in Diameter or Less
PMP = Project Management Plan
PQS = Professionally Qualified Staff
ROD = Record of Decision
RTIP = Regional Transportation Improvement Program
RTP = Regional Transportation Plan
RWQCB = Regional Water Quality Control Board
SER = Standard Environmental Reference
SEP = Senior Environmental Planner
SHPO = State Historic Preservation Officer
SLC = State Lands Commission
SP = State Parks
TIP = Transportation Improvement Program
USCG = U.S. Coast Guard
USDA = U.S. Department of Agriculture
USFWS = U.S. Fish and Wildlife Service
WD = Wetland Delineation

E. Preliminary Environmental Document Classification (NEPA)

Based on the evaluation of the project, the environmental document to be developed should be:

Check one:

☐ Environmental Impact Statement (*Note: Engagement with participating agencies in accordance with 23 USC 139 required)*

☐ Compliance with 23 USC 139 regarding Participating Agencies required

☒ Complex Environmental Assessment

☐ Routine Environmental Assessment

☐ Categorical Exclusion without required technical studies.

☐ Categorical Exclusion with required technical studies

(if Categorical Exclusion is selected, check one of the following):

☐ Section 23 USC 326

☐ 23 CFR 771 activity (c)(_____)

☐ 23 CFR 771 activity (d) (_____)

☐ Activity _____ listed in the Section 23 USC 326

☐ Section 23 USC 327

F. Public Availability and Public Hearing

Check as applicable:

☐ Not Required

☒ Notice of Availability of Environmental Document

☒ Public Meeting

☒ Notice of Opportunity for a Public Hearing

☐ Public Hearing Required

G. Signatures

Local Agency Staff and/or Consultant Signature

(Signature of Preparer)	*(Date)*	*(Telephone No.)*

(Name)

Local Agency Project Engineer Signature

This document was prepared under my supervision, according to the *Local Assistance Procedures Manual*, Exhibit 6-B, "Instructions for Completing the Preliminary Environmental Study Form."

(Signature of Local Agency)	*(Date)*	*(Telephone No.)*

Caltrans District Professionally Qualified Staff (PQS) Signature

☐ Project does not meet definition of an "undertaking"; no further review is necessary under Section 106 ("No" Section A, #35).

☐ Project is limited to the type of activity listed in Attachment 2 of the Section 106 PA and based on the information provided in the PES Form, the project does not have the potential to affect historic properties ("No" Section A, #35).

☐ Project is limited to the type of activity listed in Attachment 2 of the Section 106 PA, but the following additional procedures or information is needed to determine the potential for effect ("To Be Determined" Section A, #35):

☐ Records Search ☐ _____ ☐ _____ ☐ _____

☐ Project meets the definition of an "undertaking"; all properties in the project area are exempt from evaluation per Attachment 4 of the Section 106 PA ("No" Section A, #35).

☐ The proposed undertaking is considered to have the potential to affect historic properties; further studies for 106 compliance are indicated in Sections B, C, and D of this PES Form ("Yes" Section A, #35).

_____ _____ _____
(Signature of Professionally Qualified Staff) *(Date)* *(Telephone No.)*

The following signatures are required for all CEs, routine and complex EAs, and EISs:

Caltrans District Senior Environmental Planner (or Designee) and DLAE Signatures

I have reviewed this Preliminary Environmental Study (PES) Form and determined that the submittal is complete and sufficient. I concur with the studies to be performed and the recommended NEPA Class of Action.

_____ _____ _____
(Signature of Senior Environmental Planner or Designee) *(Date)* *(Telephone No.)*

_____
(Name)

_____ _____ _____
(Signature of District Local Assistance Engineer or Designee) *(Date)* *(Telephone No.)*

_____
(Name)

☐ HQ DEA Environmental Coordinator concurrence _____. Email concurrence attached.
(*date*)

Preliminary Environmental Investigation

Notes to Support the Conclusions of the PES Form

(May Also Include Continuation of Detailed Project Description)

Brief Explanation of How Project Complies, or Will Comply with Applicable Federal Mandate (Part A):

1. **Will the project require future construction to fully utilize the design capabilities included in the proposed project?** No, the project does not require future construction to fully utilize the design capabilities of the proposed project. The Truxel Road Bridge project will be functionally independent of any future City of Sacramento projects.

2. **Will the project generate public controversy?** Yes. Controversial issues are focused on safety and environmental impacts to the American River. Thorough public outreach and coordination will be conducted throughout the design phase of the project.

3. **Is the project a Type I project as defined in 23 CFR 772.5(h); "construction on new location or the physical alteration of an existing highway, which significantly changes either the horizontal or vertical alignment or increases the number of through-traffic lanes"?** Yes, the proposed project is constructing the Truxel bridge at a new location and is therefore a Type I project as defined in 23 CFR 772.5(h). There are multiple residences within 500 feet of the proposed bridge location. A Noise Study Report will be prepared to assess the project's potential effects on future noise conditions and to evaluate temporary construction impacts and local noise ordinances. Based on the Noise Study Report, if noise impacts warrant abatement, a Noise Abatement Decision Report would be required.
4. **Does the project have the potential for adverse construction-related noise impact (such as related to pile driving)?** Yes, a Noise Study Report will be prepared to assess the project's potential effects on future noise conditions and to evaluate temporary construction impacts and local noise ordinances. Construction of the proposed project will involve pile driving. However, construction related noise impacts will be limited in duration. Based on the Noise Study Report, if noise impacts warrant abatement, a Noise Abatement Decision Report would be required.
5. **Is the project in a NAAQS non-attainment or maintenance area?** Yes, the City of Sacramento is in a NAAQS non-attainment area for Ozone and Particulate Matter 2.5 ($PM_{2.5}$).
6. **Is the project exempt from the requirement that a conformity determination be made? (If "Yes," state which conformity exemption per 40 CFR 93.126, Table 2 applies):** No, as none of the exemptions in 40 CFR 93.126 Table 2 apply, the project is not exempt from the requirement that a conformity determination be made.
7. **Is the project exempt from regional conformity? (If "Yes," state which conformity exemption in 40 CFR 93.127, Table 3 applies):** No, as none of the exemptions in 40 CFR 93.127 Table 3 apply, the project is not exempt from regional conformity.
8. **If project is not exempt (that is, if "No" on Question #6 and Question #7) a project-level conformity determination is required. The project-level conformity determination would include both the regional emissions analysis and a hot spot analysis (in PM2.5, PM10 and CO nonattainment or maintenance areas).** The project is listed in the conforming 2023 SACOG MTP/SCS (Truxel Bridge (SAC24539)) and therefore meets regional conformity requirements for a project level conformity determination. As the project is in a non-attainment area for $PM_{2.5}$, interagency consultation is needed to determine if the project is a Project of Air Quality Concern (POAQC). If the project is determined to be a POAQC, a localized hot spot analysis for $PM_{2.5}$ is required. An Air Quality Report will be prepared and will document potential impacts of the project on air quality, potential avoidance, minimization, and/or mitigation measures, and project-level conformity documentation. Additionally, an Air Quality Conformity Analysis, which contains the information that is required to make a project-level air quality conformity determination, will be prepared and submitted to FHWA for FHWA's conformity determination.

9. **Is there potential for hazardous materials (including underground or aboveground tanks, etc.) and/or hazardous waste (including oil/water separators, waste oil, asbestos-containing material, lead-based paint, ADL, etc.) within or immediately adjacent to the construction area?** To be determined, based on a review of the California Department of Water Resources GeoTracker and the Department of Toxic Substances Control EnviroStor databases, there are no hazardous materials/waste sites within the project footprint (see Attachment 3). However, the project would include improvements along Truxel Road and Sequioa Pacific Boulevard and could result in removal of yellow thermoplastic pavement markings and other types or colors of street or municipal markings containing lead-based paint from the existing roadways. There is also potential for aerially deposited lead (ADL) to be present in soils adjacent to Garden Highway and existing roadways. The Hazardous Waste Phase 1 Initial Site Assessment will further evaluate the potential for hazardous materials/waste concerns related to construction of the proposed project.

10. **Does the project have the potential to impact water resources (rivers, streams, bays, inlets, lakes, drainage sloughs) within or immediately adjacent to the project area?** Yes, the proposed project crosses the American River. A Water Quality Assessment Report will be prepared to evaluate potential impacts to water resources and water quality and identify Best Management Practices (BMP's) to minimize and avoid water quality impacts. Work within the American River will require regulatory permits from the US Army Corps of Engineers, Regional Water Quality Control Board, California Department of Fish and Wildlife, Central Valley Flood Board, and the Coast Guard. See Section B for a list of permits required for the project.

11. **Is the project within a designated sole-source aquifer?** No, designated sole-source aquifers in California are in the counties of Fresno, Santa Cruz, San Diego, and Imperial. The project is in the City of Sacramento.

12. **Is the project within the State Coastal Zone, San Francisco Bay, or Suisun Marsh?** No, the project is not within the State Coastal Zone, San Francisco Bay, or Suisun Marsh. The proposed site is located in City of Sacramento and is roughly 70 miles inland. See Attachment 1 for Location and Vicinity map.

13. **Is the construction area located within a regulatory floodway or within the base floodplain (100-year) elevation of a watercourse or lake?** Yes, the proposed project location occurs within Zone AE, which indicates floodway areas, and Zone A99, which indicates a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. The project also occurs within Zone X, area with reduced flood risk due to levee. A Location Hydraulic Study, Floodplain Evaluation Report, and Summary Floodplain Encroachment Report will be prepared to analyze impacts of the new bridge on the floodplain. An encroachment permit from the Central Valley Flood Board will be obtained prior to construction. A FEMA Map, which includes the FEMA map number, has been included in Attachment 1 to this PES form.

14. **Is the project within or immediately adjacent to a Wild and Scenic River System?** Yes, the American River (Lower), from Nimbus Dam to Sacramento River confluence, is a nationally designated wild and scenic recreational river. The proposed project is located in this segment of the American River. The Visual Impact Assessment prepared for this project will evaluate if the construction or operation of the project will affect this segment of the American River. Additionally, the Discovery Park Area Plan Map in the American River Parkway Plan would need to be amended. Last, since the Project is a nationally designated wild and scenic recreational river, it is subject to Section 7 of the Wild and Scenic Rivers Act and will need to be evaluated under the "direct and adverse effect" standard listed in the Technical Report of the Interagency Wild and Scenic Rivers Coordinating Council. This evaluation will be documented in a Wild and Scenic Rivers Study. Coordination with the River Managing Agencies (Sacramento County Regional Parks and California Resources Agency) for the Lower American River is required as part of this process.

15. **Is there a potential for federally listed threatened or endangered species, or their critical habitat or essential fish habitat to occur within or adjacent to the construction area?** Yes, the project will impact the American River, which is considered Critical Habitat for the Chinook salmon, California Central Valley Steelhead, and the Green sturgeon. The project will also impact the American River riparian corridor, sections of which are considered Critical Habitat for Valley Elderberry Longhorn Beetle. The closest is approximately 1.4 miles upstream of the project. Lastly, western pond turtle, which is proposed for listing as federally threatened, has the potential to occur within the project area. The species list retrieved from USFWS and NMFS lists potential species of concern in relation to the proposed project (see Attachment 4). A single Natural Environment Study (NES) and separate Biological Assessments for USFWS and NMFS will be prepared to document the potential impacts to biological resources and federally threatened or endangered species.

16. **Does the project have the potential to directly or indirectly affect migratory birds, or their nests or eggs (such as vegetation removal, box culvert replacement/repair, bridge work, etc.)?** Yes, tree and vegetation removal will occur as part of this project. Bird exclusionary devices, if required, will be installed prior to the nesting season. Due to the presence of vegetation within and adjacent to the identified limits of disturbance for the proposed project, there is the potential for impacts to native nesting birds during construction activities. The requirements of the Migratory Bird Treaty Act will be addressed in the environmental document, as well as in the NES.

17. **Is there a potential for wetlands to occur within or adjacent to the construction area?** Yes, a qualified biologist will conduct a wetland delineation to confirm the limits of aquatic resources within the project area. A Wetland Assessment will be prepared to discuss results of the wetland delineation and will quantify project related impacts.

18. **Is there a potential for agricultural wetlands to occur within or adjacent to the construction area?** No, according to the National Wetland Inventory Map, no agricultural wetlands are anticipated to occur within or adjacent to the project area.

19. **Is there a potential for the introduction or spread of invasive plant species?** Yes, construction equipment traveling in and out of the project area, and ground disturbing construction activities would increase the potential for the introduction or spread of invasive plant species. BMPs will be specified in the NES to reduce the risk of introduction or spread of invasive plant species.

20. **Are there any historic sites or publicly owned public parks, recreation areas, wildlife or waterfowl refuges (Section 4[f]) within or immediately adjacent to the construction area?** Yes, the Two Rivers Bike Trail, Jedediah Smith Trail, American River Parkway, and Discovery Park are located either within or immediately adjacent to the project area. Additionally, the following historic sites, which qualify as Section 4(f) resources, are located within the project: Natomas East Main Drain / historic levees and Delta Tribal Cultural Landscape. A Programmatic Section 4(f) Evaluation will be prepared and will appropriately document minimization effort to the Section 4(f) resources within or adjacent to the project.

21. **Does the project have the potential to affect properties acquired or improved with Land and Water Conservation Fund Act (Section 6[f]) funds?** No. According to the LWCF project map, which tacks information on projects funded through LWCF over the program's history, there are multiple LWCF funded projects within the American River Parkway. However, after coordinating with the Director of Sacramento County Regional Parks, the closest LWCF funded parcel (APN 274-0050-020-0000) is outside of the Project vicinity. Thus, the Section 6(f) evaluation process is not anticipated.

22. **Does the project have the potential to affect any visual or scenic resources?** Yes. There are various visual and scenic resources within the project area, such as the Lower American River, which is a nationally designated wild and scenic recreational river. Construction of the project will introduce a new bridge across the American River and require vegetation removal; therefore, impacts to the visual environment are anticipated. To assess how these changes could impact viewer groups in the project vicinity, a Visual Impact Assessment Advanced Report will be prepared. A Caltrans format Questionnaire to Determine Visual Impact Assessment Level has been completed which resulted in a preliminary score of 39 (Attachment 6).

23. **Will the project require the relocation of residential or business properties?** To be determined, construction of the project may result in the relocation of the CalOES building, located at 630 Sequoia Pacific Blvd, Sacramento, CA 95811. If it is determined that the CalOES building will be relocated, a Relocation Impact Report will be prepared.

24. **Will the project require any right of way, including partial or full takes?** Yes, the proposed project would require sliver takes for right of way acquisition along with temporary construction easements (TCEs). Full acquisitions may be necessary.

25. **Is the project inconsistent with plans and goals adopted by the community?** No, the project is consistent with plans and goals adopted by the community by providing a multi-modal crossing across the Lower American River. The following plans address the need for a new crossing over the Lower American River: Sacramento 2040 General Plan, River Direct Specific Plan, Sacramento Railyards Specific Plan, City of Sacramento Bicycle Master Plan, City of Sacramento Pedestrian Master Plan, American River Parkway Plan, 2023 SACOG MTP/SCS.

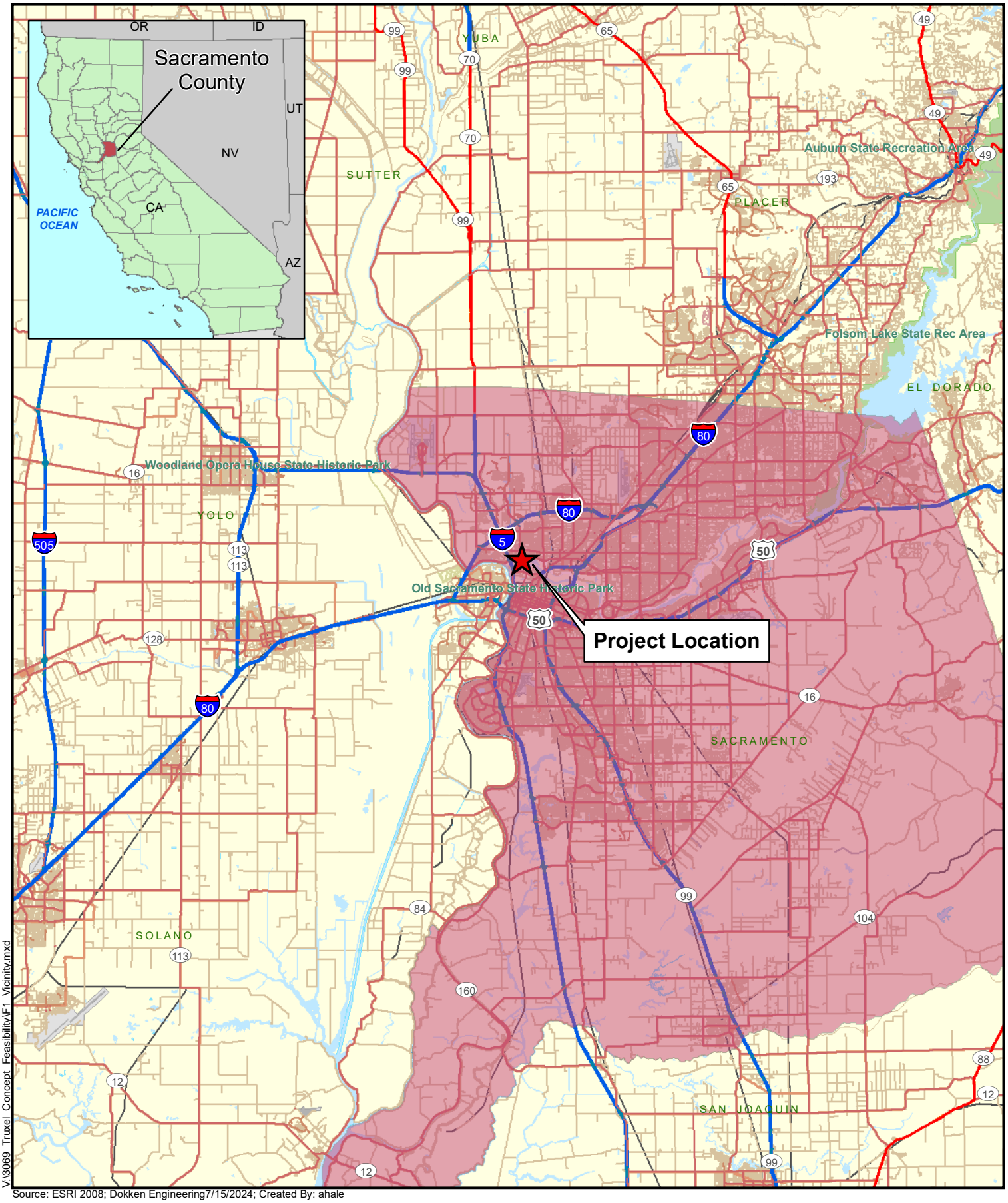
26. **Does the project have the potential to divide or disrupt neighborhoods/communities?** To be determined. Currently, there limited crossings across the Lower American River. The proposed project will construct a multi modal bridge which will create greater connectivity from South Natomas to the Central City, allowing for better mobility within the area. A Community Impact Assessment will be prepared to identify impacts to neighborhoods/communities.
27. **Does the project have the potential to disproportionately affect low-income and minority populations?** To be determined. It is anticipated that the proposed project will benefit low-income and minority populations. The Truxel Bridge will serve disadvantaged and low-income communities as identified under the CalEPA SB 535 Disadvantaged Communities website, California Climate Investments, and under CalEnviroScreen 4.0 indicators. The proposed project will provide access to more opportunities on foot, by bicycle, and transit. Additionally, the Truxel Bridge will catalyze development in the River District and the Railyards District which will provide easily accessible job opportunities in over 800,000 square feet of planned commercial development and over 3 million square feet of planned office development. A Community Impact Assessment will be prepared to assess impacts to low-income and minority populations.
28. **Will the project require the relocation of public utilities?** To be determined, utilities within the project area may require relocation as part of the project.
29. **Will the project affect access to properties or roadways?** To be determined, road closures may be necessary throughout construction and may impact access to some properties/roadways. However, these closures will be short in duration and there will be coordination with residents and businesses impacted by these closures. A Community Impact Assessment will be prepared to evaluate whether the will project affect access to properties or roadways.
30. **Will the project involve changes in access control to the State Highway System (SHS)?** No. The proposed project would not result in a change in access control as no SHS facilities would be impacted by the proposed project.
31. **Will the project involve the use of a temporary road, detour, or ramp closure?** To be determined, detours may be necessary throughout construction. A Community Impact Assessment will be prepared to discuss if any detours are necessary.
32. **Will the project reduce available parking?** No, the proposed project would not reduce available parking as no parking is currently provided within the project limits.
33. **Will the project construction encroach on state or federal lands?** No, the project does not encroach on state or federal lands. The project area comprises private properties, City owned parcels, and County owned parcels.
34. **Will the project convert any farmland to a different use or impact any farmlands?** No. According to the California Important Farmland Finder, there is no farmland within the vicinity of the project. As such, the project would not require any permanent conversion of any farmland.
35. **Is there National Register listed, or potentially eligible historic properties, or archaeological resources within or immediately adjacent to the construction area?** Yes, the Project falls within the boundaries of the Delta Tribal Cultural Landscape and the Lower American River Tribal Cultural Landscape. Furthermore, potentially eligible resources including river levees and the Natomas East Main Drian. Caltrans cultural staff will make the final determinations regarding these resources.
36. **Is the project adjacent to, or would it encroach on Tribal Land?** No. According to the Environmental Protection Agency, there are no known tribal lands or reservations within or adjacent to the project area. (https://www3.epa.gov/region9/air/maps/ca_tribe.html)

Continuation of Detailed Project Description: N/A

Distribution 1) Original - DLAE, 2) Local Agency Project Manager, 3) DLA Environmental Coordinator
4) Senior Environmental Planner (or designee), 5) District PQS

Attachment 1

Regional Map, Project Location Map, Project Footprint Map, FEMA Map



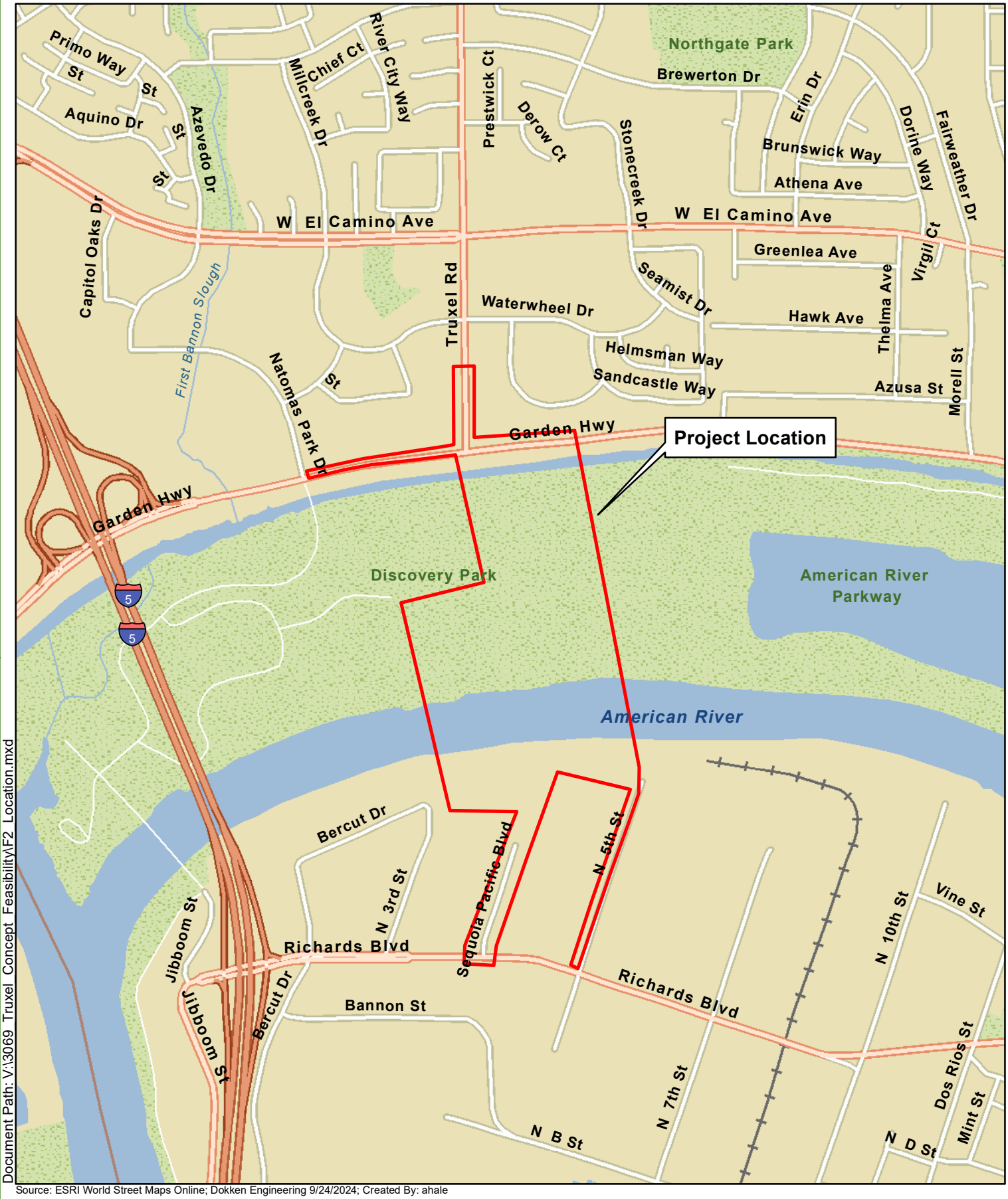
V:\3069_Truxel_Concept_Feasibility\F1_Vicinity.mxd

Source: ESRI 2008; Dokken Engineering7/15/2024; Created By: ahale

0 5 10 15 Miles

FIGURE 1
Project Vicinity

Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California



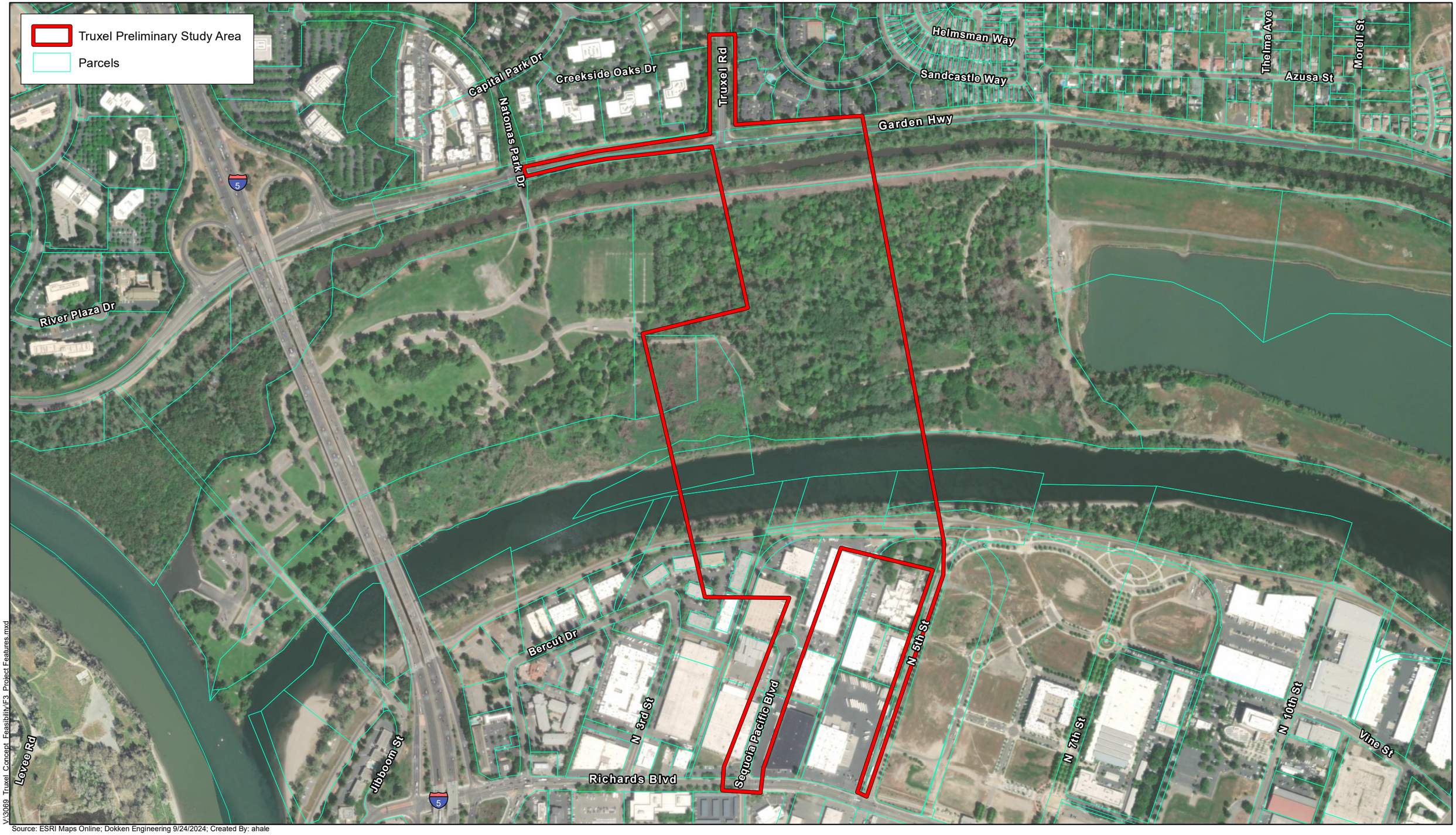
Document Path: V:\3069 Truxel Concept Feasibility\F2 Location.mxd

Source: ESRI World Street Maps Online; Dokken Engineering 9/24/2024; Created By: ahale

0 800 1,600 2,400 3,200 Feet

FIGURE 2
Project Location

Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California



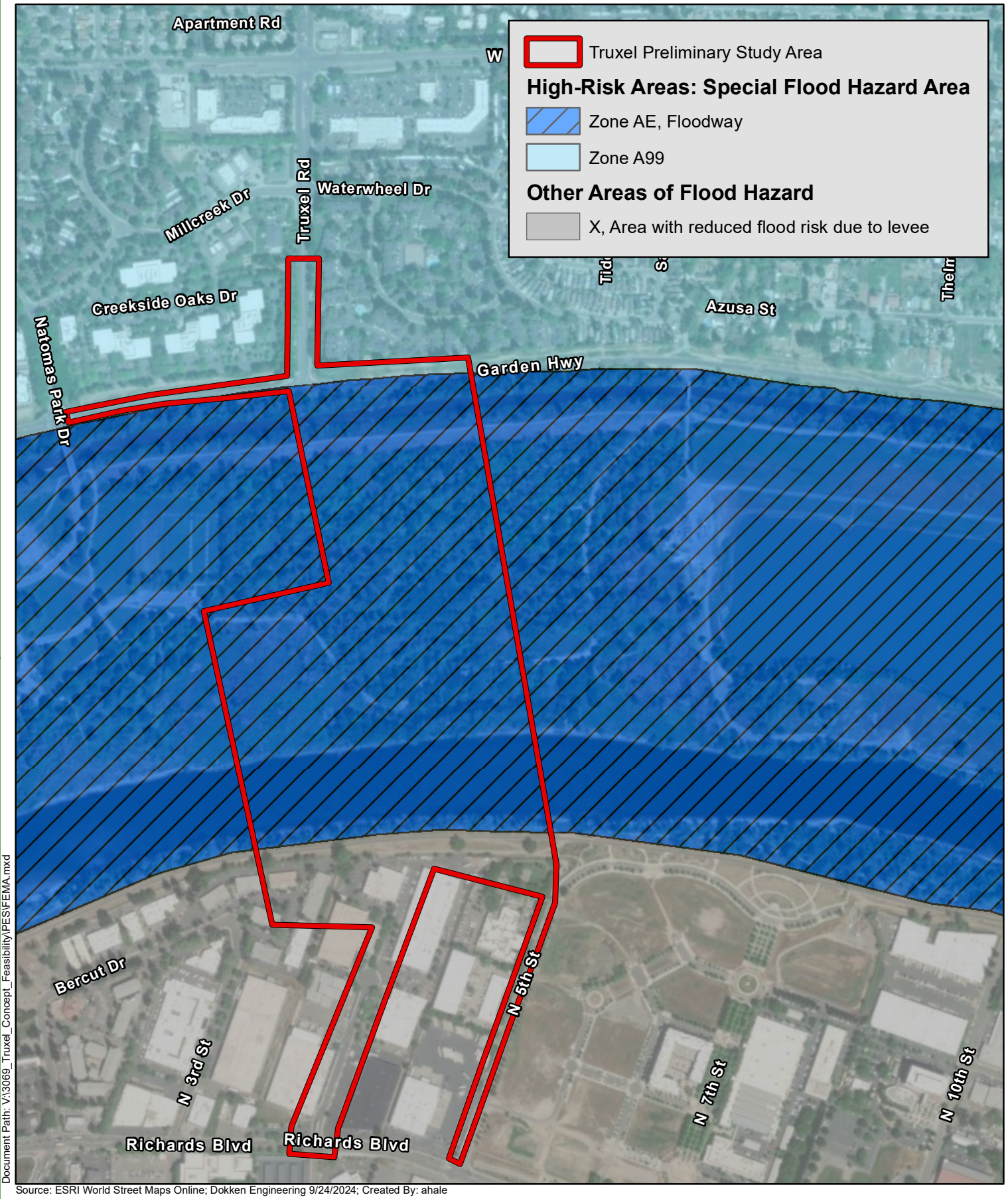
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Source: ESRI Maps Online; Dokken Engineering 9/24/2024; Created By: ahale

1 inch = 550 feet

0 550 1,100 1,650 2,200 2,750 Feet

FIGURE 3
Project Footprint
Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California



Source: ESRI World Street Maps Online; Dokken Engineering 9/24/2024; Created By: ahale

Document Path: V:\3069_Truxel_Concept_Feasibility\PES\FEMA.mxd

0 430 860 1,290 1,720 Feet

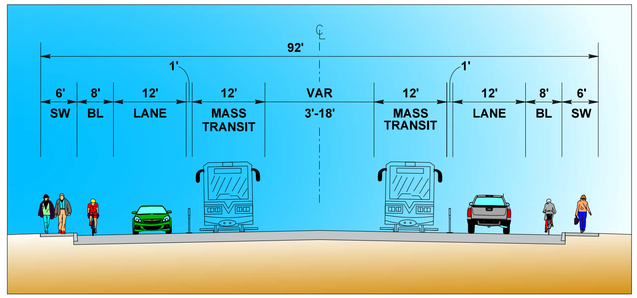
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FIGURE 4
FEMA Map

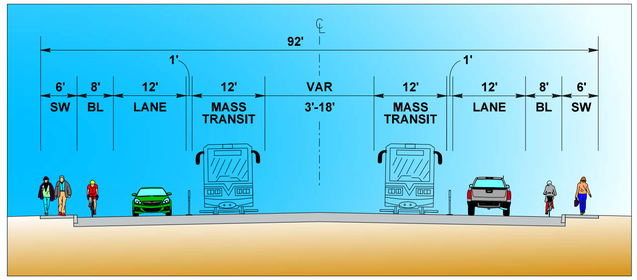
Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California

Attachment 2

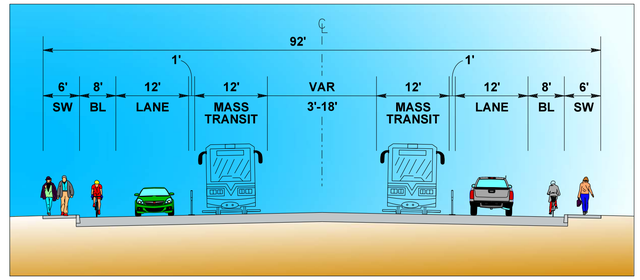
Engineering
Drawings



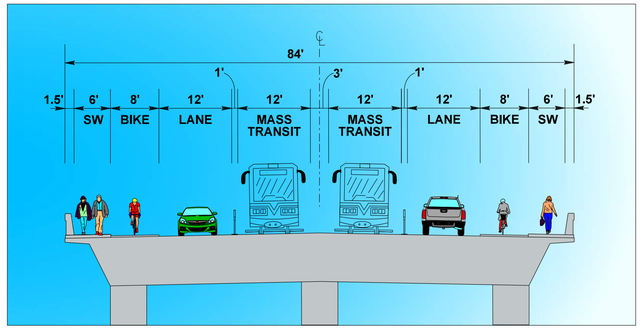
ALT 1
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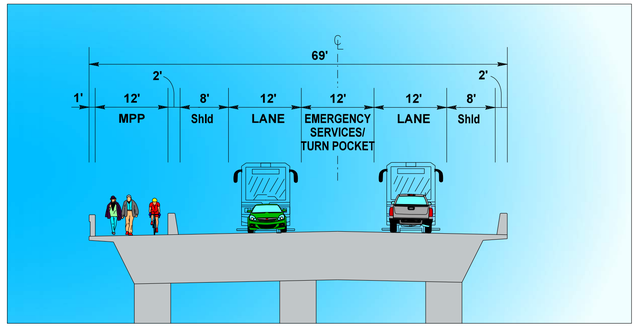
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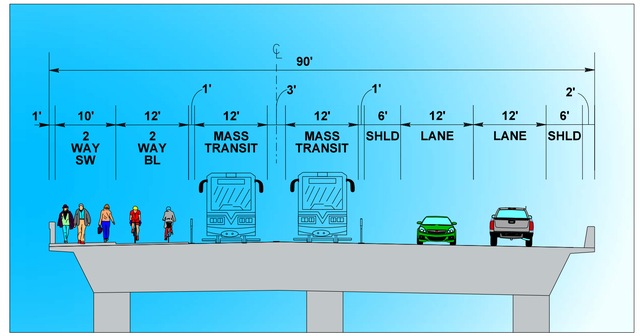
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TRUXEL RD NORTH



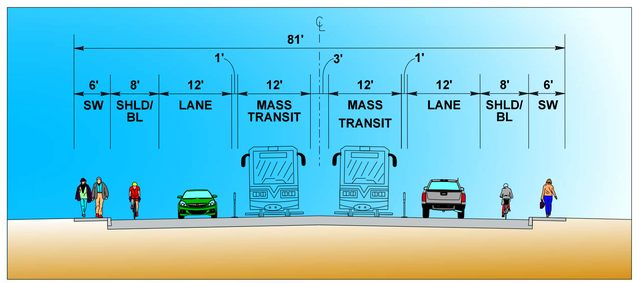
ALT 1
ON BRIDGE



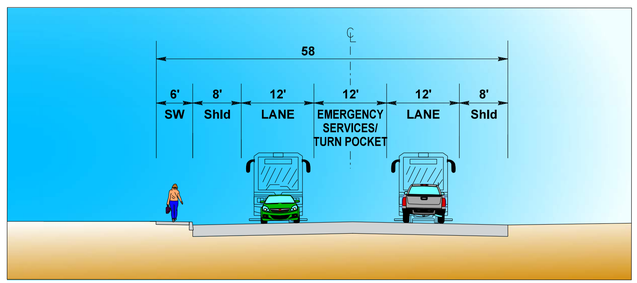
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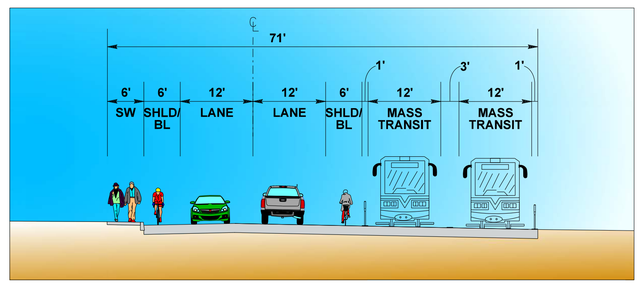
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ON BRIDGE



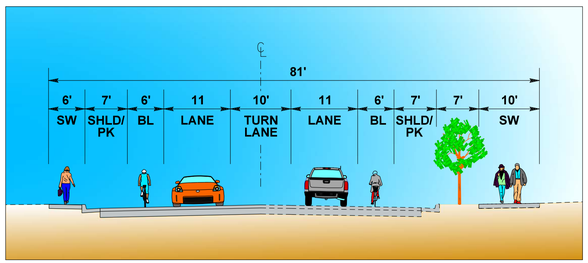
ALT 1
SEQUOIA PACIFIC BLVD



ALT 2
SEQUOIA PACIFIC BLVD



ALT 3
SEQUOIA PACIFIC BLVD

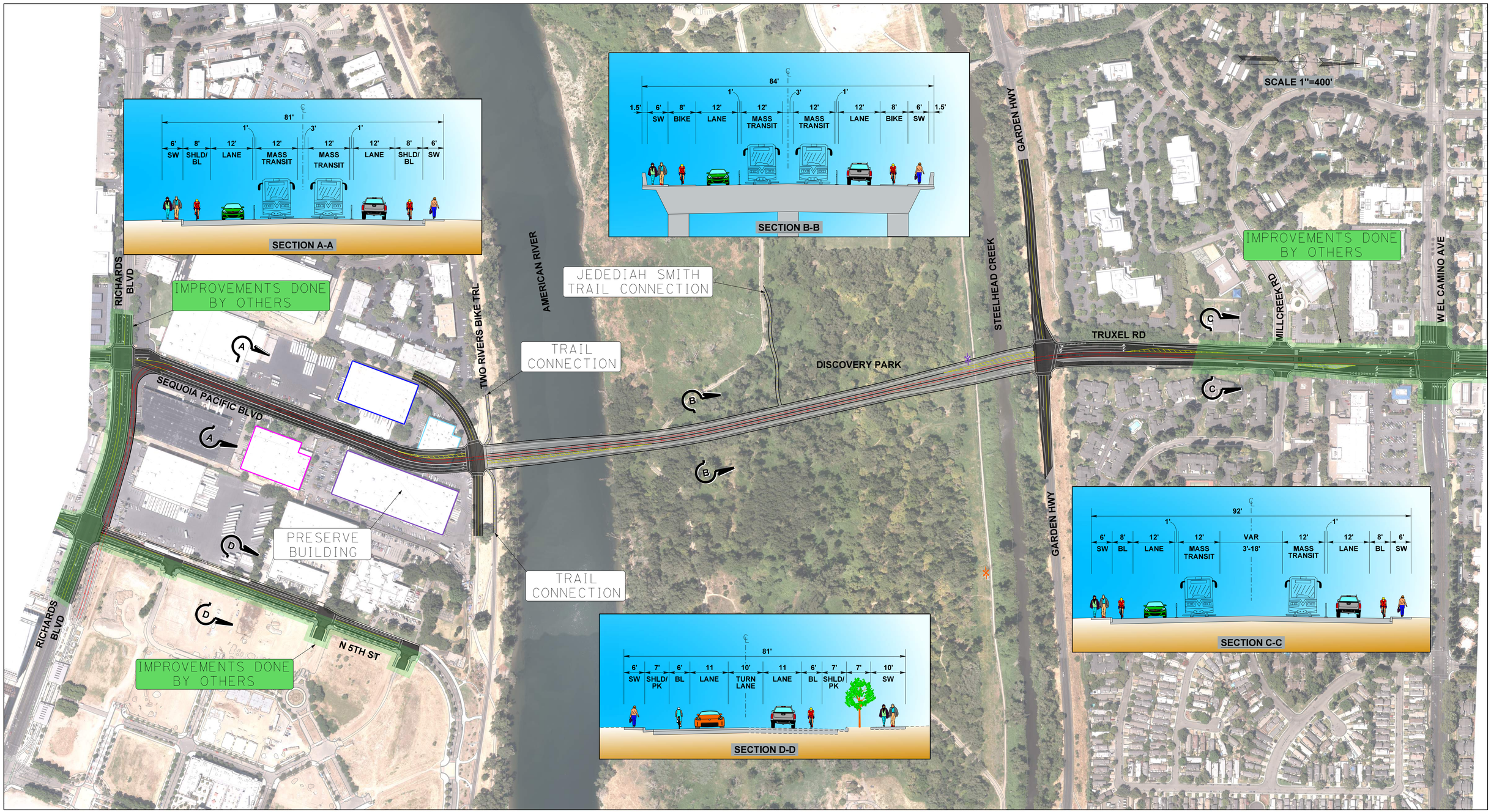


N 5TH ST

DOKKEN ENGINEERING
110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630
PH: 916-858-0642 FAX:916-858-0643

TRUXEL BRIDGE CONCEPT & FEASIBILITY STUDY

BRIDGE CROSS SECTION ALTERNATIVES FEASIBILITY STUDY

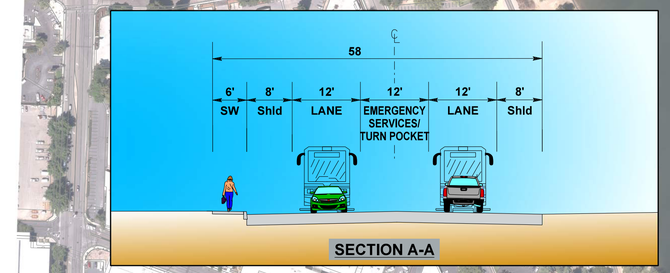


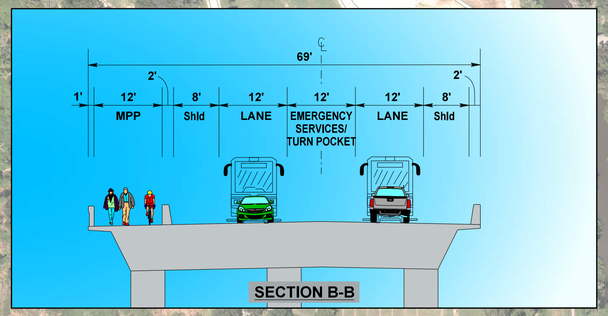
DOKKEN ENGINEERING
110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630
PH: 916-858-0642 FAX 916-858-0643

TRUXEL BRIDGE CONCEPT & FEASIBILITY STUDY

ALTERNATIVE 1

JUNE 2024





SCALE 1"=400'

IMPROVEMENTS DONE BY OTHERS

PRESERVE BUILDING

PRESERVE BUILDING

IMPROVEMENTS DONE BY OTHERS

JEDEDIAH SMITH TRAIL CONNECTION

TRAIL CONNECTION

TRAIL CONNECTION

PGE TOWER NOT IMPACTED

DISCOVERY PARK

IMPROVEMENTS DONE BY OTHERS

RICHARDS BLVD

RICHARDS BLVD

SEQUOIA PACIFIC BLVD

N 5TH ST

TWO RIVERS BIKE TRL

AMERICAN RIVER

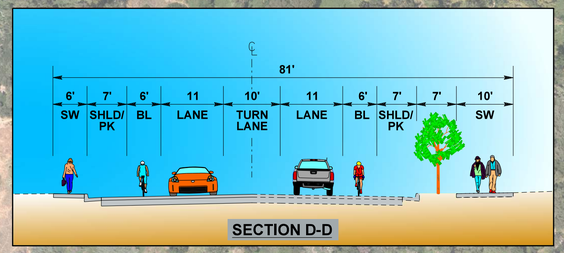
STEELHEAD CREEK

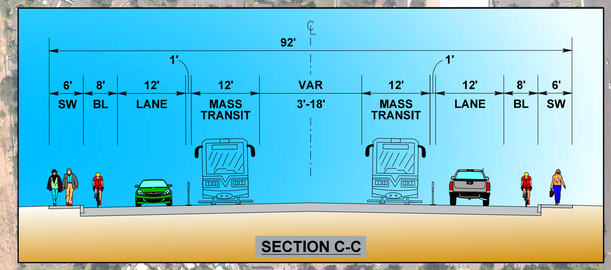
GARDEN HWY

TRUXEL RD

MILLCREEK RD

W EL CAMINO AVE



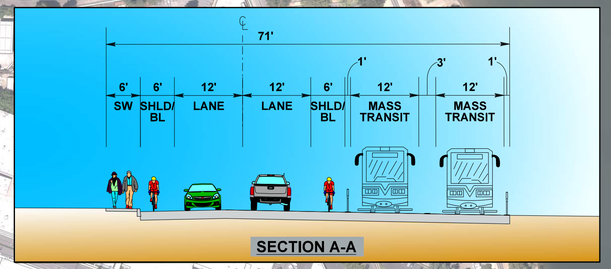


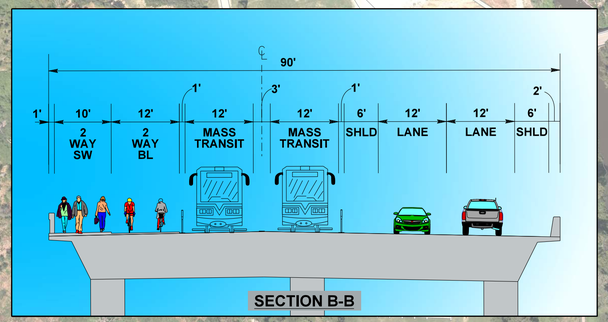
DOKKEN ENGINEERING
110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630
PH: 916-858-0642 FAX:916-858-0643

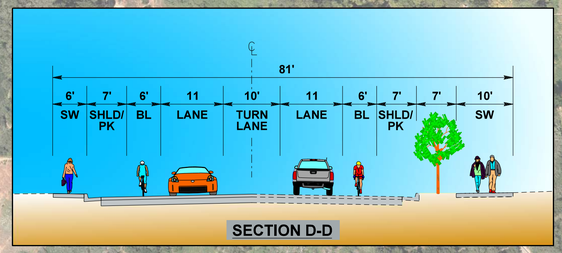
TRUXEL BRIDGE CONCEPT & FEASIBILITY STUDY

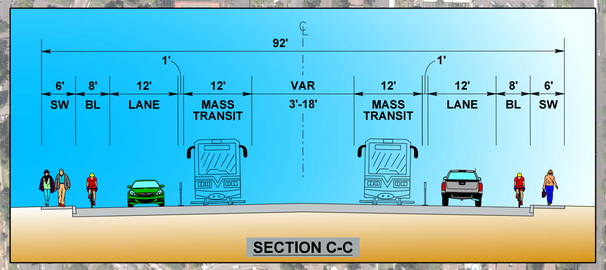
ALTERNATIVE 2

JUNE 2024









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110 BLUE RAVINE ROAD, SUITE 200
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PH: 916-858-0642 FAX:916-858-0643

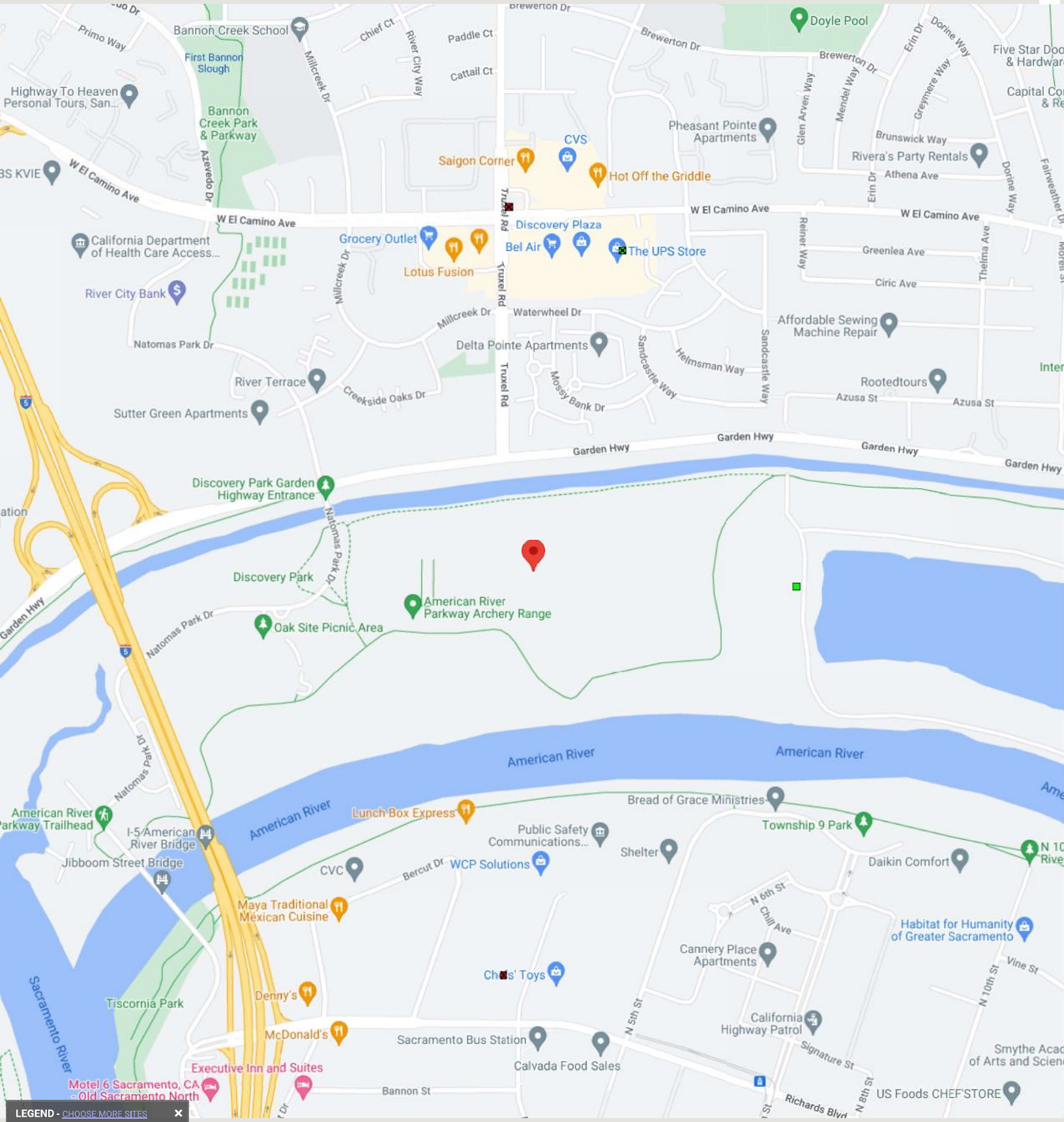
TRUXEL BRIDGE CONCEPT & FEASIBILITY STUDY

ALTERNATIVE 3

JUNE 2024

Attachment 3

Geotracker and
Envirostor Printout



LEGEND - CHOOSE MORE SITES

- LUST Cleanup Sites - REMOVE
- Cleanup Program Sites - REMOVE
- Military Cleanup Sites - REMOVE
- Military Privatized Sites - REMOVE
- Military UST Sites - REMOVE

Signifies a Closed Site

ACTIVE MAP COVERAGES:

- Military Bases - REMOVE

LIST SITES VISIBLE ON MAP

Map data ©2024 Google 100 m Report a map error

Sites Shown on Map: 5 Total Sites | 1 Open Sites | 4 Closed Sites | 2 Sites w/Water Quality Data

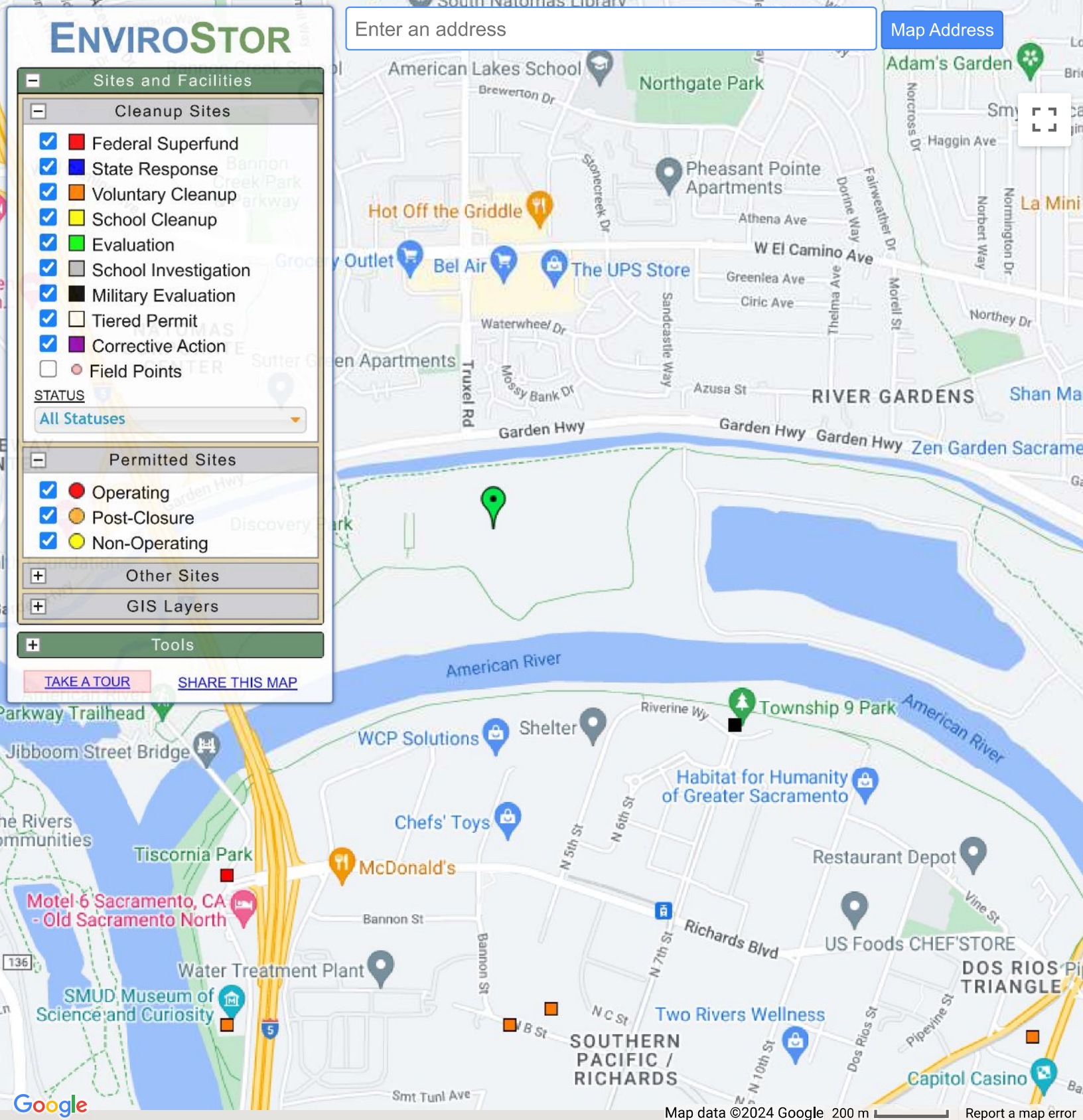
ENVIROSTOR

Enter an address | Map Address

- Sites and Facilities
  - Cleanup Sites
    - [x] Federal Superfund
    - [x] State Response
    - [x] Voluntary Cleanup
    - [x] School Cleanup
    - [x] Evaluation
    - [x] School Investigation
    - [x] Military Evaluation
    - [x] Tiered Permit
    - [x] Corrective Action
    - [ ] Field Points

    STATUS: All Statuses
  - Permitted Sites
    - [x] Operating
    - [x] Post-Closure
    - [x] Non-Operating
  - Other Sites
  - GIS Layers
- Tools

TAKE A TOUR | SHARE THIS MAP



SITES CURRENTLY VISIBLE ON MAP

13 SITES LISTED | EXPORT THIS LIST TO EXCEL

PROJECT NAME	STATUS	PROJECT TYPE	ADDRESS	CITY
A-1 PLATING COMPANY	CERTIFIED O&M - LAND USE RESTRICTIONS ONLY	STATE RESPONSE	2170 ACOMA ST	SACRAMENTO
ELKHORN VILLAGE ELEMENTARY SCHOOL	ACTIVE	SCHOOL INVESTIGATION	750 CUMMINS WAY	WEST SACRAMENTO
JIBBOOM BUILDING	CERTIFIED / OPERATION & MAINTENANCE	VOLUNTARY CLEANUP	240 JIBBOOM STREET	SACRAMENTO
JIBBOOM JUNKYARD	CERTIFIED	FEDERAL SUPERFUND	240-260 JIBBOOM STREET	SACRAMENTO
NORTH B STREET PROPERTIES	ACTIVE	VOLUNTARY CLEANUP	458 / 464 / 468 NORTH B STREET	SACRAMENTO
SACRAMENTO SIGNAL DEPOT (J09CA0924)	NO FURTHER ACTION	MILITARY EVALUATION	NORTH 7TH STREET	SACRAMENTO
SIERRA BATTERY SALES	CERTIFIED O&M - LAND USE RESTRICTIONS ONLY	STATE RESPONSE	977 LOCHBRAE ROAD	SACRAMENTO
THE RIVERS PHASE II PROPOSED SCHOOL	INACTIVE - WITHDRAWN	SCHOOL INVESTIGATION	LIGHTHOUSE AND FOUNTAIN DRIVES	WEST SACRAMENTO

Attachment 4

USFWS & NMFS
Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
Phone: (916) 414-6600 Fax: (916) 414-6713

In Reply Refer To: 07/01/2024 18:38:52 UTC
Project Code: 2024-0110948
Project Name: Truxel Road Bridge Project

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through IPaC by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)

(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see Migratory Bird Permit | What We Do | U.S. Fish & Wildlife Service (fws.gov).

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
(916) 414-6600

PROJECT SUMMARY

Project Code: 2024-0110948
Project Name: Truxel Road Bridge Project
Project Type: Bridge - New Construction
Project Description: New bridge over the American River
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@38.6054371,-121.49645563176959,14z



Counties: Sacramento County, California

ENDANGERED SPECIES ACT SPECIES

There is a total of 11 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

BIRDS

NAME	STATUS
Least Bell's Vireo *Vireo bellii pusillus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5945	Endangered

REPTILES

NAME	STATUS
Giant Garter Snake *Thamnophis gigas* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4482	Threatened
Northwestern Pond Turtle *Actinemys marmorata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1111	Proposed Threatened

AMPHIBIANS

NAME	STATUS
California Tiger Salamander *Ambystoma californiense* Population: U.S.A. (Central CA DPS) There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2076	Threatened
Western Spadefoot *Spea hammondii* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5425	Proposed Threatened

FISHES

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/321	Threatened
Longfin Smelt *Spirinchus thaleichthys* Population: San Francisco Bay-Delta DPS No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9011	Proposed Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

NAME	STATUS
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus*	Threatened

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/7850

CRUSTACEANS

NAME	STATUS
Vernal Pool Fairy Shrimp *Branchinecta lynchi*	Threatened

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/498

Vernal Pool Tadpole Shrimp *Lepidurus packardi*	Endangered

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/2246

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: Dokken Engineering
Name: Jeffrey Harris
Address: 110 Blue Ravine Rd #200
City: Folsom
State: CA
Zip: 95630
Email jharris@dokkenengineering.com
Phone: 9167651015

Quad Name **Sacramento East**

Quad Number **38121-E4**

ESA Anadromous Fish

SONCC Coho ESU (T) -

CCC Coho ESU (E) -

CC Chinook Salmon ESU (T) -

CVSR Chinook Salmon ESU (T) - **X**

SRWR Chinook Salmon ESU (E) - **X**

NC Steelhead DPS (T) -

CCC Steelhead DPS (T) -

SCCC Steelhead DPS (T) -

SC Steelhead DPS (E) -

CCV Steelhead DPS (T) - **X**

Eulachon (T) -

sDPS Green Sturgeon (T) - **X**

ESA Anadromous Fish Critical Habitat

SONCC Coho Critical Habitat -

CCC Coho Critical Habitat -

CC Chinook Salmon Critical Habitat -

CVSR Chinook Salmon Critical Habitat - **X**

SRWR Chinook Salmon Critical Habitat -

NC Steelhead Critical Habitat -

CCC Steelhead Critical Habitat -

SCCC Steelhead Critical Habitat -

SC Steelhead Critical Habitat -

CCV Steelhead Critical Habitat - **X**

Eulachon Critical Habitat -

sDPS Green Sturgeon Critical Habitat - **X**

ESA Marine Invertebrates

Range Black Abalone (E) -

Range White Abalone (E) -

ESA Marine Invertebrates Critical Habitat

Black Abalone Critical Habitat -

ESA Sea Turtles

East Pacific Green Sea Turtle (T) -

Olive Ridley Sea Turtle (T/E) -

Leatherback Sea Turtle (E) -

North Pacific Loggerhead Sea Turtle (E) -

ESA Whales

Blue Whale (E) -

Fin Whale (E) -

Humpback Whale (E) -

Southern Resident Killer Whale (E) -

North Pacific Right Whale (E) -

Sei Whale (E) -

Sperm Whale (E) -

ESA Pinnipeds

Guadalupe Fur Seal (T) -

Steller Sea Lion Critical Habitat -

Essential Fish Habitat

Coho EFH -

Chinook Salmon EFH - **X**

Groundfish EFH - **X**

Coastal Pelagics EFH -

Highly Migratory Species EFH -

MMPA Species (See list at left)

ESA and MMPA Cetaceans/Pinnipeds

See list at left and consult the NMFS Long Beach office 562-980-4000

MMPA Cetaceans -

MMPA Pinnipeds -

Thank you,

Jeff Harris
Biologist/Environmental Planner
Dokken Engineering
Phone: 916.858.0642
Email: jharris@dokkenengineering.com
110 Blue Ravine Road, Suite 200 | Folsom, CA 95630
www.dokkenengineering.com

Attachment 5

Current Photos



Photo 1. View of buildings along Sequoia Pacific Boulevard, facing south (08/07/2023)



Photo 2. View of the American River within the project area, facing north (08/07/2023)



Photo 3. View of the Two Rivers Trail within the project area, facing west (08/07/2023)



Photo 4. View the American River (upstream) within the project area, facing northeast (08/07/2023)



Photo 5. View the American River (downstream) within the project area, facing northeast (08/07/2023)

Attachment 6

VIA Questionnaire

Questionnaire to Determine Visual Impact Assessment (VIA) Level

Use the following questions and subsequent score as a guide to help determine the appropriate level of VIA documentation. This questionnaire assists the VIA preparer (i.e. Landscape Architect) in estimating the probable visual impacts of a proposed project on the environment and in understanding the degree and breadth of the possible visual issues. The goal is to develop a suitable document strategy that is thorough, concise and defensible.

Enter the project name and consider each of the twelve questions below. Select the response that most closely applies to the proposed project and corresponding number on the right side of the table. Points are automatically computed at the bottom of the table and the total score should be matched to one of the four groups of scores at the end of the questionnaire that include recommended levels of VIA study and associated annotated outlines (i.e., memo, standard, advanced).

This scoring system should be used as a preliminary guide and should not be used as a substitute for objective analysis on the part of the preparer. Although the total score may recommend a certain level of VIA document, circumstances associated with any one of the ten question-areas may indicate the need to elevate the VIA to a greater level of detail. For projects done by others on the State Highway System, the District Landscape Architect should be consulted when scoping the VIA level and provide concurrence on the level of analysis used.

The Standard Environmental Reference, Environmental Handbook, Volume I: Chapter 27-Visual & Aesthetics Review

lists preparer qualifications for conducting the visual impact assessment process. Landscape Architects receive formal training in the area of visual resource management and can appropriately determine which VIA level is appropriate.

Preparer Qualifications:

> "Scenic Resource Evaluations and VIA's are performed under the direction of licensed Landscape Architects. Landscape Architects receive formal training in the area of visual resource management with a curriculum that emphasizes environmental design, human factors, and context sensitive solutions. When recommending specific visual mitigation measures, Landscape Architects can appropriately weigh the benefits of these different measures and consider construction feasibility and maintainability."

Calculate VIA Level Score

Project Information

Project Name

Truxel Road Bridge Project

Project Identification #

Enter Project EA / Identification #

Project Location (Dist-Co-Rte-PM)

3-Sacramento

Preparer Name and CA LA License Number

Enter Preparer Name and CA LA License No

Caltrans District Landscape Architect (DLA)

For projects on State Highway System Only, Name of Caltrans District Landscape Architect (DLA) providing VIA Questionnaire Score Concurrence - if different than above.

For Projects on State Highway System Only, Enter DLA Name

Visual Features of Project and its Alternative(s)

Enter Visual Features of Project

Additional Visual Context Remarks

Enter Additional Visual Context

Regulatory Framework

Potential Agencies that may have to be Involved

- [x] **Federal**
- [x] **State**
- [x] **Local**
- [x] **Tribal**
- [ ] **Other**

Visual Change and Sensitivity

Landscape Observations

- [x] **Water**
- [ ] **Visually dominant landforms**
- [x] **Natural vegetation**
- [ ] **Visually Appealing Structures**
- [ ] **Other features of interest**

Impact of Project on Natural, Cultural, and Existing Project Environments

- [ ] **Highly compatible**
- [x] **Moderately compatible**
- [ ] **Not compatible**
- [ ] **Other**

Landscape Context and Development Patterns

- [x] **Natural/Undeveloped**
- [ ] **Rural**
- [ ] **Suburban**
- [ ] **Urban**

Scenic, Visual and Historic Resource(s) within the Area of Visual Effect

- [ ] **Officially designated State Scenic Highway**
- [ ] **Eligible Scenic Highway**
- [x] **Visual resources**
- [x] **Federally (or otherwise) designated historic, scenic resource**

Expected Agency Involvement

Expected Agency Involvement

Expected Public Feedback

- [x] **Scenic resources identified as important**
- [ ] **Not important**
- [ ] **No public feedback**

Change to Visual Environment

1. **Does the project's aesthetic approach appear to be consistent with applicable laws, ordinances, regulations, policies, or standards?**

Although the State is not required to comply with regional and local planning ordinances and other regulations, these documents are critical in understanding the importance that communities place on visual resources. The Caltrans Environmental Planning branch may have copies of the planning documents that pertain to the project. If not, this information can be obtained by contacting the local planning department.

High Consistency (2 point)

2. **Will permits be required by outside regulatory agencies (i.e., federal, state, or local)?**

Permit requirements can have an unintended consequence on the visual environment. Anticipated permits, as well as specific permit requirements may be determined by talking with the project Environmental Planner and Project Engineer. Note: coordinate with the Caltrans representative responsible for obtaining the permit prior to communicating directly with any permitting agency.

Yes, both federal and state, or multiple permits required (4 points)

3. **Will the project character be compatible with the visual character of the existing landscape?**

Consider the types of adverse changes to the scenic integrity of the landscape caused by the project. Evaluate the scale and extent of the project features compared to the surrounding scale of the community. Is the project likely to give an urban appearance to an existing rural or suburban community?

No Compatibility (4 points)

4. **Will the project contrast adversely with the memorability (vividness), natural harmony and/or cultural order (unity) of the existing landscape?**

Evaluate the scale and extent of the project features compared to the scale of the visual elements within the surroundings. Is the project likely to change the appearance in a way that is contrasting with the line, color, form, and texture of the existing landscape visual character?

High Adverse Contrast (4 points)

5. **Will the project, when viewed together with other past or foreseeable projects, result in a cumulative adverse change in the visual quality or character of the existing landscape?**

Identify any projects in the area (both Caltrans' and others') that have been recently constructed and/or are reasonably foreseeable and/or currently planned for future construction. The window of time and the extent of area applicable to possible cumulative impacts should be based on a reasonable anticipation of the viewing public's awareness of cumulative change.

Project will not result in cumulative impacts (1 point)

6. **Will the project produce a new source of substantial light or glare, which will adversely affect daytime or nighttime views within the area?**

Identify new sources of lighting and glare and how day- and nighttime visual conditions may change.

Low potential for adverse effects (2 point)

7. **What is the potential that the project proposal will be controversial within the community?**

Assess the level of public concern by talking with local agency management and staff familiar with the affected community's sentiments as evidenced by past projects and/or current information.

High Potential that project will be controversial (4 points)

8. **How sensitive are potential viewer groups likely to be regarding visible changes proposed by the project?**

Consider among other factors who the viewer groups represent, the number of viewers within the group, probable viewer expectations, activities, viewing duration, and orientation. The expected viewer sensitivity level may be scoped by applying professional judgment, and by soliciting information from other Caltrans staff, local agencies and community stakeholders familiar with the affected community's sentiments and demonstrated concerns..

High Sensitivity (4 points)

9. **What level of local concern is there for the types of specific project features (e.g., bridge structures, large excavations, sound barriers, or median planting removal) and construction impacts that are proposed?**

Certain project improvements can be of special interest to local citizens, causing a heightened level of public concern, and requiring a more focused visual analysis.

High Level of Concern (4 points)

10. **Are there federally, state, locally designated scenic or historic resources, or other visual resources within the project area of visual effect (i.e., viewshed)?**

For example: protected viewsheds, visually sensitive public use areas, national historic/scenic trails, historic sites or structures, scenic designated viewpoints, wild and scenic rivers, state scenic highways or federal scenic byways, or potential visual resources such as stands of trees, rock outcroppings, etc.

Multiple designated scenic resources (4 points)

11. **Will the project sponsor or public benefit from a more detailed visual analysis in order to help reach consensus on a course of action to address potential visual impacts?**

Consider the proposed project features, possible visual impacts, and probable environmental commitments.

Moderate Benefit (3 points)

12. **Will the project likely require design changes to reduce the extent of visual resource impacts?**

Consider design changes and enhancements such as realignment, additional alignment alternatives, vertical profile adjustments, extensive landscaping, architectural treatment, color and texture treatments and/or lighting of aboveground structures.

Some redesign or minimization measures (3 points)

Assumptions/Issues

Assumptions/Issues

Calculate Total

It is recommended that you print a copy of these calculations for the project file.

Project Score: 39

Select An Outline Based Upon Project Score

The total score will indicate the recommended VIA level for the project. In addition to considering circumstances relating to any one of the 12 questions that would justify elevating the VIA level, also consider any other project factors that would influence level selection.

Score 12-18 VIA Questionnaire

No visual resource related regulatory requirements. No or negligible visual changes to the environment are proposed. None or minimal public concern has been identified. This Questionnaire with rationale for selected responses to questions in the available spaces after each question along with a statement of no visual resource impact is appropriate and provides a sufficient rationale why a technical study is not required.

Score 19-28 VIA Memorandum

Very limited visual resource related regulatory requirements. Minor visual changes to the environment are proposed. Minor public concern from the public may be expected. A VIA Memorandum is appropriate in this case. The VIA Memorandum should briefly describe project features, impacts and any environmental commitment measures. Visual simulations are not necessary. Go to the Directions for using and accessing VIA Memorandum Annotated Outline (website link).

Score 29-38 Standard VIA Report

Several visual resource related regulatory requirements. Moderately noticeable visual changes to the environment are proposed. Moderate public concern may be expected. A fully developed Standard VIA Report is appropriate. The report should describe in detail the project's visual attributes, its visual impact and potential environmental commitment measures. Visual simulations are recommended. This report will likely receive public review. Go to the Directions for using and accessing the Standard VIA Annotated Outline (website link).

Score 39-48 Advanced VIA Report

Extensive visual resource related regulatory requirements and clearly noticeable changes to the environment are proposed. Moderate to high public concern may be expected. A fully developed Advanced VIA Report is appropriate. The report should describe in detail and numerically score the project's visual change and sensitivity, its visual impact and any environmental commitments proposed. Visual simulations are required. It is appropriate to alert the Project Development Team to the potential for highly adverse impacts and to consider project alternatives to avoid those impacts. This technical study will receive close public review. Go to the Directions for using and accessing the Advanced VIA Annotated Outline (website link coming soon).

Statewide Campaigns

- ADA Access
- Adopt-A-Highway
- Amber Alert
- Be Work Zone Alert
- CAL FIRE
- Cal OES: Power Outage and Fire Recovery Resources
- California Climate Investments
- California Connected
- California Transportation Plan 2050
- Clean California
- Energy Upgrade
- Go Safely California
- REAL ID
- Save Our Water
- Stormwater Education Campaign

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Attachment 7

SACOG 2023 MTP/SCS Listing

Appendix A: Draft 2023 MTP/SCS Transportation Project List

Projects listed as "Project Development Only" are anticipated to begin early stages of development including project planning, design, preliminary engineering, environmental clearance, and ROW acquisition by 2044. Under the financial constraint requirements for forecasting revenues, the construction phase is not included in the Draft Plan. If/when additional revenues for these projects become available to cover full construction costs, these projects can be considered as part of an amendment to the MTP/SCS following a technical analysis and reviewing consistency with plan requirements.

ID	County	Status (Planned, Programmed or Project Development Only)	Lead Agency	Budget Category	Title	Description	Total Project Cost (2018 dollars)	Year of Expenditure Cost for planned projects	Completion Timing
SAC25270	SAC	Programmed	City of Rancho Cordova	C- Maintenance & Rehabilitation	White Rock Road - Sunrise Blvd to Fitzgerald Rd	On White Rock Road, from Sunrise Blvd to Fitzgerald Road: Install a new traffic signal at Gold Valley Dr, center medians, bike lanes, striping and road rehabilitation. (Environmental completed for this project in SAC24470.)	2,442,500	-	By 2030
SAC24828	SAC	Planned	City of Rancho Cordova	C- Maintenance & Rehabilitation	Zinfandel Complex Improvements - Phase2	Construct intersection and pedestrian improvements on Zinfandel Drive between White Rock Road and Folsom Blvd, including modifications at US 50/Zinfandel to improve safety and ease congestion along the corridor, including bridge widenings, ramp and intersection reconstruction and reconstruction of intersections.	45,968,000	47,117,200	By 2044
SAC25177	SAC	Programmed	City of Rancho Cordova	C- Maintenance & Rehabilitation	Zinfandel Drive Bicycle and Pedestrian Crossing	In Rancho Cordova, from White Rock Road to Folsom Boulevard (crossing the interchange at US 50): Create a Class 1 path. . Toll Credits for ENG	27,320,000	-	By 2030
SAC22530	SAC	Planned	City of Sacramento	A- Bike & Ped	Bridging I-5/Riverfront Reconnection Phase 3	In Sacramento, at N St over I-5: construct a new bridge with one travel lane in each direction, Class II bike lanes, and sidewalks (T15998100). Phase 1 constructed under SAC24705.	42,432,709	-	By 2030
SAC24610	SAC	Programmed	City of Sacramento	B- Road & Highway Capacity	14th Ave. Extension Phase 1	Sacramento. Extension of 14th Avenue from Power Inn Rd to Florin-Perkins. Phase I includes environmental/PE for four lane roadway and construction of two-lane roadway with class II bicycle lanes and landscape planter/sidewalks on the south side of the roadway. Also includes new water and drainage facilities, new streetlights, new traffic signal at 14th Ave/Florin Perkins Rd, and modification to existing traffic signal. (Phase 2 SAC24656, Phase 3 SAC24657)	11,855,000	-	By 2030
SAC23630	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	65th St.	Widen: 5 lanes from Hwy. 50 to Broadway.	8,000,000	11,586,385	By 2035
SAC25051	SAC	Programmed	City of Sacramento	B- Road & Highway Capacity	Broadway Complete Street Phase I	Phase I: In Sacramento, Broadway from 3rd St to 16th St, convert four lane arterial to two lane arterial with buffered bike lanes, median improvements, sidewalk improvements and streetscape enhancements. Create surface street (29th St.) from X St. to Hwy 99 South. PA&ED will be completed for the entire 2-mile corridor, from 29th St. to 3rd St.	4,414,000	-	By 2030
SAC18570	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	East Commerce Way B	In Sacramento, extend East Commerce Way from Arena Blvd. to Natomas Crossing Drive, as a 6 lane road.	3,329,000	5,454,954	By 2044
SAC18580	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	East Commerce Way C	Extend East Commerce Way from planned Natomas Crossing Drive to San Juan Rd. as a 4 lane road.	4,000,000	5,938,022	By 2044
SAC18740	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	El Centro Rd.	New Overcrossing: El Centro Rd. overcrossing.	11,000,000	16,329,562	By 2044
SAC23680	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	Elder Creek Rd.	Widen: 4 lanes from Florin Perkins Rd. to South Watt Ave.	7,000,000	8,320,800	By 2030
SAC18510	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	Elkhorn Boulevard	In Sacramento, Elkhorn Boulevard from SR 99 to east city limits: widen from 2 to 6 lanes.	14,000,000	20,783,079	By 2044
SAC23810	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	Highway 99 Meister Way Overcrossing	New Overcrossing: Meister Wy. / Hwy. 99.	8,000,000	9,051,266	By 2030
SAC18670	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	I-5 / Highway 99	On/Off Ramp Improvement: Add 2nd on-ramp at I-5 / Hwy. 99 Interchange.	216,000	256,756	By 2030
SAC18650	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	I-80 at West El Camino Interchange	Expand the West El Camino interchange on I-80 from 2 to 4 lanes and modify ramps.	30,000,000	43,448,945	By 2035
SAC24539	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	Lower American River Crossing	New all-modal Bridge: between downtown Sacramento and South Natomas across the Lower American River. Includes: Auto, transit, bicycle, and pedestrian facilties. Scale and features to be determined through need and purpose study anticipated to begin in 2012.	150,000,000	217,244,725	By 2035
SAC24536	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	Main Ave. A	Road Extension: 2 lanes from Rio Linda Blvd. to Marysville Blvd.	3,000,000	4,453,517	By 2044
SAC25247	Sac	Planned	City of Sacramento	B- Road & Highway Capacity	Panhandle Roadways	Transportation improvements to implement Panhandle annexation and development	10,000,000	14,845,056	By 2044
SAC16070	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	Power Inn Rd.	Widen: 6 lanes from Fruitridge Rd. to 14th.	30,000,000	44,535,169	By 2044
SAC24537	SAC	Planned	City of Sacramento	B- Road & Highway Capacity	Railyards Streets	Construct New Road/Bike/Ped Improvements to implement Railyards Specific Plan	163,000,000	208,653,781	By 2030

Attachment P. Hydraulics Memo



Truxel Bridge

Concept and Feasibility Study

Preliminary Hydraulic Study Report

October 2024

City of SACRAMENTO

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TRUXEL BRIDGE CONCEPT AND FEASIBILITY STUDY

CITY OF SACRAMENTO, SACRAMENTO COUNTY, CALIFORNIA

Preliminary Hydraulic Study Report

Submitted To:

City of Sacramento

This report has been prepared by or under the supervision of the following Registered Engineer. The Registered Civil Engineer attests to the technical information contained herein and has judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

_____

Ashley Orsaba-Finders, PE

Registered Civil Engineer

_____

Date

Executive Summary

The City of Sacramento proposes to construct a multi-modal bridge connecting Truxel Road to Sequoia Pacific Boulevard across the American River. In 2013, the City prepared the American River Crossing Study to evaluate optional alignments to cross the American River. Eight alignments were prepared and studied, with Alignment 3 (the Truxel Road alignment) ultimately selected as the preferred alternative.

The proposed project aims to construct a multimodal bridge over the Lower American River (LAR), enhancing pedestrian, bicycle, vehicle, and public transit options in line with the City of Sacramento's Neighborhood Friendly Bridge Policy. This bridge will improve connectivity between the Central City and South Natomas, facilitate better access to resources and commerce, provide additional evacuation and emergency response routes, and enhance recreational access to the American River Parkway.

The purpose of this Preliminary Hydraulic Study Report is to summarize anticipated hydraulic impacts from the construction of the Truxel Bridge across the LAR. The report also summarizes the potential scour anticipated for the project.

The LAR Floodway is comprised of the LAR channel, Discovery Park, and Steelhead Creek. The 2024 Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) specifies a 100-year flow rate of 157,000 cubic feet per second (cfs) for the LAR channel, while the Central Valley Hydrology Study (CVHS) provides a 200-year flow rate of 160,000 cfs. The CVHS flowrate is also the maximum authorized flow out of Folsom Lake. Therefore, the slightly higher CVHS 200-year flow rate will be used as the primary inflow for the LAR channel to ensure that freeboard requirements are met. Steelhead Creek has a separate, independent flow of approximately 4,200 cfs for the 200-year storm. Both the LAR channel and Steelhead Creek overtop to contribute flow to Discovery Park.

The hydraulic analysis was performed using the U.S. Army Corps of Engineers' (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS). An existing 2-dimensional model prepared by CBEC for other LAR projects was used as the existing condition and modified to include the bridge as the proposed condition. The hydraulic analysis shows small increases in water surface elevation (WSEL) upstream/downstream of the proposed Truxel Bridge for the Central Valley 200-year WSEL between the existing and proposed conditions.

The hydraulic results for the proposed project indicate a rise in both WSEL and velocity. The WSEL increase ranges from 0.13 to 0.14 feet upstream of the bridge, while the velocity increase ranges from 2.2 to 2.3 feet per second (fps) within 100 feet downstream, with maximum velocities approaching 9 fps. As the LAR is categorized as a FEMA designated floodway, a Letter of Map Amendment will be required to be processed through FEMA for the project.

These changes necessitate mitigation measures to address potential scour and ensure the integrity of the bridge, banks, and levees. The proposed bridge meets all governing agencies freeboard requirements, including those from FEMA and USACE. However, the north levee freeboard is approximately half a foot below the required additional foot of freeboard within 100 feet of the bridge. Since the soffit of the Truxel Bridge will need to clear the north levee, the Truxel Road/Garden Highway intersection will be raised, necessitating the raising of Garden Highway to match. The additional elevation of Garden Highway will provide the required freeboard along the north levee for the segment that is 100 feet upstream and downstream of the bridge.

1. Introduction

1.1 Background

The City of Sacramento proposes to construct a multi-modal bridge connecting Truxel Road to Sequoia Pacific Boulevard across the American River (**Figure 1. Project Vicinity** and **Figure 2. Project Location**). In 2013, the City prepared the American River Crossing Study to evaluate optional alignments to cross the American River. Eight alignments were prepared and studied, with Alignment 3 (the Truxel Road alignment) ultimately selected as the preferred alternative.

Dokken Engineering (Dokken) was selected to complete a feasibility study for the Truxel Road alignment, evaluating various engineering and environmental constraints. Ultimately, three alternatives were developed and analyzed for the project (**Figure 3: Bridge Cross Section Alternatives**). For plan and profile view exhibits of the three alternatives refer to **Appendix B**. The Preliminary Hydraulic Study Report is intended to document the qualitative analysis of anticipated hydraulic impacts to water surface elevation, scour, and freeboard.

1.2 Project Purpose

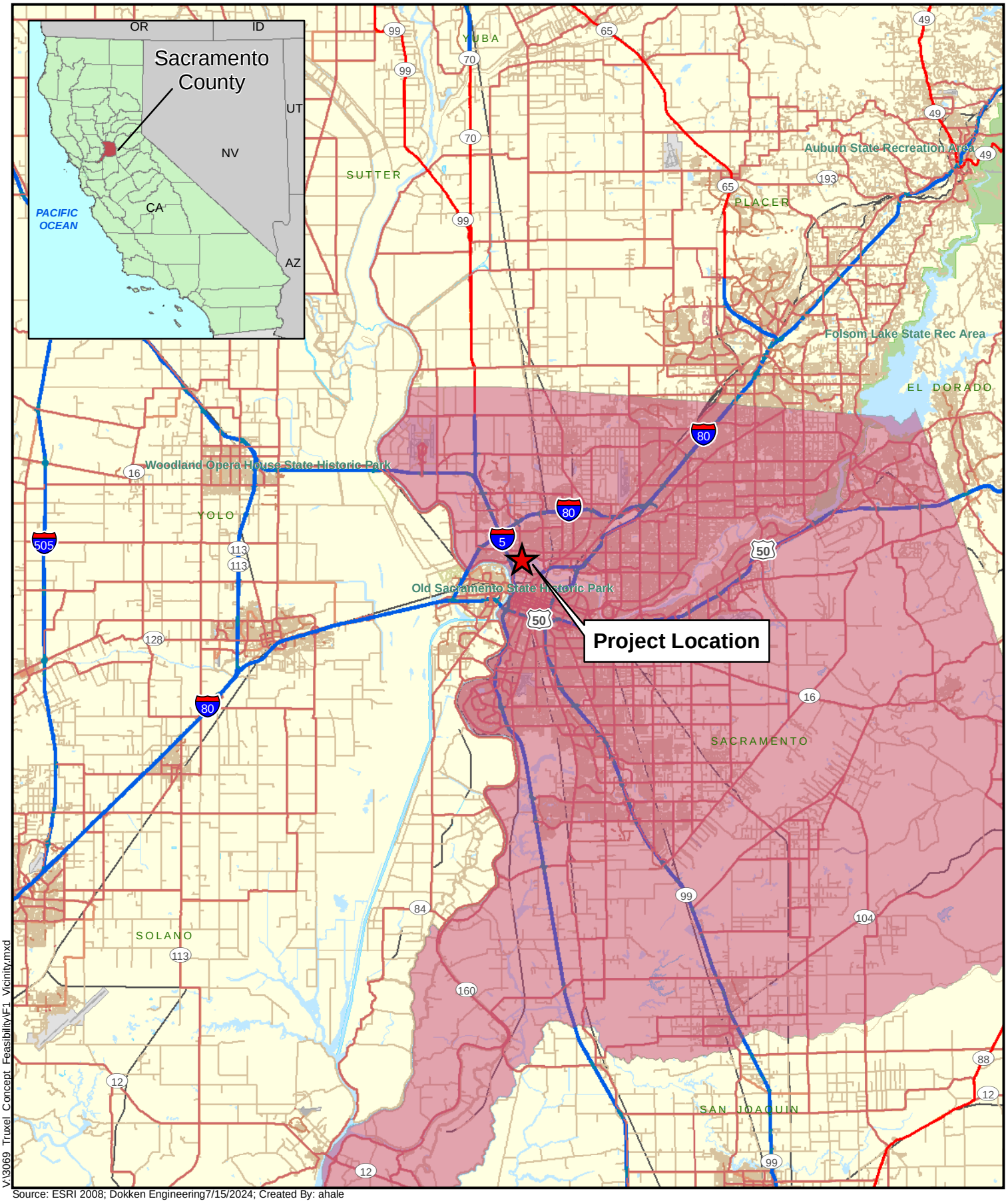
The purpose of the proposed Project is to:

- Provide a crossing of the LAR for all modes of transportation which will increase the ability of the community to walk, bike, and utilize public transit as an alternative to driving while being in compliance with the City of Sacramento's Neighborhood Friendly Bridge Policy.
- Improve connectivity across the LAR between the Central City and South Natomas for all modes of travel in order to enhance accessibility to resources, jobs, commerce, and social exchanges.
- Increase evacuation and emergency/disaster response options for Central City and South Natomas residents and businesses.
- Enhance recreational access to the American River Parkway from both banks of the LAR for pedestrians and cyclists.

1.3 Project Need

The proposed Project addresses the following needs:

- The LAR creates a barrier to mobility that causes longer trip lengths for relatively close origins and destinations which discourages walking and bicycling, leads to a dependence on automobiles, and creates inefficient transit routing. These transportation system limitations lead to negative effects on public health.
- The LAR creates a barrier to economic activity, social exchanges, and job access between the Central City and South Natomas. In addition, lack of direct connection between the Central City and South Natomas diminishes the viability of development that has been planned and approved in the City of Sacramento's General Plan, the River District Specific Plan, and the Sacramento Railyards Specific Plan.
- Limited connectivity across the LAR contributes to longer emergency/disaster response times and limits evacuation alternatives.
- Limited options for access to recreational facilities reduces opportunities to utilize the LAR Parkway, especially for those walking and biking.



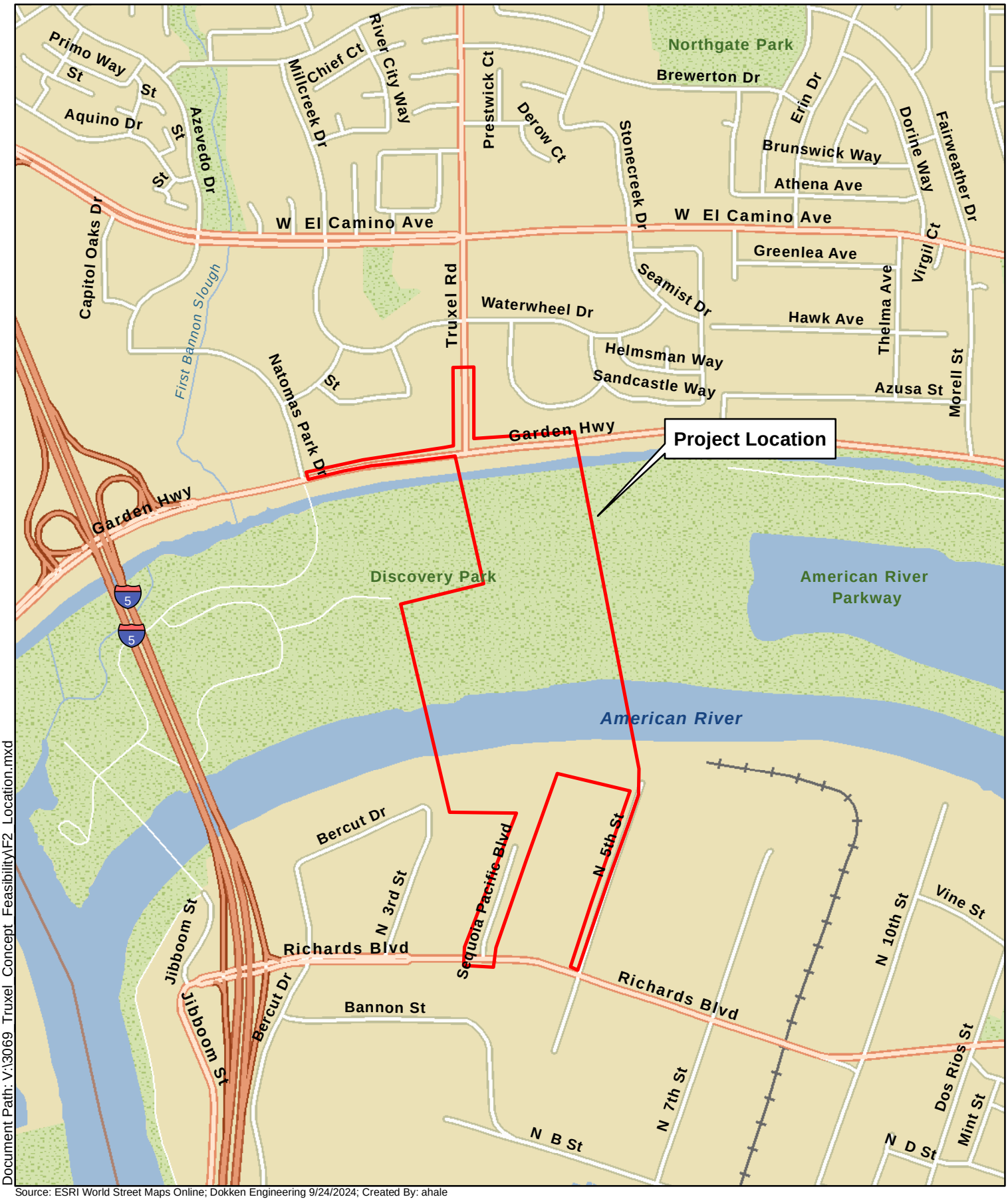
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Source: ESRI 2008; Dokken Engineering7/15/2024; Created By: ahale

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FIGURE 1
Project Vicinity

Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California



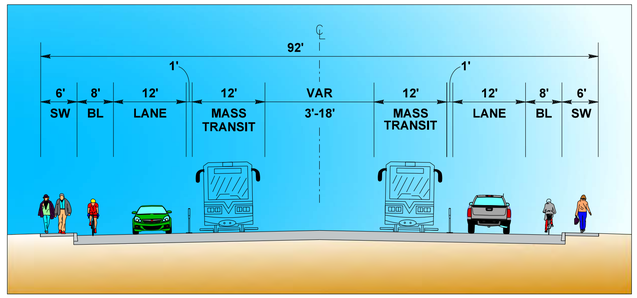
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Source: ESRI World Street Maps Online; Dokken Engineering 9/24/2024; Created By: ahale

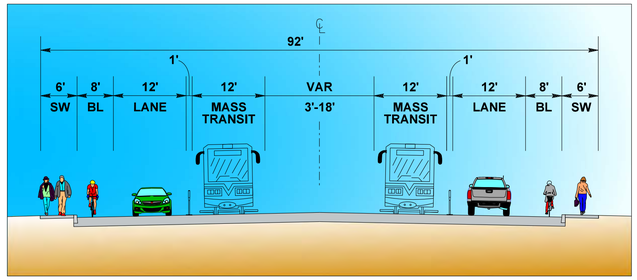
0 800 1,600 2,400 3,200 Feet

FIGURE 2
Project Location

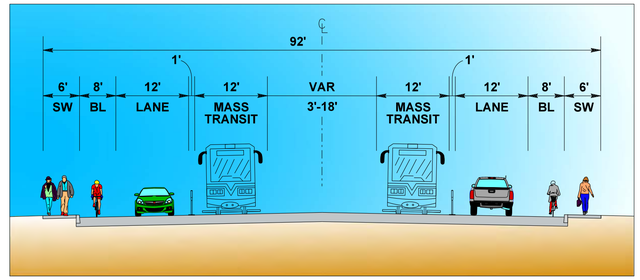
Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California



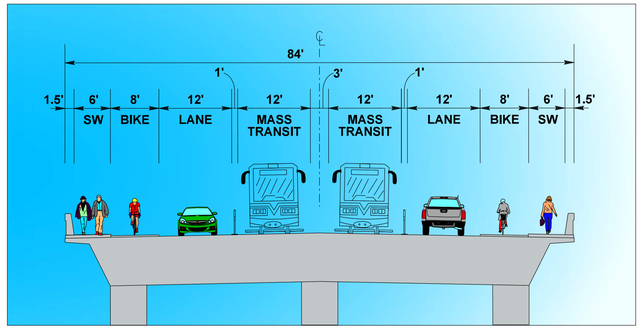
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TRUXEL RD NORTH



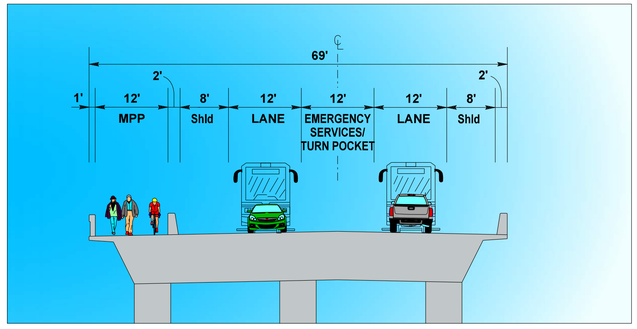
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TRUXEL RD NORTH



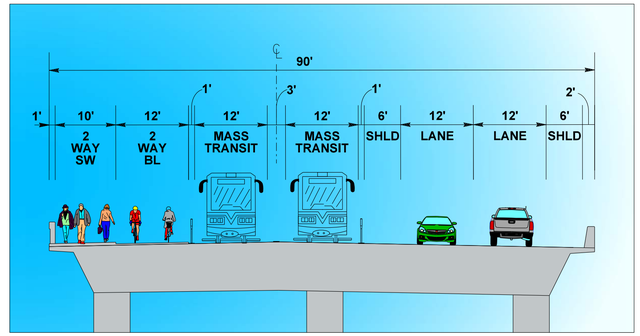
ALT 3
TRUXEL RD NORTH



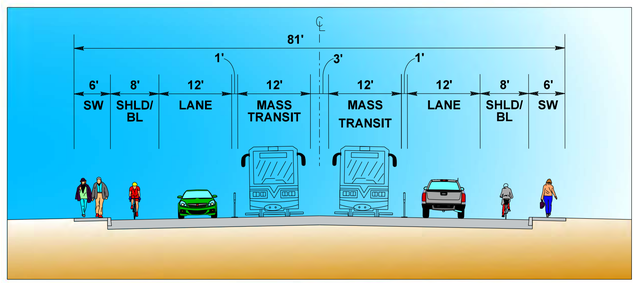
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ON BRIDGE



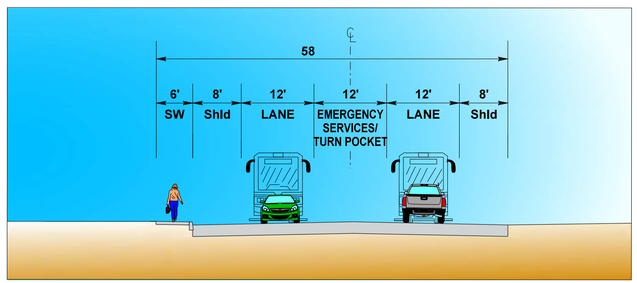
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ON BRIDGE



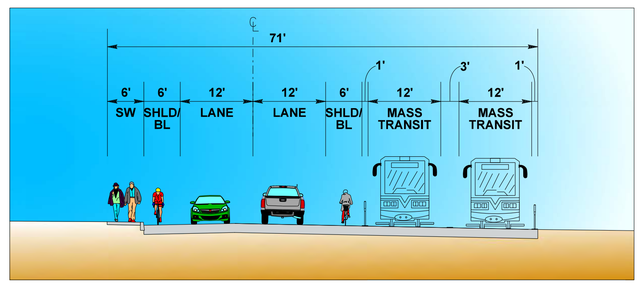
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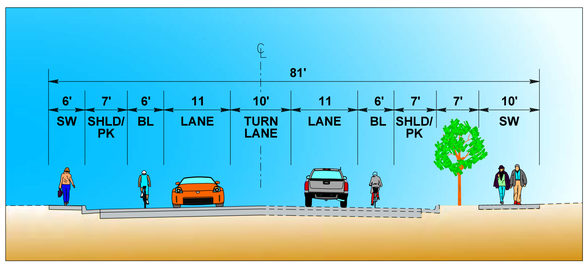
ALT 1
SEQUOIA PACIFIC BLVD



ALT 2
SEQUOIA PACIFIC BLVD



ALT 3
SEQUOIA PACIFIC BLVD



N 5TH ST

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TRUXEL BRIDGE CONCEPT & FEASIBILITY STUDY

BRIDGE CROSS SECTION ALTERNATIVES FEASIBILITY STUDY

2. Hydrologic and Hydraulic Analysis

The hydraulic analysis of the proposed Truxel Bridge was performed using HEC-RAS. The purpose of the analysis was to determine the effects of the proposed Truxel Bridge on WSELs, velocities, and scour depths of the bridge foundations.

2.1 Stakeholder Coordination

This section summarizes the Hydrologic and Hydraulic (H&H) stakeholder coordination that has taken place to date. On September 27, 2023, a project meeting was held between Dokken Engineering, City of Sacramento, Central Valley Flood Protection Board (CVFPB), USACE, and American River Flood Control District (ARFCD). The following H&H topics were discussed:

- CVFPB confirmed that this project will need to meet Urban Levee Design Criteria (ULDC).
- CVFPB provided a 200-year flow rate of 160,000 cfs which is the maximum authorized flow out of Folsom Lake and recommended that this project be designed for these maximum flows.
- CVFPB confirmed that their freeboard requirement is consistent with the USACE O&M manual and that the current levees meet this requirement.
- A key goal of this project is to avoid increasing the WSEL. CVFPB has confirmed that WSEL increases of 0.1 feet or less fall within the threshold tolerance of the modeling effort and are not considered a violation of their criteria.
- CVFPB provided typical mitigation for a rise in WSEL which consists of improving the flow within the channel (e.g., improvements to the topography so the river can flow more efficiently) and keeping abutments out of the floodway.
- CVFPB requires all new structures near the project site to have low chords set at or above the adjacent levees.
- CVFPB confirmed that the ongoing levee projects will not be raising the levees within our project area and that the current levees at the project area meet the ULDC and are adequate to protect against the peak releases from Folsom Lake.

On July 02, 2024, a meeting between Dokken and ARFCD was held. The following topics were discussed:

- After reviewing the alternatives and profiles, ARFCD expressed concerns regarding the clearance between the top of the south levee and the bottom of the proposed bridge due to potential maintenance issues. The clearance requirement, as specified in Title 23, ensures that sufficient space is available for the maintenance team to perform routine activities such as mowing the levee access road.
- Dokken stated that raising the proposed bridge profile to meet the clearance requirements would present challenges, particularly due to the need to extend the conforming limits, which could impact adjacent areas and project scope.
- Alternatives were discussed to eliminate the need for maintenance under the bridge. Ultimately, it was decided that Dokken will place fill under the bridge at the south levee, and the new maintenance access will be relocated to the land side of the levee beneath the bridge.
- ARFCD confirmed that placing fill under the proposed bridge will require pushing the landside of the south levee out with 2:1 side slopes.

2.2 Hydrology

The LAR Floodway is comprised of the LAR channel, Discovery Park, and Steelhead Creek. According to the 2024 FEMA Flood Insurance Study (FIS), a 100-year storm event in the LAR channel has a flow rate of 157,000 cfs. No flow data for a 200-year storm event was available in the FIS, so it was sourced from the Central Valley Hydrology Study (CVHS), which specifies a 160,000 cfs flow rate for this event. Given that the CVHS 200-year event is also the maximum allowable flow rate out of Folsom Lake and only slightly higher than FEMA's 100-year flow, it will serve as the primary inflow for the LAR channel and will be used to ensure that freeboard requirements are met.

Steelhead Creek, which flows parallel to LAR on the north side of Discovery Park, has a 200-year flow of approximately 4,200 cfs. Both the LAR channel and Steelhead Creek overtop to contribute flow to Discovery Park.

2.3 Hydraulic Criteria

The Truxel Bridge Project is located within the LAR levee system and is required to meet FEMA, CVFPB, USACE and USCG design requirements. See below for the required design criteria from each agency:

FEMA: Levee's must have a minimum freeboard of three feet above the water-surface level of the 100-year storm event. An additional one foot above the minimum is required within 100 feet on either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted.

CVFPB: Bridges must have a minimum of three (3) feet of freeboard above the design 200-year flood plain. Levees within one hundred feet of a bridge, or other structure which may constrict floodflows, must have one foot of additional freeboard.

USACE: A minimum levee freeboard of three feet above the water-surface level of the 100-year base flood. An additional one foot above the minimum is required within 100 feet on either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted.

USCG: Bridges must have 10 feet of vertical clearance above the design flow elevation of 37.4± feet (USACE SACRIVERBASIN G4 NAVD88 datum) to the lowest hittable portion of the bridge.

As mentioned in Section 2.2, the 200-year flow was used as the baseline for this preliminary analysis, in lieu of the 100-year event, to assess compliance with the above criteria.

2.4 Existing Condition

Dokken Engineering received a 2D HEC-RAS model from CBEC on October 24, 2023, which analyzed the lower 14 River Miles (RMs) of the LAR. This model will serve as the existing condition for the Truxel Bridge Project. This model is an unsteady model which includes hydrographs representing a 100- and 200- year discharge in the LAR.

The 2D hydraulic model encompasses the entire floodway, including the LAR channel, Discovery Park, and Steelhead Creek. The LAR channel flows along the south side of the floodway and is approximately 400 feet wide. Its banks are relatively steep and support significant riparian

vegetation, including large mature trees, bushes, and shrubs. The channel maintains a constant flow, which is regulated by Folsom Dam, with no significant obstructions aside from manmade structures up- and downstream of the project site. Steelhead Creek flows along the north side of the floodway and is approximately 125 feet wide. Its moderately sloped banks are covered with dense riparian vegetation, consisting of mature trees and thick bushes/shrubs. Supporting a highly urbanized watershed, Steelhead Creek has a constant, year-round flow. Discovery Park lies in the low-lying area between the American River and Steelhead Creek, supporting numerous recreational activities such as biking, fishing, archery, picnicking, and boat launches to the American River. The park also supports significant riparian vegetation, primarily trees, and is designed to flood when the LAR and Steelhead Creek overtop their banks. At the project site, the Lower American River floodway is protected by levees to the north and south. Garden Highway sits atop the northern levee along the north bank of Steelhead Creek and the Two Rivers Bike Trail sits atop the southern levee along the south bank of the American River. Both the Steelhead Creek and LAR channels typically experience the most concentrated floodwaters, resulting in higher velocities and depths. In contrast, the floodway at Discovery Park, features shallower water and lower velocities. See **Appendix C** for the FEMA flood map.

The model and data are in U.S. customary units. The horizontal projection is NAD83 NSRS 2007 State Plane CA Zone II (US feet) and the vertical datum is the North American Vertical Datum of 1988 (NAVD88), feet. Manning's n values range from 0.03 to 0.07 in the model.

The existing hydraulic conditions of the LAR floodway within the project area are relatively stable. This section of the LAR floodway experiences backwater effects from the Sacramento River due to its proximity. This area has mild slopes with subcritical flow, and velocities range from 6.4 to 7.2 fps within the LAR floodway. The Froude number in both the LAR channel and Discovery Park is below 0.20, indicating stable conditions without hydraulic jumps. Typical depths in the LAR channel range from 33 to 40 feet, while depths in Steelhead Creek range from 30 to 32 feet, and in Discovery Park, they vary between 7 and 15 feet.

2.5 Proposed Conditions

The proposed HEC-RAS model was created for Alternative 3 of the Truxel Bridge. Alternative 3 was determined to be the most conservative design, featuring a bridge that is 90 feet wide and 2755 feet long. This bridge will consist of three 3-foot diameter piers and sixteen 5-foot diameter piers, with three piers proposed within the LAR channel banks and two within the banks of Steelhead Creek. Piers are modeled to have a semi-circular nose shape. This project will also include a connection to the Jedediah Smith Trail, which is driving the location of the bike/pedestrian path on the bridge. For the purpose of this study, trail connections from both the east and west side of the bridge were modeled. Refer to **Appendix A** for the Truxel Bridge APS, which also includes the westerly trail connection, and **Appendix B** for the layout of the easterly connection (Alternative 3b). The hydraulic results summarize the impacts of the project with and without the trail connections. The proposed model utilized the Yarnell equation to calculate WSEL upstream and downstream of the Truxel Bridge. All other model parameters are consistent with the existing conditions modeled by CBEC.

The hydraulic results are reported separately for the Discovery Park and LAR channel portions of the floodway. This separation was necessary because the proposed trail connections are located within Discovery Park, while the bridge spans both Discovery Park and the LAR. To accurately assess the impacts of the trail connections, it was essential to evaluate the entire floodway extents.

The results of the HEC-RAS analysis are summarized in the tables below:

Table 1: WSEL Summary in LAR Channel

River Mile (mi)	Existing (ft)	Proposed (No Trail) (ft)	Proposed (With Trail - Westerly Connection) (ft)	Proposed (With Trail - Easterly Connection) (ft)
0.89	37.19	37.32	37.32	37.32
0.87	37.18	37.31	37.31	37.31
0.85	37.16	37.29	37.29	37.29
0.83	37.15	37.28	37.28	37.28
0.81	37.14	37.27	37.27	37.27
0.79 (Bridge)	37.12	37.26	37.26	37.26
0.77	37.09	37.09	37.09	37.09
0.75	37.08	37.07	37.07	37.07
0.73	37.05	37.05	37.05	37.05
0.71	37.03	37.03	37.03	37.03
0.69	37.00	37.00	37.00	37.00

[1.] WSEL is reported at the center of the LAR channel, where the impact from the proposed bridge is most evident.

Table 2: Proposed vs Existing WSEL Difference in LAR Channel

River Mile (mi)	Δ Proposed (No Trail) (ft)	Δ Proposed (With Trail - Westerly Connection) (ft)	Δ Proposed (With Trail - Easterly Connection) (ft)
0.89	+0.13	+0.13	+0.13
0.87	+0.13	+0.13	+0.13
0.85	+0.13	+0.13	+0.13
0.83	+0.13	+0.13	+0.13
0.81	+0.13	+0.13	+0.13
0.79 (Bridge)	+0.14	+0.14	+0.14
0.77	0.00	0.00	0.00
0.75	-0.01	-0.01	-0.01
0.73	0.00	0.00	0.00
0.71	0.00	0.00	0.00
0.69	0.00	0.00	0.00

Table 3: WSEL Summary in Discovery Park

River Mile (mi)	Existing (ft)	Proposed (No Trail) (ft)	Proposed (With Trail - Westerly Connection) (ft)	Proposed (With Trail - Easterly Connection) (ft)
0.89	37.15	37.26	37.27	37.27
0.87	37.14	37.24	37.25	37.25
0.85	37.12	37.23	37.23	37.24
0.83	37.11	37.22	37.22	37.23
0.81	37.10	37.21	37.21	37.21

River Mile (mi)	Existing (ft)	Proposed (No Trail) (ft)	Proposed (With Trail - Westerly Connection) (ft)	Proposed (With Trail - Easterly Connection) (ft)
0.79 (Bridge)	37.09	37.19	37.19	37.20
0.77	37.07	37.10	37.10	37.10
0.75	37.06	37.08	37.08	37.08
0.73	37.04	37.06	37.06	37.05
0.71	37.02	37.04	37.04	37.03
0.69	37.00	37.01	37.01	37.01

[1.]The WSEL is reported approximately 700 feet south of Steelhead Creek, near the proposed trail connections, where the impact from the trail is most evident.

Table 4: Proposed vs Existing WSEL Difference in Discovery Park

River Mile (mi)	Δ Proposed (No Trail) (ft)	Δ Proposed (With Trail - Westerly Connection) (ft)	Δ Proposed (With Trail - Easterly Connection) (ft)
0.89	+0.11	+0.12	+0.12
0.87	+0.10	+0.11	+0.11
0.85	+0.11	+0.11	+0.12
0.83	+0.11	+0.11	+0.12
0.81	+0.11	+0.11	+0.11
0.79 (Bridge)	+0.10	+0.10	+0.11
0.77	+0.03	+0.03	+0.03
0.75	+0.02	+0.02	+0.02
0.73	+0.02	+0.02	+0.01
0.71	+0.02	+0.02	+0.01
0.69	+0.01	+0.01	+0.01

Table 5: FEMA / CVFPB / USACE / USCG Freeboard Analysis

River Mile (mi)	[1]Soffit Elevation	Top of Levee		[2]WSEL (North Levee)	[2]WSEL (South Levee)	Freeboard Provided		
		North	South			From Top of Levee		From Soffit of Bridge
						North	South	
0.77 (100' Downstream)	-	40.74	41.50	37.03	37.09	3.71	4.41	-
0.79 (Bridge)	47.40	40.69	41.40	37.16	37.26	3.53	4.14	10.14
0.81 (100' Upstream)	-	40.81	41.47	37.18	37.27	3.63	4.20	-

[1.] The soffit elevation is provided at the lowest hittable point of the proposed bridge over the LAR channel, near the south levee.

[2.] The WSEL is based on the 200-year flow and is reported at the LAR channel adjacent to the south levee and at Steelhead Creek adjacent to the north levee.

Table 6: Velocity Summary

River Mile (mi)	Existing (ft/sec)	Proposed (No Trail) (ft/sec)	Proposed (With Trail - Westerly Connection) (ft/sec)	Proposed (With Trail - Easterly Connection) (ft/sec)	Δ (No Trail)	Δ (With Trail- Westerly Connection)	Δ (With Trail- Easterly Connection)
0.77	6.61	8.87	8.87	8.89	+2.26	+2.26	+2.28
0.79 (Bridge)	6.51	8.81	8.80	8.82	+2.30	+2.29	+2.31
0.81	6.53	6.40	6.39	6.40	-0.13	-0.14	-0.13

2.6 Conclusions

Based on **Tables 1** and **2**, the preliminary HEC-RAS analysis shows a WSEL rise of 0.13 to 0.14 feet upstream of the proposed Truxel Bridge within the LAR channel. **Tables 3** and **4** show a WSEL rise of 0.01 to 0.12 feet within the Discovery Park portion of the floodway. The WSEL rise gradually dissipates upstream, returning to existing conditions near RM 10. The HEC-RAS results for both the westerly and easterly Jedediah Smith Trail connections (**Tables 3** and **4**) are similar. However, just upstream of the easterly connection at RM 0.85, WSEL is 0.01 feet higher than at the westerly connection due to the additional piers required. The easterly connection also results in slightly higher velocities at the bridge compared to the westerly connection and the no-trail alternative, as shown in **Table 6**. While neither trail connection significantly impacts WSEL in the floodway, the westerly connection requires fewer piers and results in a slightly smaller velocity increase near the bridge, making it a safer hydraulic alternative.

A rise in WSEL within the FEMA floodway would necessitate processing a Letter of Map Revision (LOMR) and a Conditional Letter of Map Revision (CLOMR), requiring coordination with FEMA for remapping the floodplain due to this rise. However, this increase in WSEL is minimal and potentially can be mitigated by more detailed analysis and design elements during the final design phase.

As shown in Table 5, the bridge freeboard requirements set by all governing agencies are met using the 200-year flow frequency, accounting for the rise in WSEL. Similarly, the levee freeboard requirements have been satisfied along both the north and south levees up through RM 10, with the exception of the segment 100 feet upstream and downstream of the proposed bridge location. Due to the addition of the bridge, an additional foot of freeboard is required within 100 feet of the bridge. The freeboard on the north levee will be approximately 0.5 foot less than the required 4 feet in this segment of the LAR floodway. Since the Garden Highway (north levee) will be raised to accommodate the new bridge crossing, the additional elevation of Garden Highway will provide more than the needed 0.5 feet of additional freeboard along the north levee for the segment that is 100 feet upstream and downstream of the bridge. The vertical clearance from the WSEL of 37.26 feet to the lowest hittable portion of the bridge is confirmed to be around 10.14± feet, which meets the minimum Coast Guard required clearance.

As shown in Table 6, this project will result in a velocity increase ranging from 2.2 to 2.3 fps, 100 feet downstream of the proposed bridge in the LAR channel, with maximum velocities approaching 9 fps. This increase raises concerns about scour, necessitating mitigation to prevent

failures of the bridge, river/creek banks, and levees, as well as general river degradation and sediment transport. Refer to Chapter 3 for the preliminary scour analysis.

3. Scour Analysis

The scour analysis and recommendations for this project utilized the proposed preliminary model results in conjunction with the findings from the RiverSmith Engineering technical memorandum, "Geomorphic, Erosion, and Sedimentation Analysis for the Proposed Green Line Bridge Crossing over the Lower American River," completed on February 20, 2017, and the State of California Department of Transportation (DOT) memorandum, "Geological and Geotechnical Scour Evaluation for the American River Bridge," completed on March 5, 2018.

3.1 Long Term Aggradation/Degradation

The project site is underlain by Latest Holocene stream channel deposits (Qhc) described as deposits in active, natural stream channel consisting of loose alluvial sand, gravel, and silt. Long-term scour for the LAR has varied from 1907 to the present. This area previously experienced a high volume of hydraulic mining activities, leading to aggradation throughout the project reach. However, after the construction of the Folsom and Nimbus Dams, sediment supply from the upper watershed to the LAR significantly decreased. Since then, the LAR has shown a long-term trend towards degradation in the project area. Despite this, the project area still experiences some aggradation as stored upstream riverbed sediments continue to move downstream. Since 1987, the lower reach within the project vicinity has demonstrated relative vertical stability, with bed elevation variations ranging from -3 feet to +3 feet from modest river flows.

Based on the hydraulic results, it is anticipated that with design peak flows and velocities reaching up to 9 fps within 100 feet downstream of the proposed bridge, some bed scour may occur. This scour may not be replenished, as the upstream in-channel stored sediments are gradually being depleted. Additional sedimentation studies may be needed during final design.

3.2 Localized Scour

Abutment scour for this project is not a major concern due to the proposed locations of Abutments 1 and 21. Abutment 1 is located just outside the FEMA floodplain, near the conform point of Sequoia Pacific Blvd, outside of the levee prism. Abutment 21 is located on the slope of the northern levee where velocities are in the 3-5 fps range. The final design will investigate potentially armoring the northern levee to avoid any future erosion.

Pier scour presents a significant concern for this project. Previous boring data from the Interstate 5 (I-5) American River Bridge, located approximately 2700 feet downstream of the proposed Truxel Bridge, indicates the presence of very loose to compact sand, silty sand, and gravel extending from an elevation of about 0 feet down to approximately -19 feet. Below this depth, interbedded layers of dense and very dense sand, silt, gravel, and cobbles were observed, all of which are considered potentially scourable materials.

No erosion or migration is expected along the south bank of the LAR since most of this reach is already armored and maintained by the American River Flood Control District. However, the armoring may need to be modified to withstand peak flows. The north bank of the active river

channel is unarmored and further movement in the river planform can be expected in that direction from peak flows and high velocities. The flow in the main LAR channel migrates into the adjacent Discovery Park floodway during high flow events and is protected by levees along Garden Highway.

To mitigate scour, this project will implement strategies similar to those used at the I-5 American River Bridge. These measures may include removing alluvial materials around the support piles and replacing them with rip-rap boulders, and modifying or adding armoring to the north and south banks of the LAR to withstand the design flow, and designing the bridge foundation depths to be below the scour elevations.

3.3 Conclusions

Based on the scour analysis discussed, the following conclusions are drawn for this feasibility study:

- Riverbed degradation is anticipated, particularly when velocities near 9 fps in the proposed conditions. The final design will mitigate for this, and the bridge foundations will be extended accordingly.
- Armoring of the north bank of the LAR is imperative to prevent further planform movement in that direction, while modifications to existing south bank armoring are necessary to withstand the 160,000 cfs design flow.
- Abutment scour is not a concern for Abutment 1 due to it being located outside the FEMA floodplain but warrants further investigation for Abutment 21 during the final design phase.
- Pier scour will be addressed by removing alluvial material around support piles and replacing it with rip-rap boulders. The final design will specify rip-rap sizes capable of withstanding peak flows and velocities.

The existing Manning's n values at the north and south banks range from 0.035 to 0.07, corresponding to small-medium sized trees and valley foothill riparian ground cover. Additional armoring of these banks should lower the n values, allowing for smoother flow and potentially reducing the WSEL, though this may increase velocity as water will be able to travel faster. Some armoring methods that will be considered during final design include riprap and slope paving. These methods will be sized to handle peak flows and velocities, ensuring the stability and integrity of the riverbanks.

4. References

USACE-SPK, 2019b. Memorandum for Record: “CVHS Hydrograph Package for HEC-RAS Model Inputs.” Prepared by CESPK-ED-HH. 20-Feb 2019

California Department of Transportation. Geological and Geotechnical Scour Evaluation for American River Bridge. Memorandum, 5 Mar. 2018. Office of Geotechnical Support, Division of Engineering Services, MS 5.

RiverSmith Engineering. *Technical Memorandum - Geomorphic, Erosion, and Sedimentation Analysis for the Proposed Green Line Bridge Crossing over the Lower American River.* AECOM, 20 Feb. 2017.

Federal Emergency Management Agency. Flood Insurance Study: Sacramento County, California, and Incorporated Areas. FIS No. 06067CV001E, vol. 1 of 4, 31 Mar. 2024.

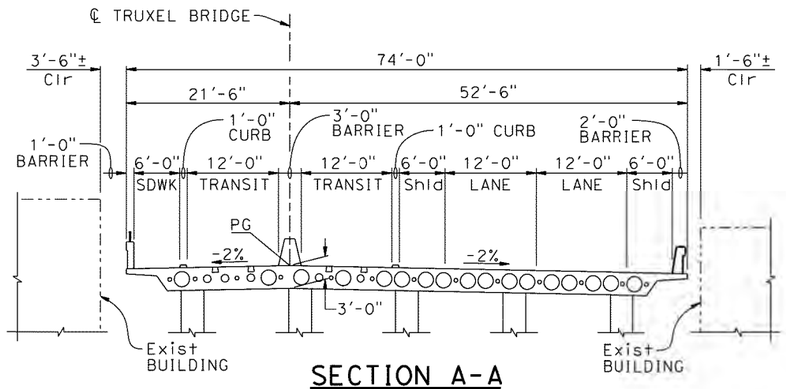
Appendix A. Truxel Bridge APS

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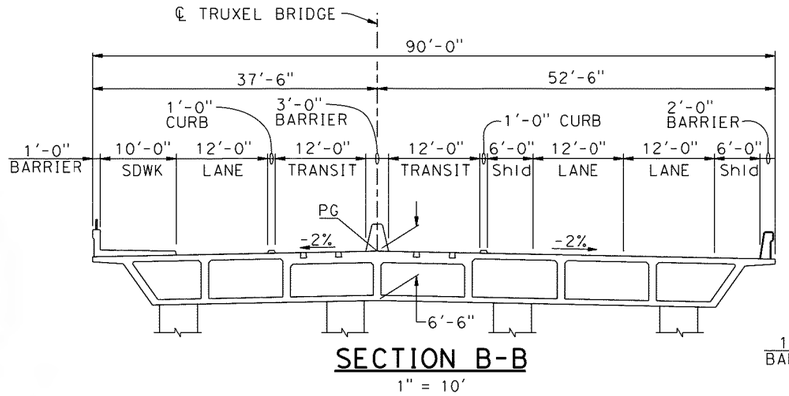
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CITY OF SACRAMENTO
915 I STREET
SACRAMENTO, CA 95814

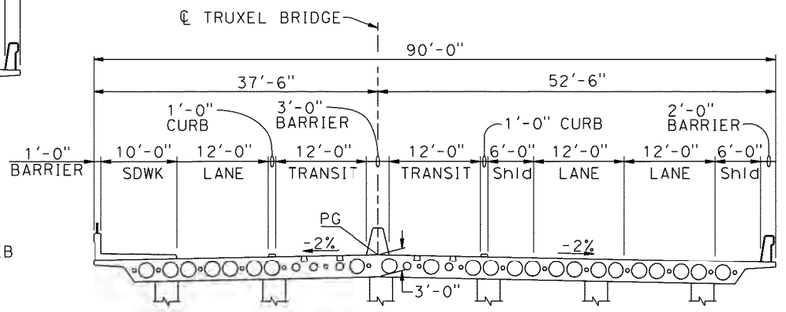
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110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630



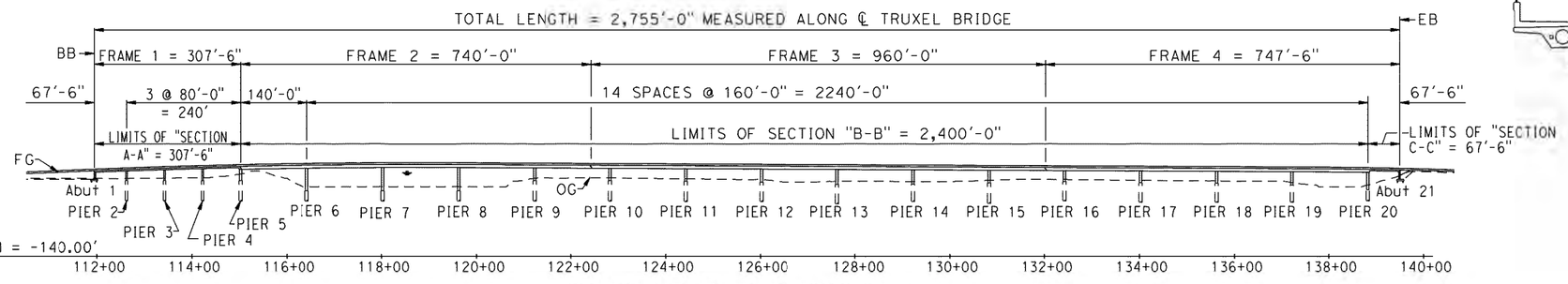
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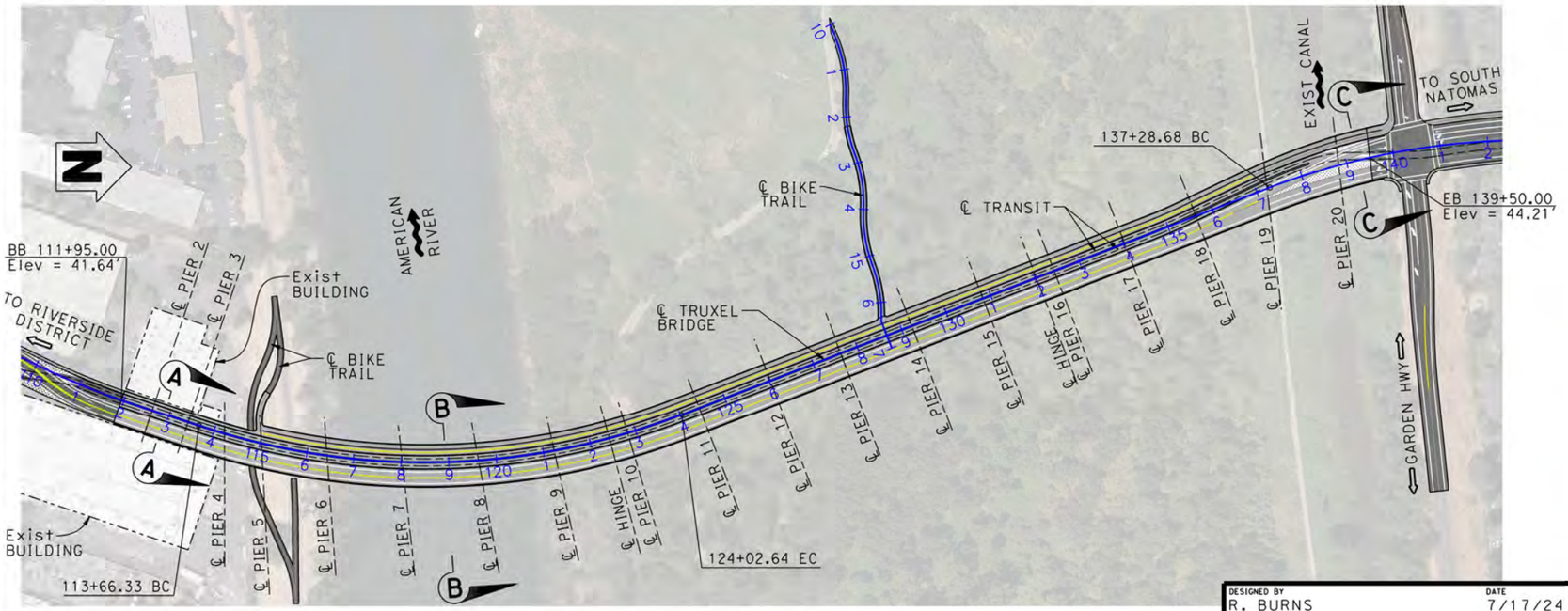
SECTION B-B
1" = 10'



SECTION C-C
1" = 10'



DEVELOPED ELEVATION
1" = 150'



PLAN
1" = 150'

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DATE OF ESTIMATE =	-	-	
STRUCTURE DEPTH =	-	-	TOTAL W/ 25% CONTINGENCY & 10% MOBILIZATION
LENGTH =	-	-	
WIDTH/AVG HEIGHT =	-	-	
AREA =	- sqft	- sqft	
COST/ SQ FT =	-	-	
TOTAL COST =	-	+ -	= -

DESIGNED BY R. BURNS	DATE 7/17/24	R. BURNS, PROJECT ENGINEER
DRAWN BY M. HENDRY	DATE 7/17/24	
CHECKED BY J. NOTTNAGEL	DATE 7/17/24	
APPROVED P. DALCIN-WALLING	DATE 7/17/24	

PLANNING STUDY (ALTERNATIVE 3)

TRUXEL BRIDGE CONCEPT AND FEASIBILITY STUDY

BRIDGE No.: TBD

PROJECT EA: N/A

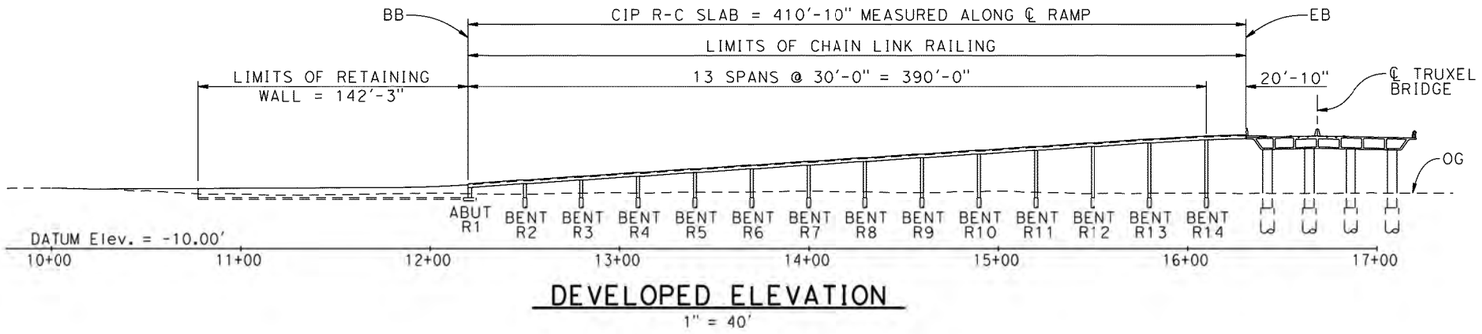
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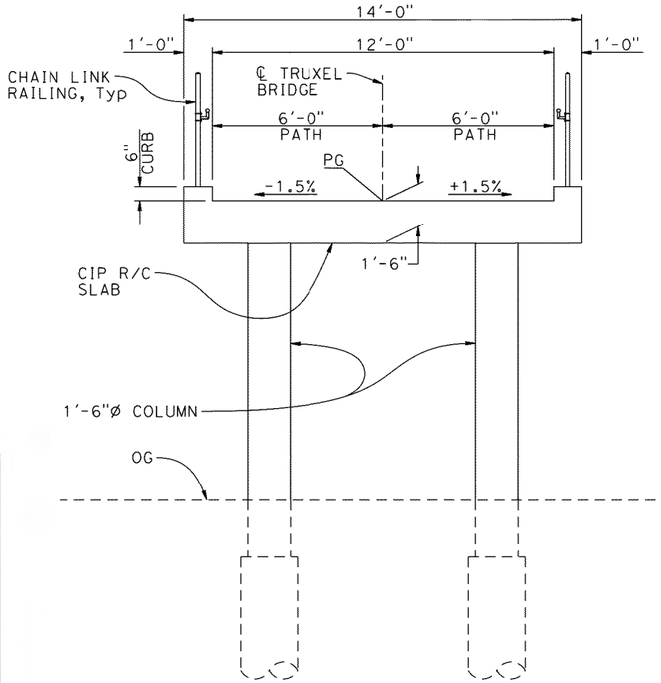
Dist	COUNTY	ROUTE	POST MILE
03	SAC	LOCAL	N/A

CITY OF SACRAMENTO
915 I STREET
SACRAMENTO, CA 95814

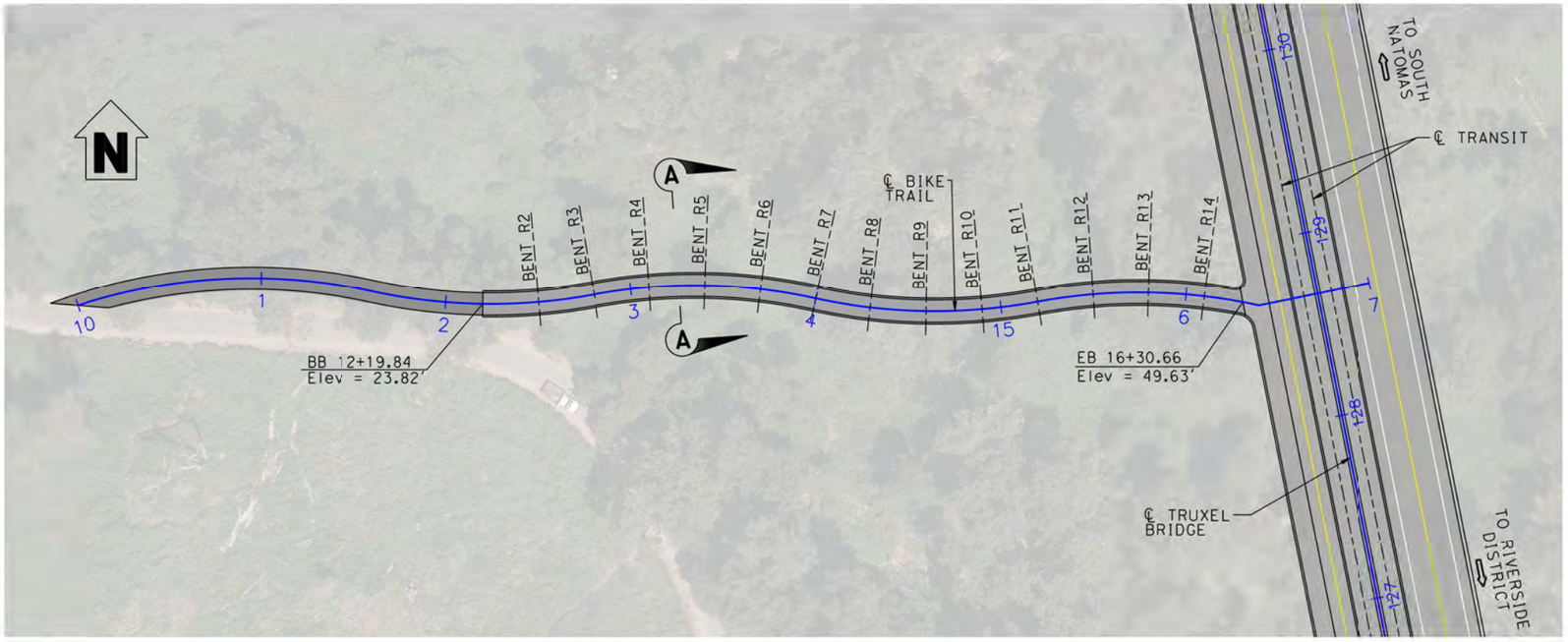
DOKKEN ENGINEERING
110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630



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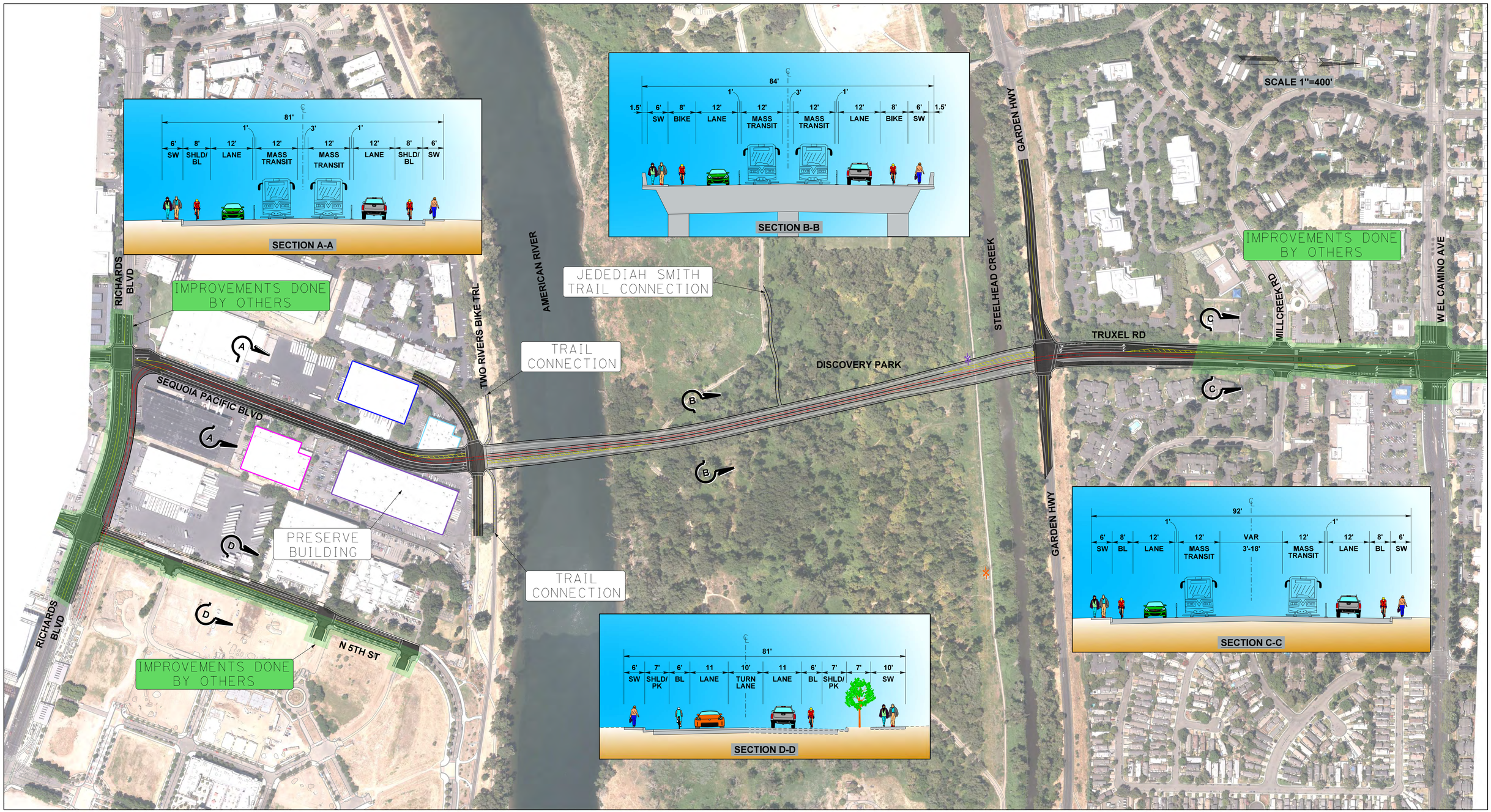
PLAN
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WIDTH/AVG HEIGHT =	-	-	
AREA =	- sqft	- sqft	
COST/ SQ FT =	-	-	
TOTAL COST =	-	+ -	= -

DESIGNED BY R. BURNS	DATE 7/17/24	R. BURNS PROJECT ENGINEER	PLANNING STUDY (BIKE TRAIL BRIDGE)
DRAWN BY M. HENDRY	DATE 7/17/24		TRUXEL BRIDGE CONCEPT AND FEASIBILITY STUDY
CHECKED BY J. NOTTNAGEL	DATE 7/17/24		BRIDGE No.: TBD
APPROVED P. DALCIN-WALLING	DATE 7/17/24		PROJECT EA: N/A / PROJECT No. & PHASE: N/A

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Appendix B. Truxel Bridge Alternative 1-3 Exhibits

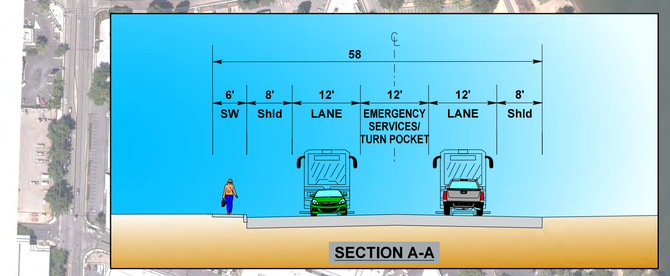


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110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630
PH: 916-858-0642 FAX 916-858-0643

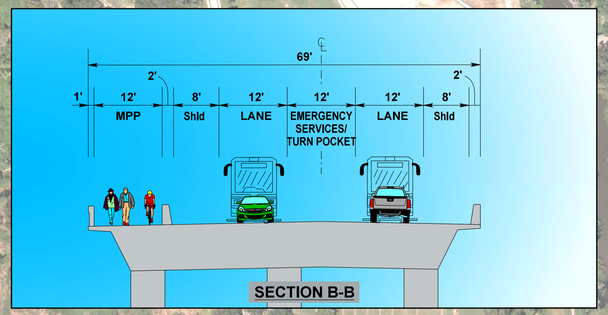
TRUXEL BRIDGE CONCEPT & FEASIBILITY STUDY

ALTERNATIVE 1

JUNE 2024



SECTION A-A



SECTION B-B

SCALE 1"=400'

IMPROVEMENTS DONE BY OTHERS

PRESERVE BUILDING

PRESERVE BUILDING

IMPROVEMENTS DONE BY OTHERS

JEDEDIAH SMITH TRAIL CONNECTION

PGE TOWER NOT IMPACTED

TRAIL CONNECTION

TRAIL CONNECTION

RICHARDS BLVD

RICHARDS BLVD

SEQUOIA PACIFIC BLVD

N 5TH ST

TWO RIVERS BIKE TRL

AMERICAN RIVER

STEELHEAD CREEK

DISCOVERY PARK

TRUXEL RD

MILLCREEK RD

W EL CAMINO AVE

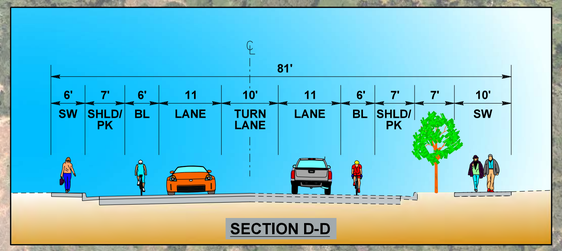
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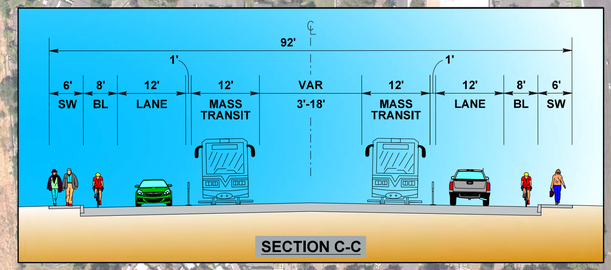
B

C

D



SECTION D-D



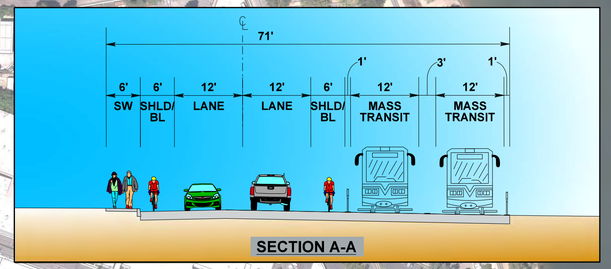
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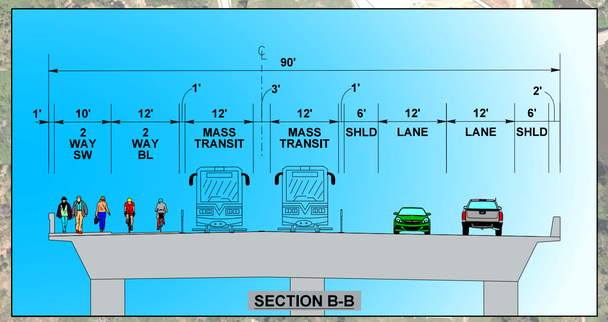
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110 BLUE RAVINE ROAD, Suite 200
Folsom, CA 95630
PH: 916-858-0642 FAX 916-858-0643

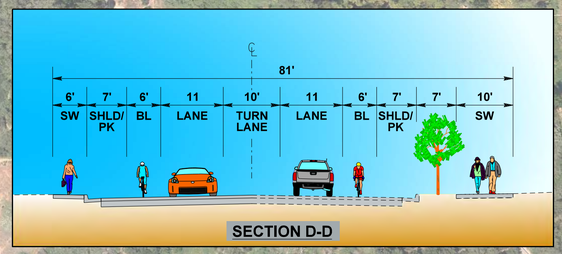
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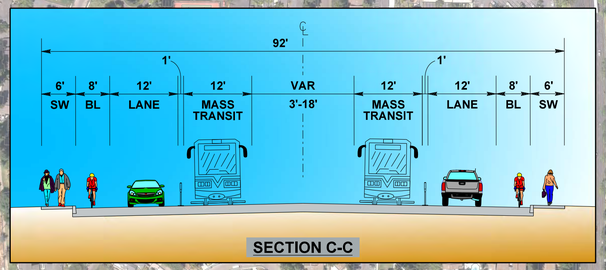
ALTERNATIVE 2

JUNE 2024







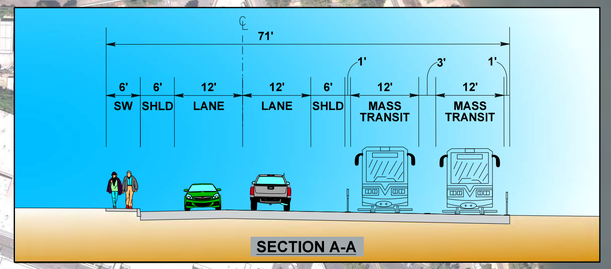


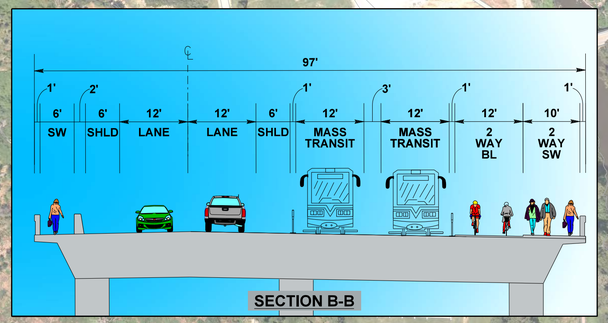
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110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630
PH: 916-858-0642 FAX 916-858-0643

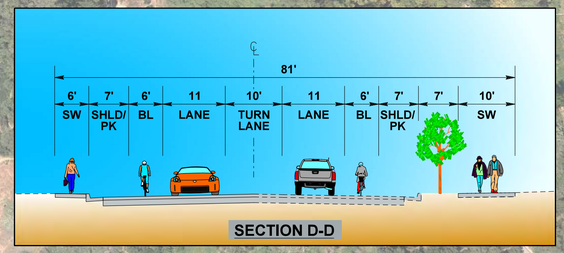
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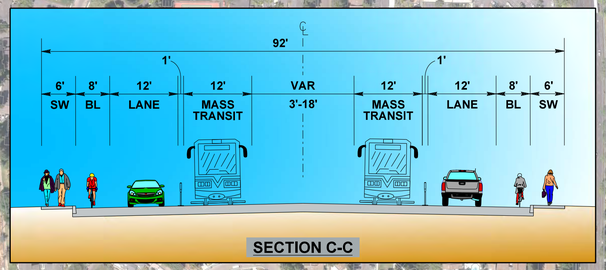
ALTERNATIVE 3

JUNE 2024







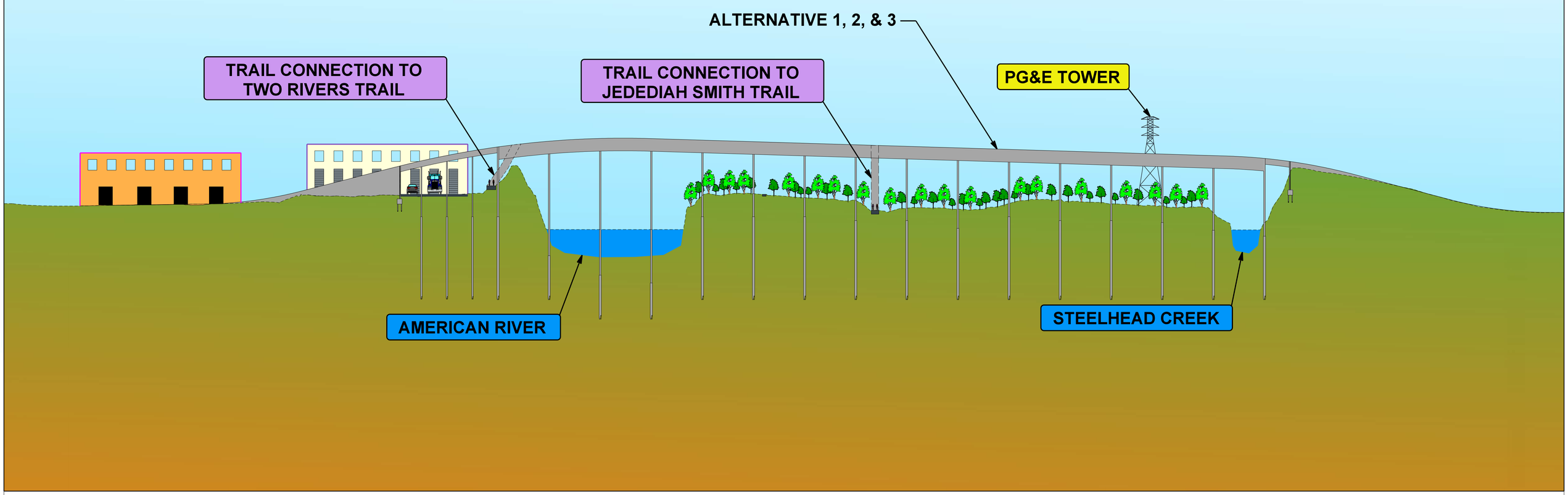


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FOLSOM, CA 95630
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TRUXEL BRIDGE CONCEPT & FEASIBILITY STUDY

ALTERNATIVE 3B

JUNE 2024



City of SACRAMENTO Department of Public Works

DOKKEN ENGINEERING

TRUXEL BRIDGE
CONCEPT & FEASIBILITY STUDY
BRIDGE PROFILE
JUNE 2024

Appendix C. FEMA Flood Map

National Flood Hazard Layer FIRMette

FEMA

121°29'54"W 38°36'33"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

121°29'17"W 38°36'4"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/8/2024 at 3:31 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Attachment Q. Constructability Memo



Truxel Bridge
Concept and Feasibility Study

Constructability Assessment

Prepared by:

DOKKEN ENGINEERING

Prepared for:

City of SACRAMENTO

October 2024

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Executive Summary

A constructability assessment was performed on the documents prepared during the initial phases of the development of the *Truxel Bridge Concept & Feasibility Study*. This review included the constructability of all alternatives presented in the Study. While all alternatives presented in the Study are constructable, the intent of this *Constructability Assessment* is to highlight critical it was determined that Alternative 3 can be constructed and is, therefore, a feasible alternative.

Alternatives for the bridge ranged in width from 63 feet to 116 feet and 2,400 feet to 2800 feet in length. The most recent Planning Studies, dated 10/16/24, are attached to this Assessment. The key differentiator of Alternatives 2 and 3 is these alternatives include extend the bridge section between two existing buildings on Sequoia Pacific Boulevard for approximately 300 feet south of the levee. These buildings are approximately 80 feet apart. Between the buildings, the bridge width is 63 feet for alternative 2 and 74 feet for alternative 3. While the bridge width physically fits between the existing buildings, the impacts to the building's operations during and after construction cannot be understated.



Figure 1 Existing Buildings at Southern Conform (Alts 2 & 3)

Communication with the building owners and their tenants to understand how they access the buildings and the equipment they use in the area between the buildings will be crucial to successfully acquire the right of way and temporary construction easements to complete the project. See Appendix B for the project right of way needs for the preferred alternative (Alternative 3). After bridge construction is complete, the space under the bridge will preserve many parking spaces and provide access to the existing entries and roll up doors on the sides of the buildings, however during construction these facilities will be unusable and inaccessible due to falsework and foundation installation. This will require significant outreach and coordination during the later phases of the project delivery.

Since the edge of the bridge will be a few feet away from each of the buildings, it is important to include safety fence on the edges of the bridge that will preclude people on the bridge from accessing or attempting to access either building.

Existing high voltage overhead power lines run east and west just south of Steelhead Creek and will cross over the new bridge. It is very important to design bridge foundations as far away from these lines as possible. Preliminary geotechnical recommendations provide recommendations for driven steel pipe piles and large diameter cast-in-drilled-hole (CIDH) concrete piles. These piles are constructed using two 250-feet tall cranes. The bridge foundations on each side of the power lines should be laid out so they provide approximately the same clearance from the lines (i.e., place the piers supporting the span under the power lines equal distances from the power lines). The Planning Studies included in Appendix A have laid out the piers immediately south of Steelhead Creek near the overhead lines to center the span on the overhead line to minimize potential impacts to the power lines. A detailed survey of the power line wire heights, as well as required clearances base on voltages should be carefully examined during the later phases of the project delivery.

Additionally, driving forces and vibrations from driven piles or driven temporary casings installed for CIDH piles adjacent to the existing buildings on Sequoia Pacific Boulevard will potentially damage the existing buildings. Oscillated casings or grouted micro piles should be considered at these locations to minimize this potential damage.

The contractor will need numerous locations to access the site. The main roadways at each end of the project are Richards Boulevard on the south end and Garden Highway on the north end, with Discovery Park in between. The American River and Steelhead Creek also create gaps in the contractor's access that will need to be improved. Numerous access points and paths of travel for the contractor and their suppliers should be identified and evaluated. Cranes, large trucks with trailers, concrete trucks, pickups, and large trailered holding tanks for the slurry circulation will need to get to all areas currently separated by the river and creek. Identifying these contractor routes will dramatically improve bidding and the results. Also, a project of this magnitude will need an area for the Contractor to set up their on-site office. No site is obvious from looking at project exhibits and aerials. A few viable locations for a field office and yard should be identified and evaluated. Ultimately, large staging areas in the flood plain as well as access trestles over the American River and Steelhead Creek will be required. The environmental study area is included in Appendix C details a large footprint to account for this access. The *Environmental Document Memorandum* also outlines all regulatory permits that will be required for the temporary and permanent impacts associated with the project.

The bridge spans the American River and includes four (4) sets of piers in the water, or close to the water's edge. Performing the bridge construction will require a temporary trestle for the contractor to use to build foundations and the bridge portion over the water. Coffer dams or oscillated casings with circulated slurry and baker tanks for dewater for foundation and column installation will be required in addition to the trestle and falsework over the water. This construction will be limited by flood control and fish windows, generally restricting in water work to a June to October work window. Working day schedules developed during the later phases of the project delivery must properly account for this restricted in-water work window.

The bridge spans the Steelhead Creek and includes one pier close to the water's edge. Performing the construction will require a temporary platform for the contractor to use to build foundations and the bridge portion over the water.

1. Introduction

1.1 Background

The City of Sacramento is undertaking an engineering feasibility study for a new multi-modal bridge across the lower American River between Truxel Road and Sequoia Pacific Boulevard to better connect North and South Natomas with the Central City.

In 2013, the City of Sacramento completed the American River crossings alternatives study, and City Council adopted the vision for a new multi-modal crossing at Truxel Road as the preferred alignment. The Truxel Bridge alignment was chosen based on its ability to address limited connectivity across the lower American River which creates a barrier to economic activity, land use development, social exchanges and access to jobs within the Central City by communities just north of the river including South Natomas and North Natomas where a significant portion of Sacramento City residents live, and a considerable amount of residential growth is planned.

Currently, there is a lack of direct multi-modal crossings over the American River, which discourages alternative modes of travel besides driving, therefore resulting in higher greenhouse gas (GHG) emissions, higher vehicle miles traveled (VMT) due to longer trips, inefficient routes for transit services, and reduced public health and air quality. Additionally, this limited connectivity leads to longer emergency response times and can hinder evacuation during future natural disasters.

1.2 Project Purpose

A significant portion of Sacramento City residents live in North and South Natomas north of the American River and are forced to use I-5 as the most direct route into the regional employment center and cultural hub which is the Central City. Interstate 5 offers no reasonable options for pedestrians and bicycles resulting in more vehicle trips, higher GHG emissions and higher VMT as well as higher public health and air quality impacts. While cyclist and pedestrians can use the Jibboom Street bridge and are permitted to use I-5 when Discovery Park is flooded, this is not ideal. The Truxel Bridge will not only provide an addition crossing, but also an all season crossing, offering improved resiliency of the existing active transportation network in the area. Transit ridership is also impacted due to inefficient routing that requires buses to use I-5.

To address this critical need, the City of Sacramento is studying the feasibility of a new multi-modal bridge between the terminus of Truxel Road north of the river and Sequoia Pacific Boulevard south of the river consistent with Sacramento Regional Transit's (Sac RT) plans to light rail to the Sacramento International Airport.

This alignment was selected following an exhaustive alternative analysis with the goal of serving all modes to reduce VMT, air pollutant, and GHG emissions; to reduce the overall reliance of local trips on state facilities; to increase options for evacuations and emergency response; and to improve recreational access to the American River Parkway.

This study will develop alternatives for the new bridge through an inclusive public outreach and engagement process, through which the study team will seek feedback on right of way configuration, conceptual design, opportunities and constraints, and funding strategies.

The proposed Project is located near the City of Sacramento in Sacramento County, California (**Figure 2. Project Vicinity** and **Figure 3. Project Location**).

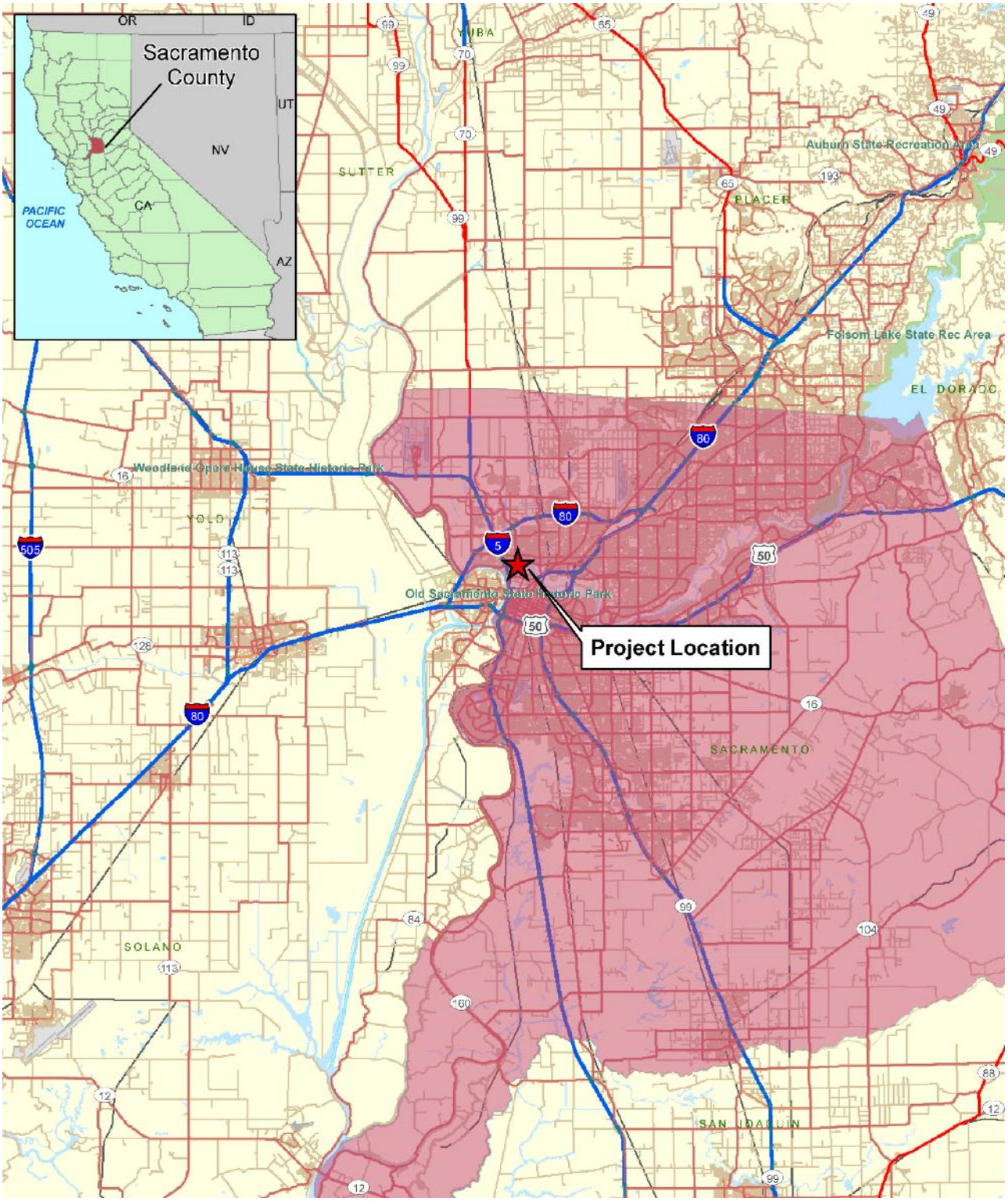


Figure 2 Project Vicinity



Figure 3 Project Location

2. Bridge Cross Section

2.1 Bridge Width Limits

Alternatives for the bridge ranged in width from 63 feet to 116 feet and 2,400 feet to 2800 feet in length. The most recent Planning Studies, dated 10/16/24, are attached to this Assessment. The key differentiator of Alternatives 2 and 3 is these alternatives include extend the bridge section between two existing buildings on Sequoia Pacific Boulevard for approximately 300 feet south of the levee. These buildings are approximately 80 feet apart. Between the buildings, the bridge width is 63 feet for alternative 2 and 74 feet for alternative 3. While the bridge width physically fits between the existing buildings, the impacts to the building's operations during and after construction cannot be understated.

The 16 foot reduction in width was possible by creating a 12 feet wide path (entrance/exit) to the ground tying into the existing trail system located on the south levee of the American River. See Planning Studies included in Appendix A for conceptual path and maintenance access routes at the south end of the bridge.

2.2 Building Impacts

The bridge will be above ground in the area between the two existing buildings. Communication with the building owners and their tenants to understand how they access the buildings and the equipment they use in their business in the area between the buildings will be crucial to a successful outcome.

Communication with the building owners and their tenants to understand how they access the buildings and the equipment they use in the area between the buildings will be crucial to successfully acquire the right of way and temporary construction easements to complete the project. See Appendix B for the project right of way needs for the preferred alternative (Alternative 3). After bridge construction is complete, the space under the bridge will preserve many parking spaces and provide access to the existing entries and roll up doors on the sides of the buildings, however during construction these facilities will be unusable and inaccessible due to falsework and foundation installation. This will require significant outreach and coordination during the later phases of the project delivery.

Additionally, driving forces and vibrations from driven piles or driven temporary casings installed for CIDH piles adjacent to the existing buildings on Sequoia Pacific Boulevard will potentially damage the existing buildings. Oscillated casings or grouted micro piles should be considered at these locations to minimize this potential damage.

2.3 Safety

Since the edge of the bridge will be a few feet away from each of the buildings, it will be important to include a special fence on the edges of the bridge that will preclude people on the bridge from accessing or attempting to access either building.

Bridge construction is anticipated to take 3 years, protected paths under the bridge construction for path users, maintenance vehicles and building tenant access should be included. Using falsework systems typical of highway overpass construction will provide necessary protection of users passing under the bridge, while limiting full closures to placement of protective covers and falsework.

3. PG&E Tower

3.1 Power Lines

Existing high voltage overhead power lines run east and west just south of Steelhead Creek and will cross over the new bridge. It will be very important to design bridge foundations as far away from these lines as possible. The bridge foundations will likely be large diameter concrete piles that are constructed using two 250-feet tall cranes. The bridge foundations on each side of the power lines should be laid out so they provide approximately the same clearance from the lines.

4. Contractor Access

4.1 Access Site

The contractor will need numerous locations to access the site. The main roadways at each end of the project are Richards Boulevard on the south end and Garden Highway on the north end, with Discovery Park in between. The American River and Steelhead Creek also create gaps in the contractor's access that will need to be improved.

The contractor will need numerous locations to access the site. The main roadways at each end of the project are Richards Boulevard on the south end and Garden Highway on the north end, with Discovery Park in between. The American River and Steelhead Creek also create gaps in the contractor's access that will need to be improved. Numerous access points and paths of travel for the contractor and their suppliers should be identified and evaluated. Cranes, large trucks with trailers, concrete trucks, pickups, and large trailered holding tanks for the slurry circulation will need to get to all areas currently separated by the river and creek. Identifying these contractor routes will dramatically improve bidding and the results. Also, a project of this magnitude will need an area for the Contractor to set up their on-site office. No site is obvious from looking at project exhibits and aerials. A few viable locations for a field office and yard should be identified and evaluated. Ultimately, large staging areas in the flood plain as well as access trestles over the American River and Steelhead Creek will be required. The environmental study area is included in Appendix C details a large footprint to account for this access. The *Environmental Document Memorandum* also outlines all regulatory permits that will be required for the temporary and permanent impacts associated with the project.

The bridge spans the American River and includes four (4) sets of piers in the water, or close to the water's edge. Performing the bridge construction will require a temporary trestle for the contractor to use to build foundations and the bridge portion over the water. Coffer dams or oscillated casings with circulated slurry and baker tanks for dewater for foundation and column installation will be required in addition to the trestle and falsework over the water. This construction will be limited by flood control and fish windows, generally restricting in water work to a June to October work window. Working day schedules developed during the later phases of the project delivery must properly account for this restricted in-water work window.

4.2 Construction in American River and Steelhead Creek

The bridge spans the American River and includes four (4) sets of piers in the water, or close to the water's edge. Performing the bridge construction will require a temporary trestle for the contractor to use to build foundations and the bridge portion over the water. Coffer dams or oscillated casings with circulated slurry and baker tanks for dewater for foundation and column installation will be required in addition to the trestle and falsework over the water. This construction will be limited by flood control and fish windows, generally restricting in water work to a June to October work window. Working day schedules developed during the later phases of the project delivery must properly account for this restricted in-water work window.

5. Light Rail

5.1 Systems

It is anticipated that the bridge will eventually carry electric powered Light Rail vehicles which require substantial amounts of ducting, cables in and on the bridge, access hatches and special large penetrations into the bridge to allow the systems to rise from the ground and into the bridge at various locations. Provisions to run these elements up bridge columns and create blockouts as large as 2 feet by 3 feet in the soffit of the bridge and bents caps and diaphragms will need to be made. These same elements are also placed in the ground along the alignment. With the American River and Steelhead Creek as obstacles, the systems will need to be entirely carried by the bridge, which increases the impacts on the bridge and bridge design by increasing the numbers of penetrations. Design and layout of all of these Systems will be critical to the design of the bridge and should be determined as soon as feasible.

5.2 Stray Currents

With electric power for the trains, the bridge will need to include provisions for stray currents. Special welding of reinforcing in the bridge and columns along with monitoring equipment must be incorporated in the design.

5.3 Light Rail Tracks

The bridge will include two sets of tracks for future Light Rail vehicles on the bridge deck. In the interim these lanes will be used as a Bus Rapid Transit (BRT) lane. Sacramento Regional Transit (SacRT) requires track plinths to be placed with the bridge construction. To facilitate use of these lanes by busses until the Light Rail is extended to the project area, the track plinths can be covered with precast deck panels. Additionally, SacRT requires foundations for the Overhead Catenary System (OCS) poles to be installed with the bridge construction. The anchors for these poles can be embedded in the median barrier. See Figure 4 below.

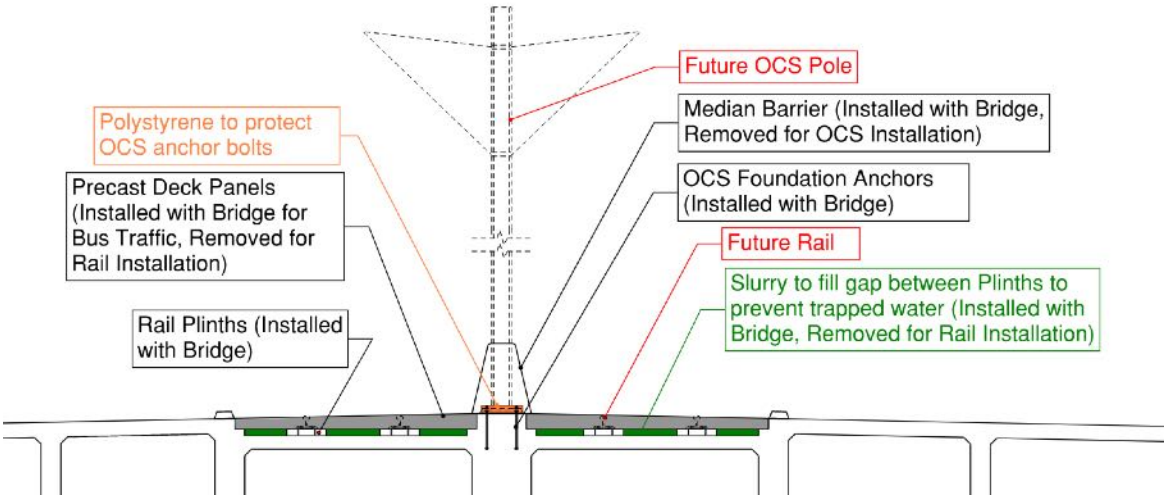


Figure 4 SacRT Light Rail Infrastructure Installation Concept

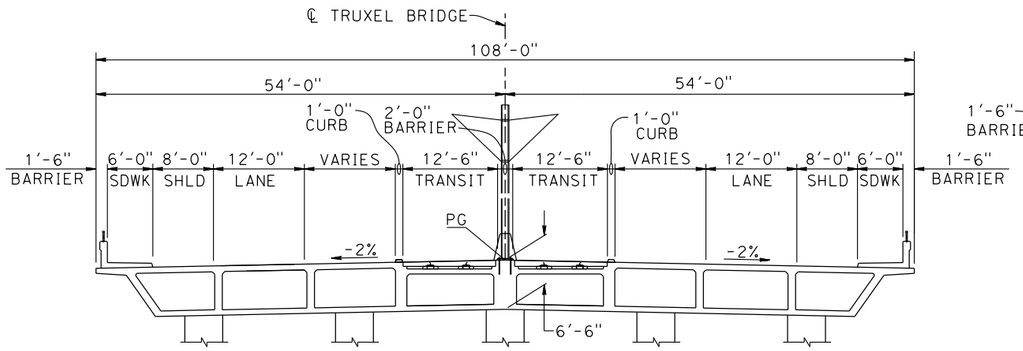
Appendix A. Planning Studies

PREPARED FOR THE CITY OF SACRAMENTO - DEPARTMENT OF PUBLIC WORKS

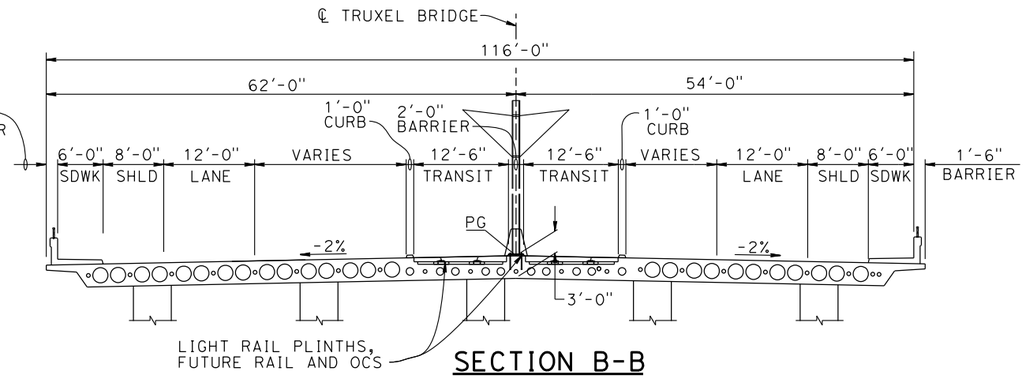
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CITY OF SACRAMENTO
915 I STREET
SACRAMENTO, CA 95814

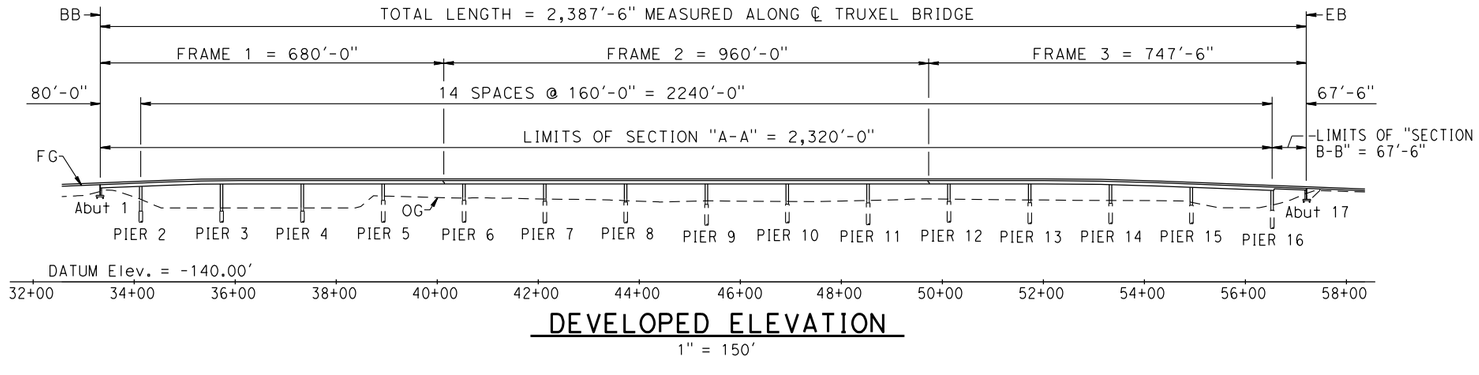
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110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630



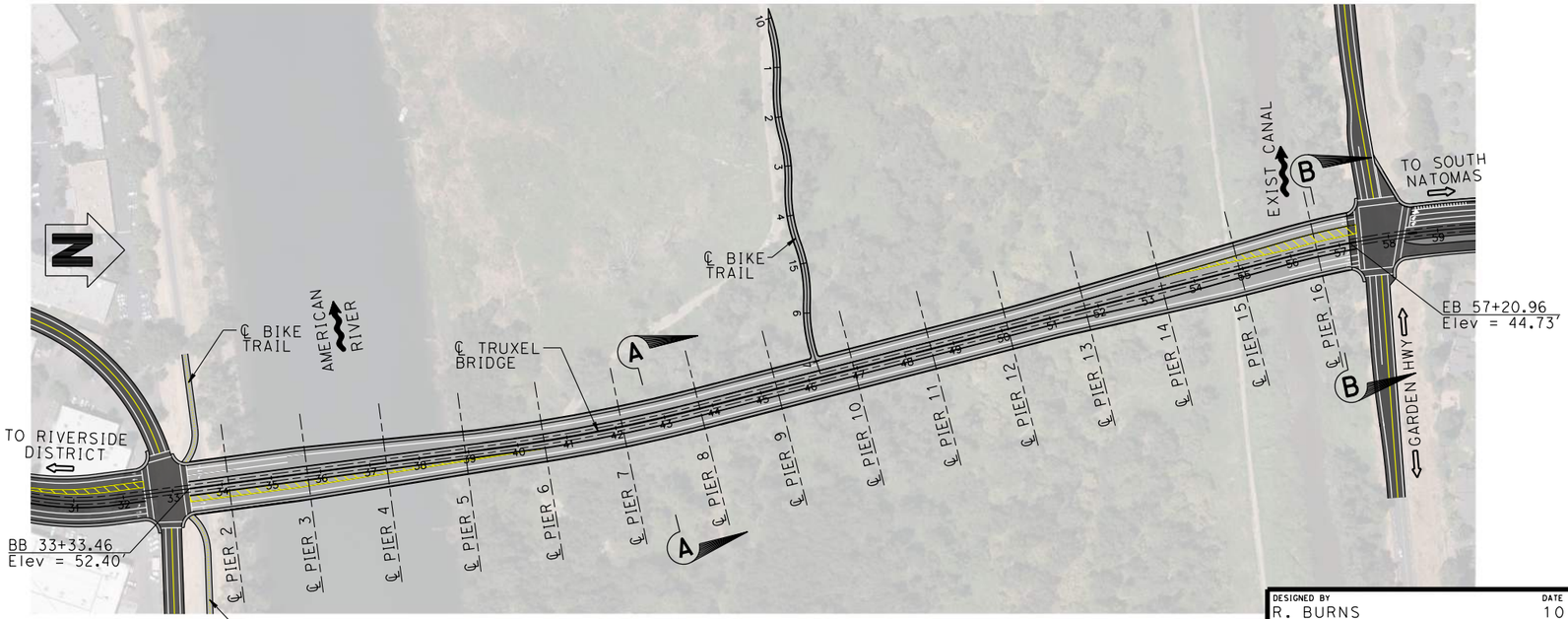
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SECTION B-B
1" = 10'



DEVELOPED ELEVATION
1" = 150'



PLAN
1" = 150'

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STRUCTURE DEPTH	=	6'-6"/3'-0"
LENGTH	=	2387'-6"
MAX WIDTH*	=	116'-0"
AREA*	=	222,953 sqft
COST/ SQ FT	=	$560.66
TOTAL COST**	=	**$125,000,000**

TOTAL W/ 25% CONTINGENCY & 10% MOBILIZATION
$172,000,000

* WIDTH VARIES, AREA USED ACCOUNTS FOR VARYING WIDTH.

** THE BRIDGE DESIGN PHYSCALLY FITS ADJASCENT TO THE EASTERN BUILDING ON ON SEQUOIA PACIFIC BOULEVARD, BUT WILL SIGNIFICANTLY IMPACT ACCESSIBILITY, UTILITY AND OPERATIONS OF THE BUILDING THAT WILL RESULT IN ADDITIONAL PROJECT COSTS. THESE COSTS ARE NOT INCLUDED IN THE ESTIMATE ABOVE.

DESIGNED BY: R. BURNS	DATE: 10/16/24	R. BURNS, PROJECT ENGINEER	**PLANNING STUDY (ALTERNATIVE 1)**
DRAWN BY: M. HENDRY	DATE: 10/16/24		**TRUXEL BRIDGE CONCEPT AND FEASIBILITY STUDY**
CHECKED BY: J. NOTTNAGEL	DATE: 10/16/24		BRIDGE No.: TBD
APPROVED: P. DALCIN-WALLING	DATE: 10/16/24		PROJECT EA: N/A / PROJECT No. & PHASE: N/A

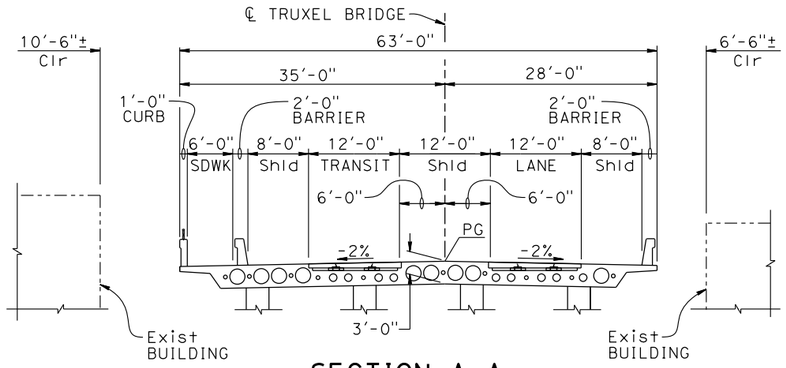
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PREPARED FOR THE CITY OF SACRAMENTO - DEPARTMENT OF PUBLIC WORKS

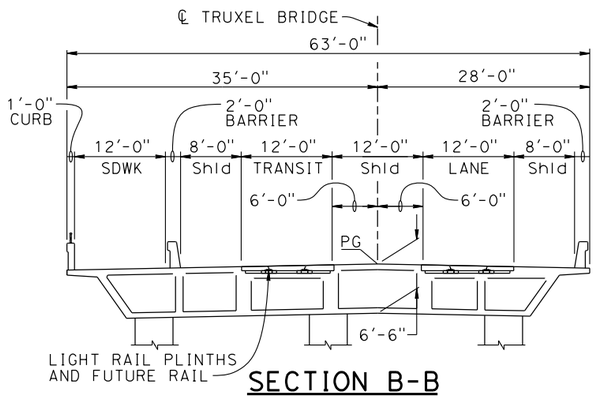
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03	SAC	LOCAL	N/A

CITY OF SACRAMENTO
915 I STREET
SACRAMENTO, CA 95814

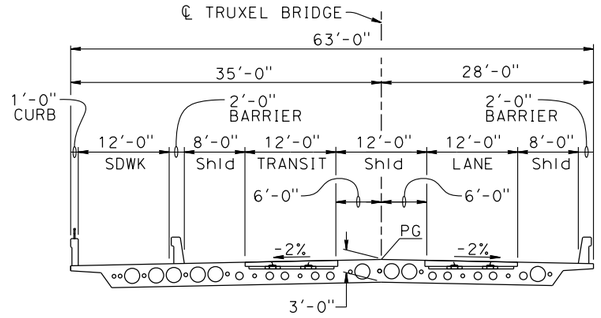
DOKKEN ENGINEERING
110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630



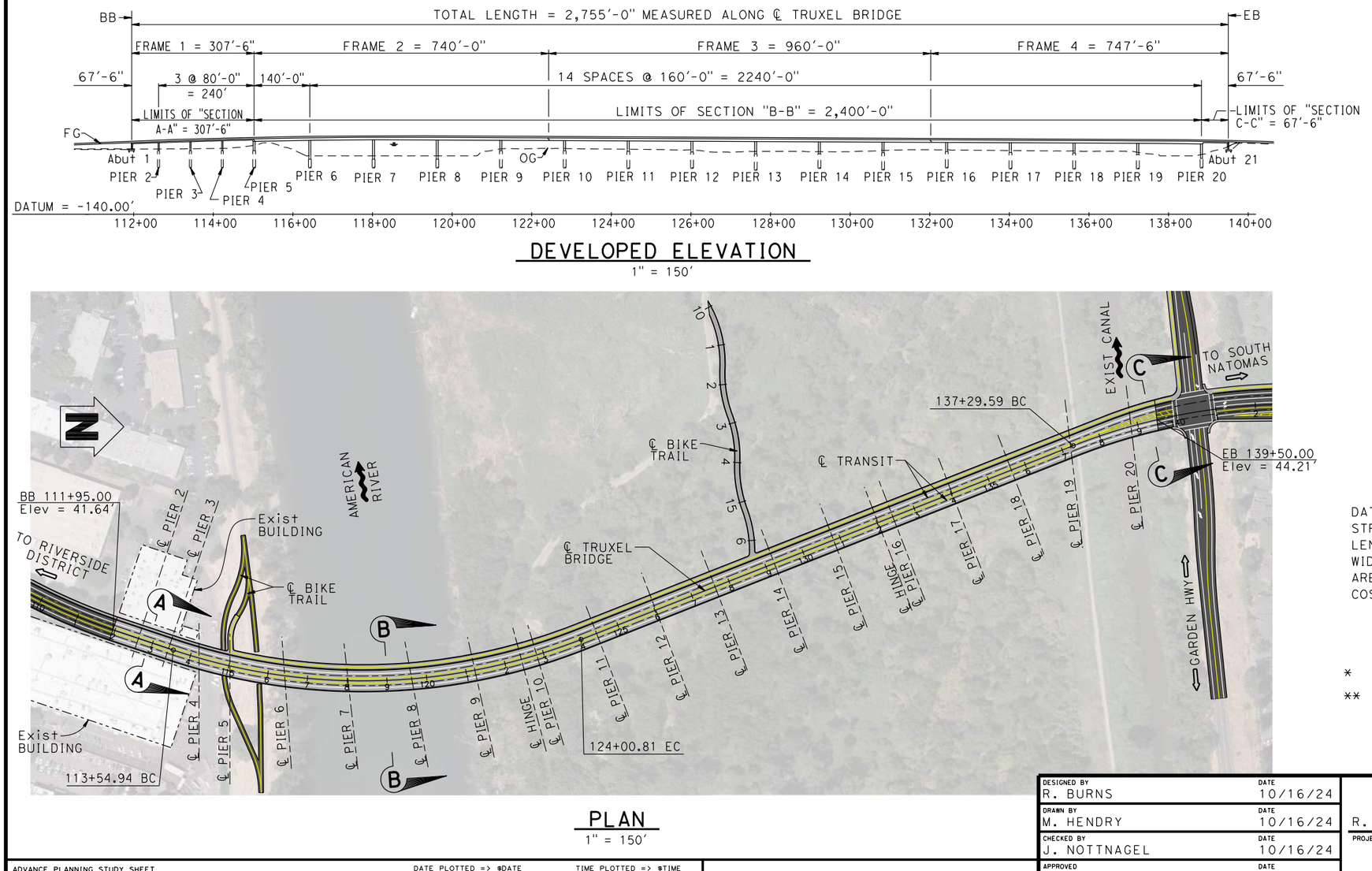
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SECTION B-B
1" = 10'



SECTION C-C
1" = 10'



DEVELOPED ELEVATION
1" = 150'

PLAN
1" = 150'

DATE OF ESTIMATE	=	10-16-2024
STRUCTURE DEPTH	=	6'-6"/3'-0"
LENGTH	=	2755'-0"
WIDTH*	=	63'-0"
AREA*	=	190,406 sqft
COST/ SQ FT	=	$577.71
TOTAL COST**	=	**$110,000,000**

TOTAL W/ 25% CONTINGENCY & 10% MOBILIZATION
$151,000,000

* AREA USED ACCOUNTS FOR SOUTHERN TRAIL CONNECTION.

** THE BRIDGE DESIGN PHYSCALLY FITS ADJASCENT TO THE EASTERN BUILDING ON ON SEQUOIA PACIFIC BOULEVARD, BUT WILL SIGNIFICANTLY IMPACT ACCESSIBILITY, UTILITY AND OPERATIONS OF THE BUILDING THAT WILL RESULT IN ADDITIONAL PROJECT COSTS. THESE COSTS ARE NOT INCLUDED IN THE ESTIMATE ABOVE.

DESIGNED BY R. BURNS	DATE 10/16/24	R. BURNS, PROJECT ENGINEER
DRAWN BY M. HENDRY	DATE 10/16/24	
CHECKED BY J. NOTTNAGEL	DATE 10/16/24	
APPROVED P. DALCIN-WALLING	DATE 10/16/24	

PLANNING STUDY (ALTERNATIVE 2)

TRUXEL BRIDGE CONCEPT AND FEASIBILITY STUDY

BRIDGE No.: TBD

PROJECT EA: N/A

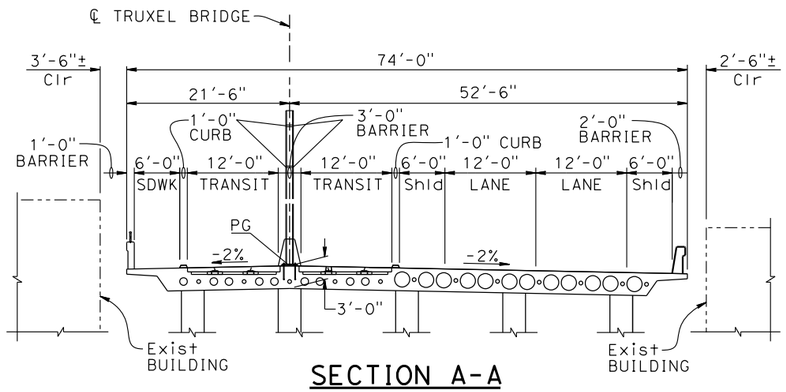
PROJECT No. & PHASE: N/A

PREPARED FOR THE CITY OF SACRAMENTO - DEPARTMENT OF PUBLIC WORKS

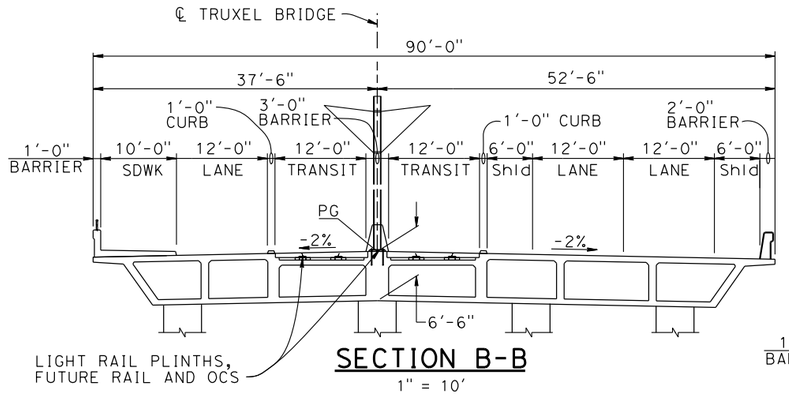
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03	SAC	LOCAL	N/A

CITY OF SACRAMENTO
915 I STREET
SACRAMENTO, CA 95814

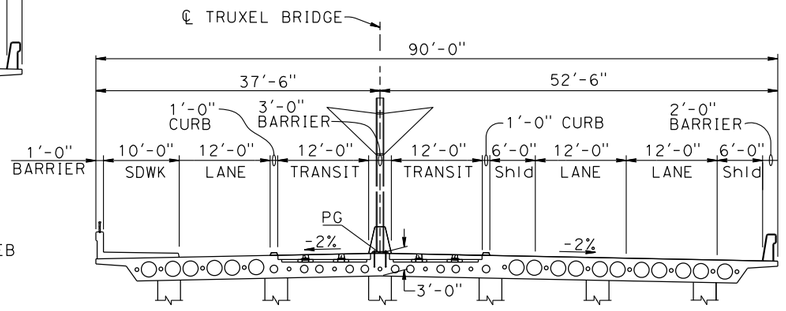
DOKKEN ENGINEERING
110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630



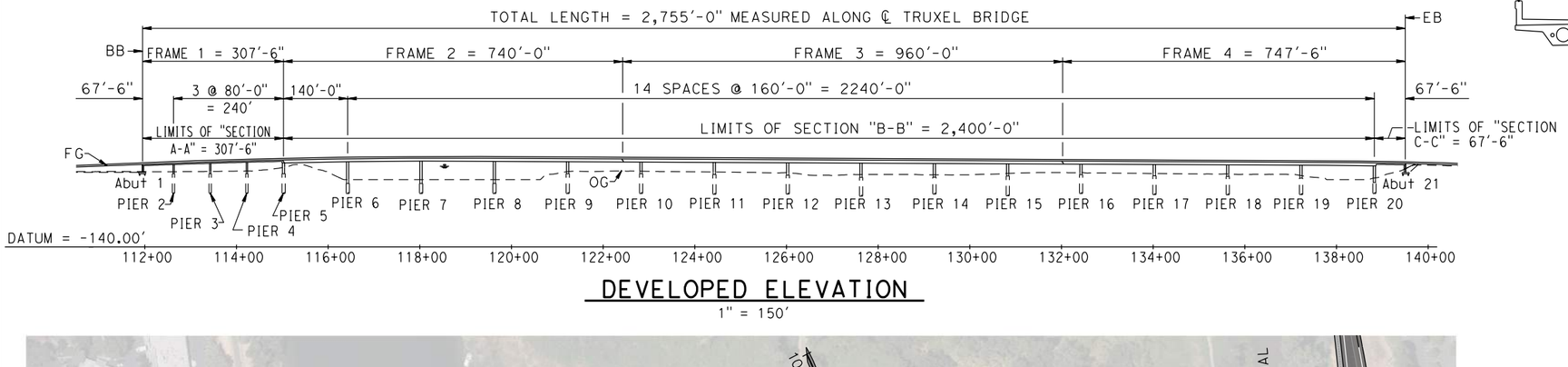
SECTION A-A
1" = 10'



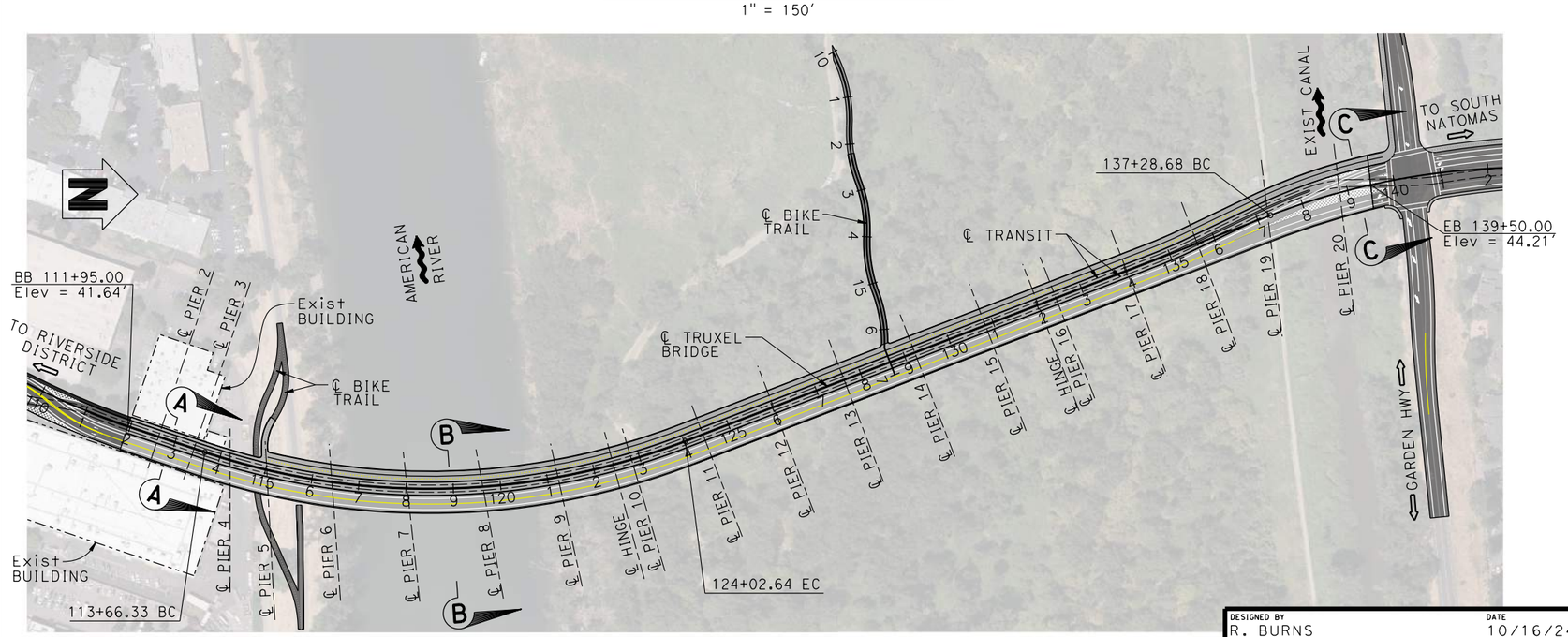
SECTION B-B
1" = 10'



SECTION C-C
1" = 10'



DEVELOPED ELEVATION
1" = 150'



PLAN
1" = 150'

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LENGTH	=	2755'-0"
MAX WIDTH*	=	90'-0"
AREA*	=	251,937 sqft
COST/ SQ FT	=	$555.69
TOTAL COST**	=	**$140,000,000**

TOTAL W/ 25% CONTINGENCY & 10% MOBILIZATION
$193,000,000

* WIDTH VARIES, AREA USED ACCOUNTS FOR VARYING WIDTH.

** THE BRIDGE DESIGN PHYSCALLY FITS ADJASCENT TO THE EASTERN BUILDING ON ON SEQUOIA PACIFIC BOULEVARD, BUT WILL SIGNIFICANTLY IMPACT ACCESSIBILITY, UTILITY AND OPERATIONS OF THE BUILDING THAT WILL RESULT IN ADDITIONAL PROJECT COSTS. THESE COSTS ARE NOT INCLUDED IN THE ESTIMATE ABOVE.

DESIGNED BY R. BURNS	DATE 10/16/24	R. BURNS, PROJECT ENGINEER
DRAWN BY M. HENDRY	DATE 10/16/24	
CHECKED BY J. NOTTNAGEL	DATE 10/16/24	
APPROVED P. DALCIN-WALLING	DATE 10/16/24	

PLANNING STUDY (ALTERNATIVE 3)

TRUXEL BRIDGE CONCEPT AND FEASIBILITY STUDY

BRIDGE No.: TBD

PROJECT EA: N/A

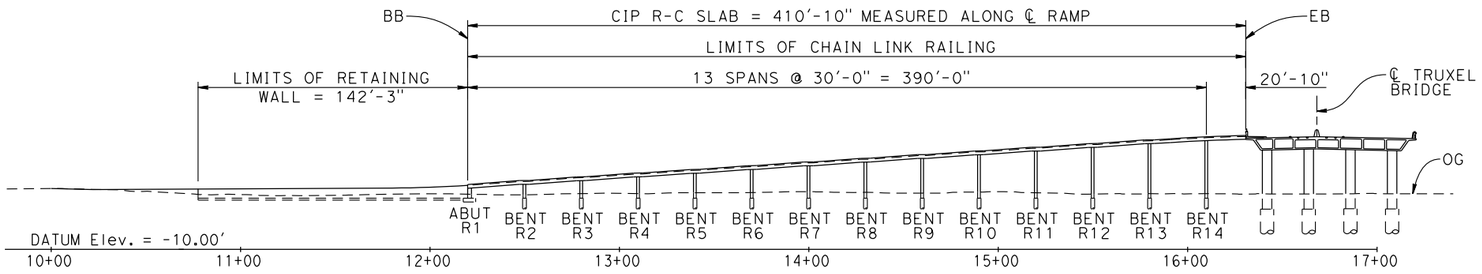
PROJECT No. & PHASE: N/A

PREPARED FOR THE CITY OF SACRAMENTO - DEPARTMENT OF PUBLIC WORKS

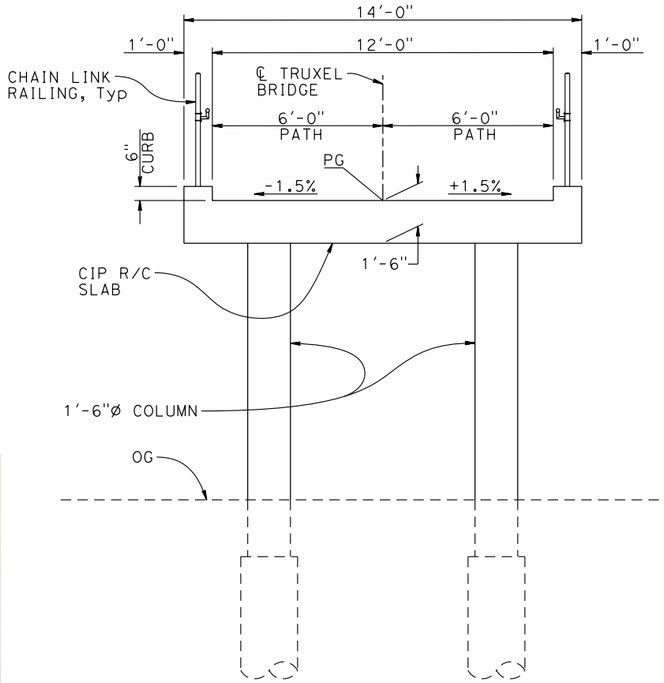
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03	SAC	LOCAL	N/A

CITY OF SACRAMENTO
915 I STREET
SACRAMENTO, CA 95814

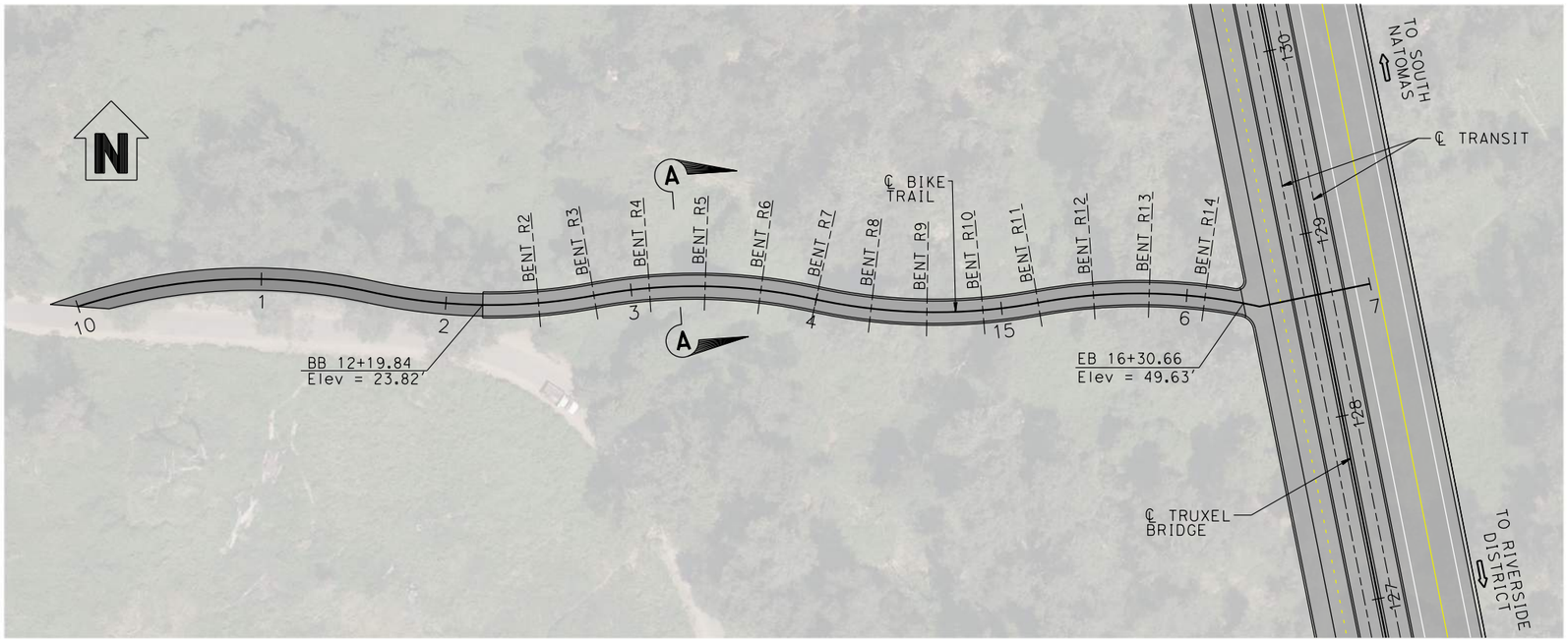
DOKKEN ENGINEERING
110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630



DEVELOPED ELEVATION
1" = 40'



SECTION A-A
3/8" = 1'-0"



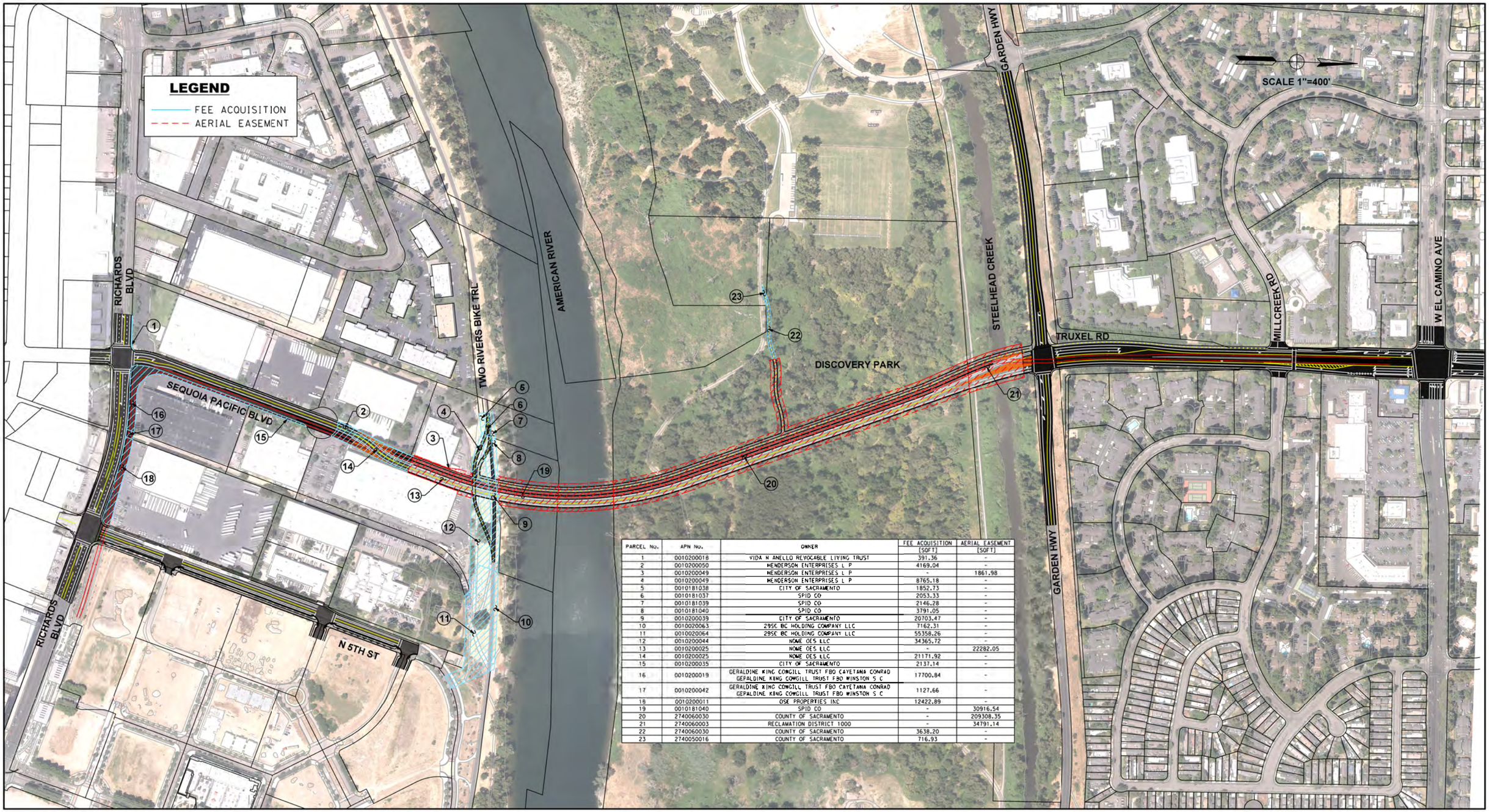
PLAN
1" = 40'

DATE OF ESTIMATE	=	10-16-2024
STRUCTURE DEPTH	=	1'-6"
LENGTH	=	410'-10"
WIDTH	=	14'-0"
AREA	=	4,103 sqft
COST/ SQ FT	=	$1,218.62
TOTAL COST	=	**$5,000,000**

TOTAL W/ 25% CONTINGENCY & 10% MOBILIZATION
$6,900,000

DESIGNED BY: R. BURNS	DATE: 10/16/24	R. BURNS, PROJECT ENGINEER	**PLANNING STUDY (BIKE TRAIL BRIDGE)**
DRAWN BY: M. HENDRY	DATE: 10/16/24		**TRUXEL BRIDGE CONCEPT AND FEASIBILITY STUDY**
CHECKED BY: J. NOTTNAGEL	DATE: 10/16/24		BRIDGE No.: TBD
APPROVED: P. DALCIN-WALLING	DATE: 10/16/24		PROJECT EA: N/A / PROJECT No. & PHASE: N/A

Appendix B. Right of Way Exhibit



PARCEL No.	APN No.	OWNER	FEE ACQUISITION [SQFT]	AERIAL EASEMENT [SQFT]
1	0010200018	VIDA N ANELLO REVOCABLE LIVING TRUST	391.36	-
2	0010200050	HENDERSON ENTERPRISES L P	4169.04	-
3	0010200049	HENDERSON ENTERPRISES L P	-	1861.98
4	0010200049	HENDERSON ENTERPRISES L P	8765.18	-
5	0010181038	CITY OF SACRAMENTO	1852.73	-
6	0010181037	SPID CO	2053.33	-
7	0010181039	SPID CO	2146.28	-
8	0010181040	SPID CO	3791.05	-
9	0010200039	CITY OF SACRAMENTO	20703.47	-
10	0010020063	295C BC HOLDING COMPANY LLC	7162.31	-
11	0010020064	295C BC HOLDING COMPANY LLC	55358.26	-
12	0010200044	NCWE OES LLC	34365.72	-
13	0010200025	NCWE OES LLC	-	22282.05
14	0010200025	NCWE OES LLC	21171.92	-
15	0010200035	CITY OF SACRAMENTO	2137.14	-
16	0010200019	GERALDINE KING CONGILL TRUST FBO CAYETANA CONRAD GERALDINE KING CONGILL TRUST FBO WINSTON S C	17700.84	-
17	0010200042	GERALDINE KING CONGILL TRUST FBO CAYETANA CONRAD GERALDINE KING CONGILL TRUST FBO WINSTON S C	1127.66	-
18	0010200011	OSE PROPERTIES INC	12422.89	-
19	0010181040	SPID CO	-	30916.54
20	2740060030	COUNTY OF SACRAMENTO	-	209308.35
21	2740060003	RECLAMATION DISTRICT 1000	-	34791.14
22	2740060030	COUNTY OF SACRAMENTO	3638.20	-
23	2740050016	COUNTY OF SACRAMENTO	716.93	-

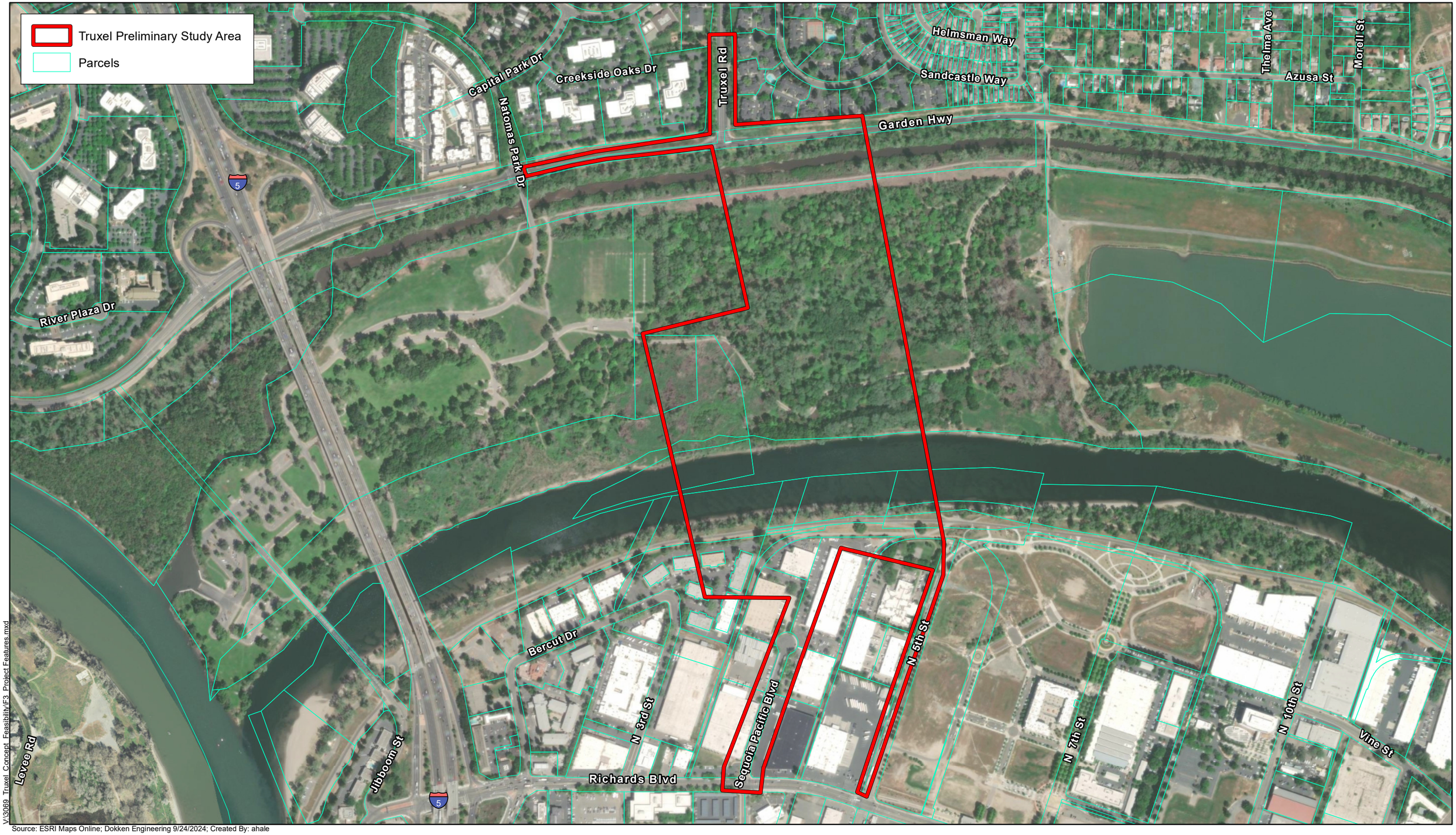
DOKKEN ENGINEERING
110 BLUE RAVINE ROAD, SUITE 200
FOLSOM, CA 95630
PH: 916-858-0642 FAX:916-858-0643

TRUXEL BRIDGE CONCEPT & FEASIBILITY STUDY

ALTERNATIVE 3
RIGHT OF WAY EXHIBIT

JULY 2024

Appendix C. Project Footprint



V:\3069_Truxel_Concept_Feasibility\F3_Project Features.mxd

Source: ESRI Maps Online; Dokken Engineering 9/24/2024; Created By: ahale

1 inch = 550 feet

0 550 1,100 1,650 2,200 2,750 Feet

FIGURE 3
Project Footprint
Truxel Bridge Concept and Feasibility Study
City of Sacramento, Sacramento County, California

Attachment R. Funding Strategy



Truxel Bridge

Concept and Feasibility Study

Funding Strategy Memo

July 2024

City of SACRAMENTO

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Table of Abbreviations

Abbreviation	Spelling	Abbreviation	Spelling
ADA	Americans with Disabilities Act	IFP	Infrastructure Financing Plan
BAB	Build America Bureau	IIJA	Infrastructure Investment and Jobs Act
BCA	Benefit-Cost Analysis	ISRF	Infrastructure State Revolving Fund
BRT	Bus Rapid Transit	LRT	Light Rail Transit
CalSTA	California State Transportation Agency	NEPA	National Environmental Policy Act (NEPA)
Caltrans	California Department of Transportation	NOFO	Notice of Funding Opportunities
CAPTI	Climate Action Plan for Transportation Infrastructure	PA&ED	Project Approval & Environmental Documentation
CARB	California Air Resource Board	PLBP	Priority Legislative Budget Projects
CEQA	California Environmental Quality Act	PS&E	Plans, Specifications, and Estimates
CFP	Call for Projects	RAISE	Rebuilding American Infrastructure with Sustainability and Equity
CIG	Capital Investment Grants	RIA	Regional Infrastructure Accelerator
CMAQ	Congestion Mitigation and Air Quality	ROW	Right-of-Way
CM/GC	Construction Manager/General Contractor	RTPA	Regional Transportation Planning Agencies
CPFCDS	Community Project Funding/Congressionally Directed Spending	SACOG	Sacramento Area Council of Government
CTC	California Transportation Commission	SacRT	Sacramento Regional Transit District
DB	Design-Build	SCCP	Solution for Congested Corridor Program
DBB	Design-Bid-Build	SHS	State Highway System
DOT	Department of Transportation	SIB	State Infrastructure Bank
EIFD	Enhanced Infrastructure Financing District	SMF	Sacramento International Airport
EIR	Environmental Impact Report	STA	Sacramento Transportation Authority
EJ	Environmental Justice	STBG	Surface Transportation Block Grant Program
ETC	Equitable Transportation Community	STIP	State Transportation Improvement Program
FHWA	Federal Highway Administration	SVS	Sacramento Valley Station
FTA	Federal Transit Administration	TIF	Tax Increment Financing
GHG	Greenhouse Gas	TIFIA	Transportation Infrastructure Finance and Innovation Act
GO	General Obligation	TIRCP	Transit & Intercity Rail Capital Program
HFT	High-Frequency Transit	TOD	Transit-Oriented Development
ICE	Independent Cost Estimator	USDOT	United States Department of Transportation
		VMT	Vehicle Miles Traveled

Executive Summary

The Truxel Bridge project has the potential to significantly transform how people travel between Natomas and the Central City in the City of Sacramento (the City). The future multimodal bridge will connect the two growing parts of Sacramento, mitigating the substantial mobility barrier that is the American River and providing more convenient, direct access to destinations and activity centers on both sides of the river. At the same time, a new crossing will enable Sacramento Regional Transit District (SacRT) to extend the long-awaited Green Line Light Rail Transit (LRT) or Bus Rapid Transit (BRT) Extension into Natomas, creating a new high-frequency transit (HFT) corridor that expands access to affordable transportation options and increases transit ridership in Natomas. Furthermore, the Truxel Bridge and the associated HFT corridor are an important component of the Sacramento Area Council of Government's (SACOG's) regional transit vision, and future HFT into Natomas and eventually the Sacramento Internation Airport (SMF) will help the region meet its Greenhouse Gas (GHG) emissions reduction and land use goals.

To move this transformative project forward, the City must have a strategy to acquire the necessary funds to advance each phase of project delivery. This Funding Strategy Memo was developed to help the City understand what funding and financing assistance exists and how to coordinate with key partners to position the Truxel Bridge project to successfully acquire those funding and/or financing sources. This funding strategy also contains brief sections about alternative financing and delivery models, but additional analysis is required from the City to explore those options in greater depth. Finally, this funding strategy is not meant to be a static document, and it will need to evolve with changes in funding programs, partners' needs, legislation and policy, the economy, and the political environment. This memo is the start of what will be a living document. To accomplish the goals of this funding strategy, the document includes the following sections:

10,000-Foot Overview of Funding for Each Phase of the Truxel Bridge Project contains a table that simplifies what funding sources can be applied to each phase and potential award sizes. It is meant to be updated regularly, and the first draft is not a specific recommendation, especially given that there is no guarantee of what programs will exist when the Truxel Bridge project is ready to pursue construction funds. This section also contains a flow chart of potential funding decisions and options for the Truxel Bridge project and a breakdown of the components of a project funding strategy.

Funding Needs for Truxel Bridge provides a brief overview of the funds required to deliver each phase of the project. Current cost estimates are $6 million for Project Approval & Environmental Documentation (PA&ED), $14 million for final design, and $501 million for construction.

Overview of Potential Funding and/or Financing Scenarios proposes four theoretical scenarios based on whether the project only pursues discretionary sources or receives Federal Transit Administration (FTA) and/or financing assistance.

Partner Coordination assesses the roles of current and potential partners in pursuing funding for the Truxel Bridge and insights from previous engagements with those partners. Some of the partners have not yet been formally engaged during the development of this funding strategy.

Identify and Track Funding Sources reviews the existing local, regional, state, and federal funding sources that could potentially assist the Truxel Bridge project. There are a limited number of discretionary funding sources that the Truxel Bridge project could be eligible for, and all of them have been oversubscribed in the past. High-cost projects must piece together awards from multiple funding programs, and even "highly recommended" projects are often not awarded funds until the second or third application. In addition, there is always an uncertainty of what the funding landscape will look like in the future as new legislation is passed, policies evolve, and new elected officials enter office.

Align the Project with How Funding Decisions are Made provides considerations and insights to position the Truxel Bridge project for success before pursuing discretionary programs, overviews the importance of aligning the project with existing plans and policies, and calls out key strengths of the Truxel Bridge project with consideration to existing funding programs. High-cost projects must adequately demonstrate exceptional benefits and performance outcomes to compete in the discretionary funding landscape.

Alternative Project Financing Models introduce potential project financing options and value capture mechanisms the City could consider to fill large funding gaps and expedite project delivery. The strategy does not recommend a specific type of project financing without further analysis.

Alternative Project Delivery Models briefly summarizes the available project delivery models for the Truxel Bridge project. Alternative delivery models have the potential to reduce project costs and the delivery timeline, but there are many factors the City needs to consider before determining what is suitable for the Truxel Bridge project.

Key Takeaways for the Truxel Bridge Funding Strategy:

1. **Addressing the reality of the current funding landscape relative to the Truxel Bridge's funding needs:** Projecting the existing discretionary funding landscape into the future, funding the construction phase of the Truxel Bridge will be challenging without FTA investment (which requires SacRT to advance the Green Line Extension/HFT project in parallel with the Truxel Bridge), project financing, or another local sales tax measure. However, there is always the possibility of greater state and federal resources in the future, which could result in a more beneficial funding landscape for the Truxel Bridge project.

2. **What makes the Truxel Bridge a fundable project:** Considering the very high cost of the project and the direction of state funding policies, the Truxel Bridge's greatest strength as a project is that it will be a multimodal bridge with transit-priority infrastructure and accommodate a future HFT service between the Central City and Natomas, and eventually to the airport. Compared to driving and active modes, HFT across the Truxel Bridge is more likely to result in project performance metrics and impacts that are strongly aligned with existing funding policy (i.e., access to affordable travel options, increased transit ridership, reduced vehicle miles traveled (VMT), reduced GHG emissions, etc.), especially given the high project cost. Emphasizing the beneficial local and regional impacts of extending HFT into Natomas is critical to increasing the project's competitiveness in a crowded funding landscape. The City will need to gain more insight into SacRT's project delivery timeline for HFT to Natomas (whether that is the Green Line or an interim BRT service) and how it will be funded.

3. **FTA funds could be available in the future, but it depends on SacRT's readiness:** Bundling SacRT's Green Line Extension/HFT project across the bridge and the Truxel Bridge project could help the City access FTA funds, which in an optimal scenario, could fund a share of the bridge's construction cost. SacRT would need to be willing to coordinate with the City to advance the HFT project into FTA's Capital Improvement Grants (CIG) New Starts Program at some point in the future, and at this moment in time, there is no certainty as to how much FTA funds would go towards the Truxel Bridge project. In addition, FTA's CIG Program considers factors such as projected ridership and transit-supportive land uses to determine if a project is eligible for funding.

4. **Fostering a shared vision for delivering the Truxel Bridge and Green Line Extension/HFT projects will benefit both projects in the long term:** The Truxel Bridge and Green Line Extension/HFT projects are unique in that they are two high-cost projects closely linked in terms of funding and project delivery outcomes. An inter-agency working group, quarterly inter-agency meetings, or similar forum for communication and collaboration could benefit both projects. The intention of such a forum is to ensure all parties are informed about short- and long-term project delivery goals, improve project delivery coordination and inter-agency relations, maintain clarity about project funding efforts, and develop a shared vision for how the two projects can be funded and delivered.

Truxel Bridge Funding Strategy Memo

What is a Funding Strategy?

In the United States (U.S.), local governments are allocated state and federal assistance to fund transportation needs, from project planning and design to construction and maintenance. However, these funds must be distributed to numerous projects and programs that serve many communities and modes of transportation. There is limited local financial capacity to deliver high-cost capital projects, such as the Truxel Bridge project. To ensure our communities have the resources to advance transformative transportation projects, additional assistance is available through competitive state and federal funding programs, and for certain projects, financing can also be a viable option.

The funding strategy has been developed to identify potential funding and financing options for each phase of project delivery. The funding strategy provides an overall approach to aligning key partners, leveraging locally available resources, and positioning the Truxel Bridge project for the regional, state, and federal funding programs that can help advance this project.

Funding strategies for large projects that will take a decade or longer to deliver must also be able to evolve. New legislation and policy initiatives at the state and federal levels will eventually be enacted, the needs and priorities of key partners may change, and other external factors, such as changes in political leadership and the economy, influence the availability of transportation funding as well. This memo is the start of a living Funding Strategy Memo.

The Funding Challenge: Most state and federal funding programs are oversubscribed, and even highly beneficial projects must apply to programs multiple times to be awarded funds. Due to this scarcity, high-cost projects must demonstrate exceptional benefits and performance outcomes to be competitive for funding assistance. In addition, most discretionary programs can only fund a portion of the total project cost, requiring projects to piece together funds from various local, regional, state, and federal sources.

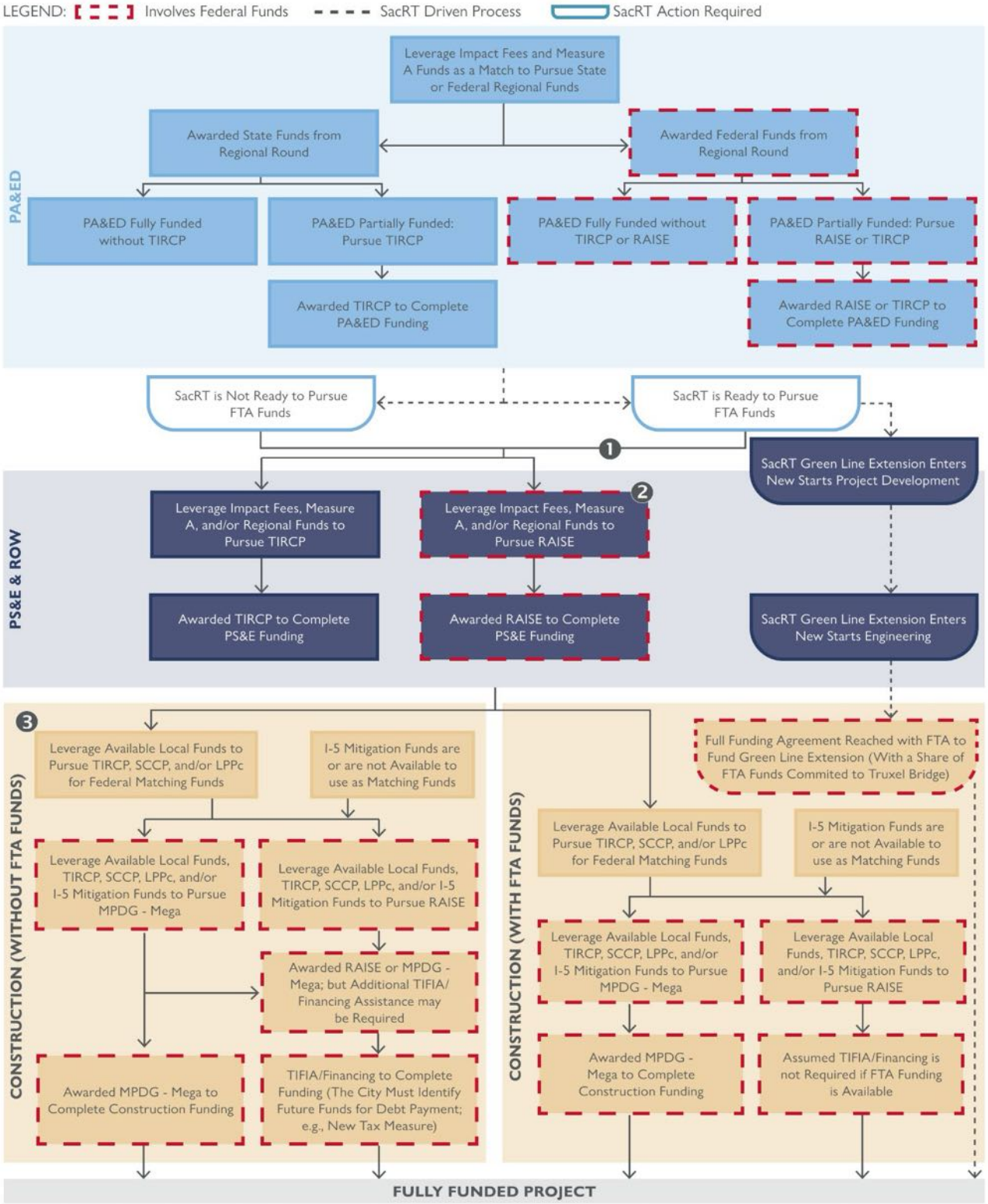
10,000-Foot Overview of Funding for Each Phase of the Truxel Bridge Project

Table 1 represents possible funding sources based on Scenario 1 (see *Overview of Potential Funding and/or Financing Scenarios*) and assumes the City does not pursue state or federal funding for PA&ED, financing is not a viable option, earmarked funds are not allocated, and that SacRT and Caltrans are not a funding partner. The dollar amounts are not recommendations but examples of how the funding could be pieced together from multiple discretionary programs in a favorable funding environment. The dollar amounts for state and federal programs represent the medium to higher award sizes for somewhat similar projects (bridges/transit extensions), and the Measure A values are based on estimates provided by the City. The federal share for construction in this example is ~60%, but that could be increased. This table should be updated regularly as the City advances the project.

Table 1. Overview of funding sources for each phase of the Truxel Bridge project. Values are in millions (M).

Source	PA&ED (~$6M)	Final Design (~$14M)	Construction (~$501M)
Local	*Impact Fees ($3M) *Measure A ($2M)	*Impact Fees ($2.4M) *Measure A ($2.6M)	*Measure A ($20M)
State Funds	SACOG Funding Round ($1M) CalSTA TIRCP	*SACOG Funding Round ($2M) CalSTA TIRCP ($7M)	**CalSTA TIRCP ($111M) **CTC SCCP ($45M) **CTC LPPc ($25M)
Non-FTA Federal Funds	USDOT RAISE	USDOT RAISE	SACOG Funding Round ($5M) USDOT MPDG Mega ($270M) USDOT RAISE ($25M)
FTA Funds	-	-	-
Financing	-	-	-

*Local matching funds to pursue state or federal programs. **State matching funds to pursue federal programs.



❶ Even if SacRT is ready to pursue FTA funds, the City's funding strategy doesn't change what funding sources they can pursue. However, the amount of FTA funds committed to Truxel may impact the non-federal match requirement for RAISE and MPDG - Mega.
❷ Note that by the time the City pursues PS&E funding, RAISE could be rebranded with a new program name.
❸ It is generally preferred to pursue state funds before federal funds for construction dollars due to the matching requirements, which is what this flowchart presents. However, that is not a strict requirement, and projects can go back for state dollars after receiving federal assistance.
* This flowchart does not include state or federal earmarks, which could be appropriated to the design and/or construction phases.
* This flowchart assumes Regional Funds will not be available for the construction phase, but the future funding landscape could change that.

Figure 1. Flowchart of potential funding decisions and options for the Truxel Bridge project.

Funding Strategy Components

Figure 1 displays the basic components of a funding strategy and provides the City with a structured approach to identifying, tracking, positioning the project for, and pursuing future funding and/or financing opportunities. *Alternative Financing/Funding Considerations* and *Alternative Delivery Considerations* are optional because they do not apply to every project. Each component will evolve as the funding landscape changes and the City and its partners make more concrete project delivery and funding decisions.

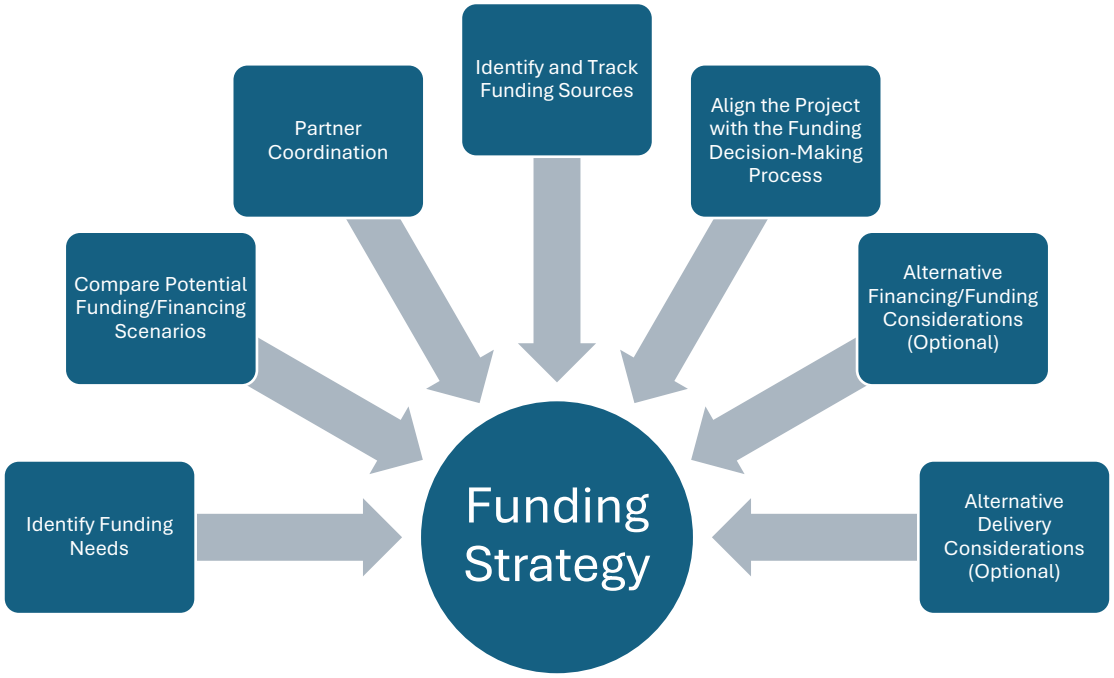


Figure 2. The components of the Truxel Bridge funding strategy.

Funding Needs for Truxel Bridge

Following the completion of the Truxel Bridge Concept and Feasibility Study, the City will need to secure funds for each phase of project delivery moving forward, including PA&ED, Final Design (Plans, Specifications, and Estimates or PS&E), and Capital Construction. With the standard Design-Bid-Build delivery model, funding is usually pursued one phase at a time, but there are alternative delivery models where final design and construction funds can be pursued simultaneously.

Dokken Engineering developed the 10% design cost estimates and schedule for each phase of the Truxel Bridge project. To advance the project on schedule, the City must acquire the necessary funding for each phase before they begin.

Table 2. Truxel Bridge project schedule and cost estimate.

Phase	Timeline	Cost Estimate	*Non-Federal Match (20%)
PA&ED Support (CEQA and NEPA Documentation)	2025-2027	$6.0 Million	$1.2 Million
PS&E (Final Design)	2027-2030	$14.0 Million	$2.8 Million
Capital Construction, ROW, & Construction Support	2031-2034	$500.8 Million	$100.2 Million

*Applies to federal discretionary programs.

Overview of Potential Funding and/or Financing Scenarios

Given that the Truxel Bridge project is still in the pre-environmental phase and the funding strategy will be updated as funding sources evolve, the first draft of this memo presents four broad project funding and/or financing scenarios. The scenarios are based on whether the City decides to pursue financing and whether FTA funds would be committed to the project. In the scenarios with FTA funding, it is assumed that SacRT would receive the FTA New Starts Project Funding Agreement.

	Local & Discretionary Funds Only	**Local & Discretionary Funds + Financing**
No FTA Funding	Scenario 1	Scenario 3
FTA Funding	Scenario 2	Scenario 4

Scenario 1 – Local & Discretionary Funds Only

Scenario 1 would put 100% of the project funding responsibility on the City. SacRT would be a key partner but not a major funding partner.

Benefits	**Challenges**
- The City maintains total ownership of the project delivery and funding acquisition process. - The City does not acquire any long-term debt obligations. - Least complex funding scenario.	- Potentially the longest project delivery timeline, assuming the future state and federal discretionary funding landscape is similar to today. Longer project delivery timelines risk cost increases. - Uncertainty of when SacRT will implement the Green Line Extension/HFT project, potentially impacting the project's competitiveness on grant applications.

Scenario 2 – Local & Discretionary Funds Only (w/ FTA Funding)

Scenario 2 would make the City and SacRT partners in funding and delivering the project. SacRT would likely be the lead agency pursuing the FTA New Starts Project Funding Agreement.

Benefits	**Challenges**
- SacRT has a greater stake in the success of the project's delivery. The City shares some of the project funding burden and risk with SacRT. - Ensures the SacRT Green Line Extension/HFT is delivered somewhat parallel to the Truxel Bridge project, strengthening grant applications. - New BRT services qualify for FTA New Starts funding if SacRT is not ready to deliver LRT. - The City does not acquire any long-term debt obligations.	- Requires SacRT to commit to a HFT project (LRT or BRT) and be willing to pursue FTA funds. - Potentially longer project delivery timeline if SacRT's timeline for pursuing FTA funding is further out than Truxel Bridge's proposed timeline. Longer project delivery timelines risk cost increases. - Receiving a New Starts Funding Agreement can be a long and complex process, and changes in federal legislation could impact funding availability. - Currently, we cannot make explicit assumptions regarding what cost share the Truxel Bridge would receive from FTA. The boldest assumption would be the percentage of right-of-way (ROW) dedicated to transit-priority infrastructure on the bridge, but it could be significantly less.

Scenario 3 – Local & Discretionary Funds + Financing

Scenario 3 is similar to Scenario 1, but the City also pursues project financing options, such as a Transportation Infrastructure Finance and Innovation Act (TIFIA) loan, State Infrastructure Bank (SIB) loan (i.e., IBank), or bonds.

Benefits	Challenges
- The City maintains total ownership of the project delivery and funding acquisition process. - Allows the City to leverage available funding to address funding gaps and expedite project delivery. - Potential to reduce project lifecycle cost. - Delivers project benefits quickly. - Strengthens the project's competitiveness in some discretionary funding applications. - The TIFIA and IBank terms of agreement can be negotiated and provide added flexibility. - Local tax measures can be used to repay TIFIA loans.	- The City acquires long-term debt obligations and would need to identify funds to cover the long-term debt obligations.

Scenario 4 – Local & Discretionary Funding + Financing (w/ FTA Funding)

Scenario 4 is similar to Scenario 2, but the City also pursues project financing options, such as a TIFIA loan, SIB loan, or bonds.

Benefits	Challenges
- Same benefits of Scenario 2, but the City does acquire long-term debt obligations. - Potentially the fastest delivery timeline, assuming SacRT is willing to commit to pursuing FTA New Starts funds in the near future.	- Same challenges as Scenarios 2 and 3. - Most complex scenario.

Partner Coordination

As the project owner, the City is primarily responsible for advancing the project delivery and securing the funds necessary for each phase. However, other government partners will be important in advancing the Truxel Bridge project and supporting the City in pursuing various funding sources.

Partner coordination is critical to funding large, regionally significant transportation projects. Aligning partners' goals and developing broad support for a project results in more competitive grant applications and reduces the potential for inter-agency friction throughout the project delivery process. However, partners' priorities may evolve over time, influencing the City's approach to funding and delivering the project.

Table 3 summarizes each partner's role and/or relevance, key insights from previous engagements with the partners, and relevant plans, policies, or initiatives that may influence how the City pursues funds or crafts the messaging around the project. Some partners have not been formally engaged to discuss funding.

Table 3. Partner information table.

Partner(s)	Role/Relevance	Key Insights from Previous Engagements	Relevant Plans, Policies, or Initiatives
SacRT	• Primary transit operator for Sacramento County. • Plans to deliver the Green Line Extension/HFT into Natomas, which requires the construction of the Truxel Bridge. • Design coordination for transit-priority infrastructure. • Direct FTA funding recipient.	• The City has not formally engaged this partner in project funding discussions yet. • Potential to be a key funding partner. SacRT would likely need to pursue FTA CIG funds to advance the Green Line Extension/HFT into Natomas. • Uncertainty of when SacRT will advance the Green Line Extension/HFT beyond the environmental phase, which impacts the funding strategy for the Truxel Bridge project.	• Green Line Extension EIR/EIS (Program EIR adopted in 2008; updated administrative draft pending).
SACOG	• MPO and RTPA for Sacramento County. • Responsible for long-term transportation and planning and programming initiatives. • Administers state and federal transportation funds (including the upcoming 2025 Regional Funding Program). Future funding rounds can be used to obtain matching funds. • Administers yearly Project Prioritization process (required to receive letters of support/conformity). • Potential partner for pursuing TIRCP grants.	• Believes the project can help achieve regional transit and VMT/GHG reduction goals. • Appreciates the project's potential to overcome a mobility barrier and connect people to jobs/destinations via transit. • Recommends the City to pursue the 2025 Regional Funding Round. • Recommends the City apply to the Regional Project Prioritization Program each cycle. Truxel Bridge applied in 2024 and has been prioritized for RAISE (Planning) 2025. • Concerned about the City having three high-cost bridge projects in the pipeline and uncertain about the City's funding priorities for bridge projects.	• 2025 MTP/SCS • Regional Transit Network Plan • Next-Gen Transit Strategy • Regional Trail Network • Green Means Go Funding Initiative
STA	• Governing and administrative body for Measure A sales tax funds. • Responsible for the existing Measure A Expenditure Plan and the future Expenditure Plan of a voter-approved measure.	• The City has not formally engaged this partner in project funding discussions yet.	• Measure A Expenditure Plan • Yearly Adopted Budgets

Partner(s)	Role/Relevance	Key Insights from Previous Engagements	Relevant Plans, Policies, or Initiatives
Caltrans District 3	• State DOT responsible for the State Highway System (SHS) and coordinating with jurisdictions on local projects impacting the SHS in some capacity. • Develops plans and policies that influence funding decisions. • Truxel Bridge is within the I-5 CMCP study area and will influence traffic patterns along the I-5 corridor. • Truxel Bridge can potentially serve as a VMT mitigation measure for the I-5 Managed Lanes Project, led by Caltrans District 3.	• Has roughly $50 million to spend on environmental mitigation measures for the I-5 Managed Lanes Project. • Mitigation funds will go towards projects with the greatest VMT reduction potential per dollar spent and can only be allocated to the construction/implementation phase. • Must spend the mitigation funds within three years of completing the I-5 Manage Lanes Project. • There is uncertainty on whether the Truxel Bridge delivery schedule meets Caltrans' timeline to allocate funds and if the project achieves adequate VMT reduction (Note: the City must use Caltrans VMT methodology to help make this determination).	• I-5 CMCP • I-5 Managed Lanes Project • California Transportation Plan 2050 • 2023 State Rail Plan Draft • California Transportation Carbon Reduction Strategy • 2017 Towards an Active California
CTC/CalSTA	• Establishes state policies that guide project funding decisions. • Responsible for programming and allocating the state's discretionary transportation funds.	• The City has not formally engaged this partner in project funding discussions yet.	• Climate Action Plan for Transportation Infrastructure (CAPTI)
USDOT/FHWA/ FTA/BAB	• Establishes federal policies that guide project funding decisions. • Administers discretionary federal funds. • Finances public infrastructure projects.	• The City has not formally engaged this partner in project funding discussions yet.	• USDOT Strategic Plan • USDOT National Roadway Safety Strategy • U.S. National Blueprint for Transportation Decarbonization.
CCJPA/SJJPA/ SJRRC	• Agencies that manage, plan, and/or operate intercity rail in the Sacramento Region. • The construction of the Truxel Bridge improves transit connectivity to rail services at SVS and potentially the future Valley Rail Natomas Station. • Potential partners for pursuing TIRCP grants.	• The City has not formally engaged this partner in project funding discussions yet.	• CCJPA Business Plan • SJJPA Business Plan
Elected Officials	• Creates and votes on legislation that creates transportation funding policy and funding. • Helps build public support and educate the public about projects. • Helps improve inter-agency communication and coordination. • Advocates for project funding. • Can provide Earmark funding for specific projects.	• U.S. Representative Ami Bera has shown interest in the project.	

Recommendations/Takeaways:

- Consider developing a simplified *Partner Engagement Plan* that tracks ongoing engagement activities with key partners, including but not limited to partners' needs and concerns about the project, how each partner makes organizational decisions and what/who influences those decisions, partners' projects or operations impacted by the project, and opportunities to strengthen relationships with partners.
- An inter-agency working group, quarterly senior management meetings, or a similar forum could benefit the Truxel Bridge and Green Line Extension/HFT projects. The intention of such a forum is to ensure all parties are informed about short- and long-term project delivery goals, improve project delivery coordination and inter-agency relations, maintain clarity about project funding efforts, and develop a shared vision for how the two projects can be funded and delivered. In addition, there is currently no other partner that can replace the role of SacRT on this project. Other FTA recipients like CCJPA and SJJPA can be partnered with to pursue TIRCP funds, but the HFT component of the project will be led by SacRT.
- This funding strategy will evolve as the City gains deeper insight into SacRT's proposed schedule and funding strategy to deliver HFT into Natomas. Delivering both projects in somewhat parallel timelines will demonstrate to funding agencies that the Truxel Bridge will accommodate transit service(s), ideally HFT services, after construction.
- Continue to provide Caltrans with project delivery updates when touch points occur. Complete the VMT analysis using Caltrans' approved methodology, which is needed for them to determine if the Truxel Bridge project could be a valuable project for mitigation funds.
- Consistently engage with state and federal elected officials to build political interest in the project and have an influential advocate for funding the project. State and federal elected officials can help reinforce the broad support for a project, develop stronger inter-agency relationships, increase public interest in a project, request allocation of Earmarked funds, and influence the decisions of funding agencies by emphasizing the project's critical need and benefits. Special events like Sacramento Metropolitan Chamber of Commerce's Cap-to-Cap are crucial opportunities to advocate for the project and show a united front in front of elected officials.
- Receiving letters of support/conformity is critical to advancing a project as large as the Truxel Bridge. Funding agencies are more likely to award funding to projects with broad support at multiple levels of government. For the Truxel Bridge project, the most important partners to provide letters of support/conformity are SacRT, SACOG, and elected officials.
- Take advantage of workshops, office hours, and other opportunities to engage with CTC, CalSTA, and USDOT staff to discuss the Truxel Bridge project. Agency staff can provide insight into how funding decisions are evolving each cycle.

Identify and Track Funding Sources

As previously stated, the Truxel Bridge project will be delivered with assistance from various local, regional, state, and federal funding programs. State and federal funding programs will evolve as existing legislation expires and new legislation is passed and implemented. For instance, the federal Infrastructure Investment and Jobs Act (IIJA) programs will be awarded through FY 2026, and a new federal infrastructure bill may have different programs.

Note that the City is not eligible to pursue some of these funding sources without an eligible project partner, such as FTA CIG New Starts funding and multiple state programs.

Local Sources

Measure A

Description: Measure A established Sacramento County's 0.5% local transportation sales tax and transportation impact fee program. The measure was initially passed in 1988 and, in 2004, was extended by voters to 2039. Measure A also created the Sacramento Transportation Authority (STA) as the governing body responsible for administering the sales tax revenues.

The City is exploring the possibility of moving future Measure A funds from lower-priority projects to the Truxel Bridge project. Measure A funds will be a critical source for matching funds when pursuing state and federal grants.

Truxel Bridge is included in STA's 2024-25 Budget, with the expenditure assumption of $2 million in FY25-26, $2.4 million in FY 26-27, and $2 million in FY 27-28.

Evaluation Criteria: Funding allocation must be compliant with the Measure A Expenditure Plan.

Award Maximum	Required Match	Next Cycle	BCA Required?	Project Phases
None	N/A	Ongoing	No	Any

Impact Fees

Description: Impact Fees are among the most common mechanisms for generating local funding for transportation and infrastructure projects. The City has multiple impact fee programs in the project area. As of Fall 2024, the City has about ***$5 million*** in impact fees available to be used as matching funds. The availability of impact fees may increase as new development occurs, but the revenue growth is difficult to estimate.

Evaluation Criteria: The use of funds must comply with local impact fee ordinances and state laws.

Award Maximum	Required Match	Next Cycle	BCA Required?	Project Phases
N/A	N/A	N/A	No	Any

Recommendations/Takeaways:

- Measure A revenues and impact fees are currently the City's primary source of matching funds. While matching funds can be acquired from certain regional and state programs in the future, they are not guaranteed. The City may consider transferring additional Measure A funds to the Truxel Bridge project if it is a higher priority than other Measure A projects. In addition, growth in impact fee revenues, even if minimal, could help increase the amount of local matching funds in the future. Review Table 2 for an estimate of matching funds to pursue federal programs. Many state programs do not have matching requirements, but the local match is considered during project evaluation.
- Continue to work with STA, elected officials, and other project partners to advocate for a new tax measure, including set-aside funding for the Truxel Bridge in the new Expenditure Plan. Increased revenue from a new sales tax measure would increase the amount of funding committed to the local match, which will also improve the project's competitive advantage when pursuing discretionary funds.

Regional Sources (Allocates State and Federal Funds)

SACOG Regional Funding Round

Description: SACOG is currently developing its Regional Funding Round for FY 2025. The Regional Funding Program intends to meet federal and state performance objectives, position the region's most important projects for larger state and federal grants, and implement regional policies and priorities in the MTP/SCS.

The Truxel Bridge qualifies for the following federal programs:

- **Next Generation Solutions and Clean Air Program (CMAQ Funds):** Funds projects or programs that contribute to attaining or maintaining the national ambient air quality. The selected project should advance the Next Gen Transit, Regional Transit Network Study, and Regional Trails Network.
- **System Performance Program (STBG Funds):** To fund projects that increase the performance of the regional transportation network. STBG funding is the most flexible and can go to many projects, including high-frequency/capacity transit and new transit infrastructure.

The project also qualifies for the ***Four-County STIP*** funds.

The Regional Funding can be used as a match to pursue larger state and federal assistance programs.

Evaluation Criteria - Next Generation Solutions and Clean Air Program (based on draft guidelines): GHG/VMT Reduction; Reduce Regional Congestion; Increase Multimodal Travel Options; Provide Long-Term Economic Benefit; and Climate Adaptation and Resilience.

Evaluation Criteria - System Performance Program (based on draft guidelines): GHG/VMT Reduction; Reduce Congestion; Increase Multimodal Travel Options; Provide Long-Term Economic Benefit; Improve Goods Movements; Improve Safety and Security; and State of Good Repair.

Evaluation Criteria - Four-County STIP Program (based on draft guidelines): State of Good Repair; Improve Safety and Security; Increase Multimodal Travel Options; Improve Goods Movements; and Climate Adaptation and Resilience.

Award Maximum	Required Match	Next Cycle	BCA Required?	Project Phases
TBD in 2025	TBD in 2025	2025	No	Any

Recommendations/Takeaways:

- Continue to track SACOG's funding programs, which could be used to partially fund PA&ED or final design or increase matching funds for larger discretionary programs. The upcoming Regional Funding Program will accept applications in 2025. The Truxel Bridge project is eligible for the federal 'Next Generation Solutions and Clean Air Program' and 'System Performance Program' and the Four-County STIP program. SACOG staff called out the following factors to increase the Truxel Bridge project's competitiveness for regional funding: partnership with partners (i.e., SacRT), VMT/GHG reduction, regional transit connectivity, and mobility barrier removal.
- Continue to engage with SACOG staff and apply to the yearly Regional Project Prioritization Program to build project support at the regional level and receive future letters of support/conformity for future grant applications. To be positioned as a regionally significant project, it is critical to show SACOG's support of the project to state and federal officials. The City applied to SACOG's Regional Project Prioritization Program in August 2024 and was selected by SACOG to be prioritized for RAISE 2025 (Planning).

State Sources

California State Transportation Agency (CalSTA) Transit & Intercity Rail Capital Program (TIRCP)

Description: TIRCP funds transformative capital improvements (including environmental review and design) that will modernize California's intercity, commuter, urban rail, bus, and ferry transit systems to significantly reduce emissions of greenhouse gases, vehicle miles traveled, and congestion.

The City must partner with an FTA recipient (e.g., SacRT, CCJPA, or SJJPA) to pursue TIRCP funds.

Evaluation Criteria: Reduce GHG Emissions; Increase Ridership; Integrate with Rail & Transit Operators; and Improve Safety.

*Requires the completion of the "Jobs Co-Benefit Modeling Tool" and "CARB Quantification Tool."

Award Maximum	Required Match	Next Cycle	BCA Required?	Project Phases
No	No	Spring 2026	*No, see note above	Any

CTC/Caltrans Solution for Congested Corridor Program (SCCP)

Description: Every two years, the SCCP makes $500 million available to construction projects (including design for alternative delivery projects) that reduce congestion in highly traveled and highly congested corridors through performance improvements that balance transportation improvements, community impacts, and environmental benefits. Projects must be part of a comprehensive corridor plan. Truxel Bridge is in the I-5 CMCP under the project name "New American River Crossing."

The City must partner with Caltrans or SACOG to pursue SCCP funding. City governments are not eligible applicants.

Evaluation Criteria: Safety; Congestion; Accessibility; Economic Development/Job Creation; Air pollution and GHG Reduction; Efficient Land Use; Level of Matching Funds; and Timely Project Completion.

Award Maximum	Required Match	Next Cycle	BCA Required?	Project Phases
No	No	Summer 2026	Yes	Construction

CTC Local Planning Partnership (LPPc)

Description: Every two years, the LPPc Competitive provides funding to jurisdictions where voters have approved fees or taxes dedicated solely to transportation improvements or have imposed fees, including uniform developer fees, dedicated solely to transportation improvements. LPPc solely funds construction.

Evaluation Criteria: Accessibility & Multimodal Infrastructure; Air Quality and GHG Reduction; Community Engagement; Economic Development/Job Creation; Cost Effectiveness; Deliverability; Matching Funds; Safety; System Preservation; Land Use & Housing Goals; Vehicle Miles Traveled; Innovative Delivery Methods; and Project Segmenting/Scalability.

Award Maximum	Required Match	Next Cycle	BCA Required?	Project Phases
$25 Million	1-to-1 Match	Summer 2026	Yes	Construction

Caltrans I-5 Managed Lane Project Mitigation Funding

Description: Caltrans has about $50 million to invest in projects that will mitigate the environmental impacts of the I-5 Managed Lanes Project in Sacramento County. The Truxel Bridge corridor is parallel to the I-5 and can lower VMT along the I-5 corridor. However, Caltrans must be able to fund the Truxel Bridge project within three years of the I-5 Managed Lanes Project's start of operations, and it is uncertain if Truxel will advance in time. In addition, the City needs to utilize Caltrans' VMT methodology to determine the potential VMT reduction per dollar spent.

Evaluation Criteria: VMT Reduction Potential per Dollar Spent.

Award Maximum	Required Match	Next Cycle	BCA Required?	Project Phases
TBD	No	N/A	No	Construction

Priority Legislative Budget Projects (PLBP)

Description: PLBP are earmarked funds for specific projects authorized by state legislation. The legislative sponsors identify projects that are a priority in their respective districts and authorize PLBP funding for these projects through legislation. Caltrans is the authorizing agency for distributing the funding provided by this legislation. Matching funds are not a requirement. The funding capacity varies yearly, with project awards historically ranging from $250,000 to $20,000,000. However, the most recent PLBP, AB 102, ranged between $500,000 and $3,000,000 per project.				
Evaluation Criteria: Not applicable.				
Award Maximum	**Required Match**	**Next Cycle**	**BCA Required?**	**Project Phases**
No	No	Yearly	No	Design & Con

Recommendations/Takeaways:

- TIRCP and SCCP do not require a 20% match and can be pursued to create a larger match for federal programs. TIRCP and SCCP do consider the size of the match in evaluating the project, but a low match will not necessarily disqualify a project if it performs well in other aspects of the evaluation.
- Complete the *Jobs Co-Benefit Modeling Tool* and California Air Resources Board (*CARB) Quantification Tool* for the Truxel Bridge project before the next TIRCP cycle to see how well the project performs. During the 2024 cycle, many agencies did not use those tools until the CFP and had to remove projects and make significant changes to their applications.
- Continue to communicate project benefits to elected officials. Earmarked funds are flexible and can be used as a match for larger discretionary programs.
- As previously stated, utilize opportunities to meet with CTC and CalSTA staff, who can provide their perspective about the project and insights into how funding decisions are evolving each cycle.
- If The City is unsuccessful is pursuing state discretionary funds, it is critical the City receive a debrief from CTC or CalSTA staff to understand why the project wasn't selected and how to improve the application for the next cycle.

Federal Sources

With the passage of IIJA in 2021 came a significant increase in federal funding for large multimodal transportation projects like the Truxel Bridge. However, most discretionary funding programs created or extended by IIJA will be awarded by the end of FY 2026. For now, the City can only assume today's federal discretionary funding landscape will be somewhat similar in the future, but that is not a certainty. The funding strategy must be updated to align with programs created or extended by the next large federal transportation and infrastructure bill.

USDOT Rebuilding American Infrastructure with Sustainability and Equity (RAISE)

Description: The RAISE program invests in surface transportation projects that will have a significant local or regional impact and align with USDOT's strategic goals. Planning Grants are for project activities related to planning, preparation, or design, including pre-construction activities, and Capital Construction Grants are for the construction of surface transportation projects.				
Priority Criteria: Safety; Environmental Sustainability; Quality of Life; and Mobility and Community Connectivity. **Other Criteria:** Economic Competitiveness and Opportunity; State of Good Repair; Partnership and Collaboration; and Innovation Areas (Technology, Project Delivery, and Financing).				
Award Maximum	**Required Match**	**Next Cycle**	**BCA Required?**	**Project Phases**
$25 Million	20% Non-Federal; 40% non-RAISE	Fall 2024	Yes (Con Only)	Env, Design, & Con

USDOT Multimodal Project Delivery Grant (MPDG) - Mega

Description: The Mega program invests in large, complex projects that are difficult to fund by other means and are likely to generate national or regional economic, mobility, or safety benefits. Previous cycles have included extremely large awards to multimodal bridge projects, such as the Interstate Bridge Replacement Program (Oregon and Washington State), awarded $600 million in MPDG – Mega funds.				
Evaluation Criteria: Safety; State of Good Repair; Economic Impacts/Freight Movement/Job Creation; Climate Change/Resilience/Environment; Equity/Multimodal Options/Quality of Life; and Innovation Areas (Technology, Project Delivery, and Financing).				
Award Maximum	**Required Match**	**Next Cycle**	**BCA Required?**	**Project Phases**
No	20% Non-Federal; 40% non-MPDG	TBD (No More NOFOs under IIJA)	Yes	Env, Design, & Con

FTA Capital Investment Grants (CIG) Program - New Starts

Description: The CIG program funds large transit and rail capital investments, including BRT. FTA recipient agencies seeking CIG funding must complete a series of steps over several years. ***New Starts*** projects must be new fixed guideway projects or extensions to existing fixed guideway systems with a total estimated capital cost of $400 million or more or seeking $150 million or more in CIG program funds. The FTA CIG program has specific processes, requirements, and timelines to advance a project through the statutorily defined Project Development and Engineering phases, which can take many years to navigate before reaching a funding agreement with the FTA.				
Project Justification Criteria: Mobility improvements; Environmental Benefits; Congestion Relief; Economic Development Effects; Land Use; and Cost Effectiveness. **Local Financial Commitment Criteria**: Availability of reasonable contingency amounts, availability of stable and dependable capital and operating funding sources, and availability of local resources to recapitalize, maintain, and operate the overall existing and proposed public transportation system without reducing existing services.				
Award Maximum	**Required Match**	**Next Cycle**	**BCA Required?**	**Project Phases**
No	50% non-CIG (can vary)	Ongoing	No	Construction

Community Project Funding / Congressionally Directed Spending (CPFCDS, "Congressional Earmark")

With the passage of IIJA, the CPFCDS program was created to support specific community projects as part of the Annual Appropriations process. For every year of funding, the CPFCDS projects are solicited and selected by the members of the U.S. Congress and U.S. Senate. Once selected, the individual scope and funding amount for each CPFCDS project is written into law via the Annual Appropriations bill. Most CPFCDS funding requests are usually between $1 and $10 million per project, but a higher amount can be requested.

Evaluation Criteria: Depends on the elected official's political priorities.

Award Maximum	Required Match	Next Cycle	BCA Required?	Project Phases
No	No	Yearly	No	Design & Con

Recommendations/Takeaways:

- Gain insight into how SacRT will fund the Green Line Extension/HFT project, including if the agency plans to pursue FTA Small Starts funds and the preferred timeline for entering the Small Starts program. SacRT's strategy for funding the Green Line Extension/HFT project will influence the potential for FTA funds on the Truxel Bridge project. The CIG program is prescriptive and has specific timeframes for project delivery activities, so if the City wants to explore FTA as a funding source for construction, they need to discuss it with SacRT sooner rather than later.
- Utilize opportunities to meet with USDOT and FTA staff to gauge their opinion of the Truxel Bridge project and its potential performance in the federal programs identified above.
- IIJA funds will be obligated through FY 2026. When meeting with elected officials, the City should advocate for another large transportation and infrastructure bill with programs designed for large multimodal projects like the Truxel Bridge.
- Continue to communicate project benefits to elected officials. Earmarked funds are flexible and can be used as a match for larger discretionary programs.
- If the City is unsuccessful is pursuing federal discretionary funds, it is critical the City receive a debrief from the federal agency to understand why the project wasn't selected and how to improve the application for the next cycle.

Align the Project with how Funding Decisions are Made

Most discretionary funding programs are highly competitive, and even "highly recommended" projects are often not awarded funds until the second or third time applying. For this reason, to maximize the project's competitiveness, the City should pursue discretionary funding programs with an understanding of how funding agencies make decisions.

Key Considerations Before Pursuing Discretionary Programs:

- Understand how grant applications are evaluated, with specific attention to the merit criteria. After reviewing project eligibility and readiness (usually a pass/fail grade), alignment with program evaluation/merit criteria determines the likelihood of a project being awarded funds.
- The decisions made by funding agencies have become increasingly performance- and data-driven. As the project advances, the City should consider what data and further studies are needed to highlight the project's strengths and long-term performance outcomes. When applicable, leverage government-recommended GIS and analysis tools, including but not limited to the Climate and Economic Justice Screening Tool (CEJST), Equitable Transportation Community (ETC) Explorer, Environmental Justice Screening and Mapping Tool (EJ Screen), Screening Tool for Equity Analysis of Projects (STEAP), CalEnviroScreen 4.0, and Healthy Places Index (HPI) Tool.
- As the project approaches final design and construction, consider completing an initial Benefit-Cost Analysis (BCA) before Notice of Funding Opportunities (NOFOs) or Call for Projects (CFPs). State and federal programs increasingly require BCAs to ensure a project's economic returns exceed the initial investment. Completing BCAs early gives insight into how the project performs and how certain factors, such as projected transit ridership, impact the BCA. Coordination with SacRT may be required to complete the BCA.
- Build consensus with project partners before NOFOs or CFPs. Continue to coordinate and foster inter-agency relations with SacRT to ensure they can provide a letter of support when requested and to understand the project delivery timeline for HFT into Natomas relative to Truxel Bridge. How SacRT funds its HFT project could impact how the Truxel Bridge is funded and/or the project delivery timeline. Continue applying to SACOG's Regional Project Prioritization Program each cycle to qualify for board approval for letters of support/conformity. Letters of support/conformity from project partners reinforce that there is broad support for the project and that it advances or supports the goals and priorities of other partners.
- Take advantage of touch points with funding agencies, such as office hours and workshops. Agency staff can provide insight into how to approach specific funding programs and how funding programs are evolving each cycle.
- If funds are not awarded and the City plans to pursue a funding program for a second time, scheduling debriefs with funding agency staff can provide insight into improving the application for the next cycle.
- Keep state and federal elected officials informed about the project. Take advantage of touch points with elected officials to regularly communicate why the project is needed and its benefits. Fostering political support for a project ensures letters of support will be received when requested and helps elected officials leverage some level of influence in funding the project.
- When developing the application, provide adequate time for reviewing application materials. Two rounds of review are recommended, at 60-70% complete and 90-95% complete. Rushed applications can often result in a less competitive project.

Alignment with Regional and State Plans and Initiatives

Funding programs and, in turn, funding decisions are guided by regional, state, or federal policy. In California, state policy has increasingly guided funding agencies to invest in transportation projects that help accomplish the state's ambitious climate change goals (i.e., CalSTA's CAPTI) and result in more equitable outcomes (i.e., SB 535, later followed by AB 1550). Federal policy is less predictable when considering the long project delivery timeline for the Truxel Bridge, and the results of future elections may impact future federal transportation policy.

The *Partner Coordination* section identifies project partners' plans and policies potentially relevant to the Truxel Bridge project. However, some plans and policies are more relevant from a funding perspective. In discussing the need and benefits of the Truxel Bridge project with funding agency staff and elected officials and on grant applications, the City may want to emphasize how the project supports the following policy initiatives at the regional and state levels. Federal plans and policies, such as USDOT's Strategic Plan and the White House's Justice40, are relevant as well, but they are not included due to the likely administration changes by the time Truxel Bridge is pursuing federal construction dollars.

Regional Plans and Initiatives

2025 MTP/SCS, "The Blueprint" (Planned Adoption in 2025): SACOG's 2025 Blueprint will serve as the long-range, comprehensive vision for transportation investments and land use patterns in the six-county Sacramento region. The Triple Bottom Line Framework, equity, economy, and environment, guides the policies and projects in the Blueprint. The updated Blueprint will include a financially constrained project list, which collectively is required to meet the region's challenging GHG emission reduction and land use goals. The Truxel Bridge project is included in the draft financially constrained 2025 Blueprint project list (Project ID #SAC24539), and the "Future Green Line Station Areas" are identified as Center and Corridor Communities in the 2025 Blueprint land use assumptions, with an estimated increase of 1,260 jobs and 2,040 housing units by 2050.

Overall, the Truxel Bridge project is well-aligned with the policy framework and goals of the 2025 Blueprint. The project will expand access to affordable transportation options in disadvantaged communities (equity), reduce GHG emissions and air pollutants (equity & environment), enhance multimodal connectivity to employment opportunities and popular destinations (equity & economy), and promote more sustainable transit-supportive land uses (equity, environment, & economy).

Regional Transit Network Plan (Adopted 2021): This plan develops and prioritizes a list of regional transit corridors for future investment and inclusion in the 2025 Blueprint. The Truxel/Commerce corridor has been identified as a Medium-Distance HFT Corridor in the plan and received a prioritization score of 3.3, roughly in the middle compared to other corridors. Truxel Bridge must be constructed to expand a new HFT corridor into Natomas.

Regional Trail Network/Ready-Set-Trails (Adopted Action Plan in 2022): This plan identifies a regional network of existing and planned trails, with the intention of filling trail gaps and improving connections between trails. The Truxel Bridge is not part of the Regional Trail Network, but it will be constructed near existing trail segments. The bridge will be constructed over the Jedediah Smith Trail and Two Rivers Trail and be sited roughly a mile from the Ninos Parkway Trail. To improve competitiveness in SACOG Funding Rounds, the City may consider how the Truxel Bridge can enhance active transportation connectivity with the trail network.

State Plans and Initiatives

Climate Action Plan for Transportation Infrastructure, CAPTI (Adopted 2021): CAPTI was developed to align CalSTA's transportation programming policies with Executive Order N-19-19, which identifies the critical need to fund transportation projects that advance more sustainable, equitable, and healthy modes of transportation. The plan also calls for a more data- and performance-driven investment strategy to ensure state funds effectively advance statewide mobility, GHG reduction, and equity goals. CalSTA and its agencies (CTC and Caltrans) must align discretionary grant funding decisions with the goals and strategies in CAPTI and the CAPTI Investment Strategy. As previously stated, elements of the Truxel Bridge project are well-aligned with the State's climate goals. As the project approaches construction, the City may want to consider how it will be able to quantify the performance of the alternative modes using the bridge – transit and active transportation – since the state's funding programs are becoming increasingly performance-based.

California State Rail Plan (2023 Draft Plan Under Review): The draft State Rail Plan identifies the need to improve connectivity between rail and transit networks at regional mobility hubs like Sacramento Valley Station (SVS). The Truxel Bridge project enables a new HFT connection between Natomas and intercity rail services at SVS. The new Truxel Bridge could also enable a more direct transit service between Valley Rail's future Natomas Station and SVS, creating a more resilient/redundant transit and rail network during potential shutdowns or delays at Valley Rail's Midtown Station. Showing that the project advances the goals of the State Rail Plan is a required component of TIRCP applications.

I-5 Comprehensive Multimodal Corridor Plan, CMCP (Adopted 2022): The goal of the I-5 CMCP document is to create a decision-making process for developing mobility solutions that increase accessibility and mobility, improve safety, and enhance the quality of life and the environment within the I-5 corridor in the region. The Truxel Bridge project, referred to as "Lower American River Crossing," is included in the I-5 CMCP study area, which makes it eligible for future SCCP funding and Caltrans I-5 Managed Lanes project mitigation funding. The Truxel Bridge project will reduce congestion on I-5 by creating a more direct route for vehicles, transit, and active modes between Natomas and the Central City.

Truxel Bridge's Project Strengths

The following summarizes the key strengths of the Truxel Bridge project that will improve its competitive advantage when pursuing state and federal funding programs and help develop broad support from the public, agency partners, and elected officials. Many of these project strengths also align with existing merit/evaluation criteria for the discretionary programs included in *Identify and Track Funding Sources*.

It is recommended the City thoroughly review the merit criteria for funding programs they are about to develop applications for, including developing a general outline of how the Truxel Bridge project will address each criterion and identifying what kind of data and information are needed to craft a compelling narrative (e.g., if a BCA is required, it is recommended the City complete it before the NOFO or CFP is released).

Overall, Truxel Bridge's key strengths as a project are:

- **Improved multimodal connectivity** over an existing mobility barrier, connecting two parts of the City with growing employment and housing opportunities, accommodating HFT into Natomas with transit-priority infrastructure, and improving active transportation connectivity across the river.
- **Reduced transportation-related environmental impacts** by improving access to affordable and clean modes of transportation, promoting mode shift behaviors, accommodating more efficient travel patterns, and incentivizing more sustainable infill development patterns.
- **Safer transportation network** by using a Complete Streets design approach, designating separate ROWs for transit, vehicles, and active modes, creating a more direct and visible route for active modes, improving intersections at both ends of the bridge, and authorizing emergency vehicles to use transit-priority lanes to quickly reach medical resources in the Central City.
- **Equitable Investment that will benefit disadvantaged populations** by expanding affordable transportation options in Natomas, creating new connections to employment opportunities and community amenities for those who cannot drive or have access to a vehicle, and improving air quality in an area heavily impacted by air pollution.
- **Positive economic outcomes** by improving connectivity to growing employment and activity centers in Natomas and the Central City, incentivizing investment near future HFT stations, and by extending HFT to the airport in the future, enhancing Sacramento as a destination for conferences and tourism.
- **Regionally impactful project** by improving transit connectivity to regional destinations like the airport and growing employment centers, changing travel behaviors beyond the project area, and relieving congestion on major highways in the region.

Mobility and Connectivity

The American River is a natural mobility barrier that constrains north-south trips to a limited number of crossings in the City of Sacramento. Despite the population and employment growth occurring in Natomas and the Central City, there is no direct route for transit or vehicles to cross the river. The one nearby active transportation crossing, the Jibboom Bridge, is not well connected to the existing street network, is often flooded in the wet season, and is uncomfortable to utilize at night due to a lack of public visibility. SacRT has planned a major HFT extension into Natomas, the Green Line Extension project, but the project cannot be built without a new crossing over the river.

The Truxel Bridge project creates a direct, multimodal connection between Natomas and the Central City, mitigating an existing mobility barrier and providing access to new destinations and opportunities on both sides of the river. The new bridge will provide significant benefits for multiple modes of transportation:

Transit: The bridge will include transit-priority infrastructure to accommodate a direct HFT corridor extending from the Central City to North Natomas. To maximize transit performance and improve traffic safety along the new HFT corridor, the City has planned lane reductions and transit-priority infrastructure on Truxel Road in Natomas. The new HFT service will expand access to affordable transportation options in Natomas and connect to growing housing and employment centers in North Natomas and the Central City. The HFT service between Natomas and the Central City will offer shorter headways and faster, more reliable travel times than existing transit services in Natomas, promoting mode shift to transit and decreasing VMTs. Ultimately, Truxel Bridge will accommodate HFT to the airport, enabling travelers to reach the airport from any part of SacRT's light rail network and SVS. HFT to the airport will shift a share of vehicle trips to and from the airport to lower-cost and potentially faster transit.

Vehicles: Drivers who typically rely on I-5 or SR 160 to cross between Natomas and the Central City can utilize a more direct route on the local street network. More efficient travel patterns will reduce driving travel times and reduce VMTs and congestion on I-5. The improved roadway connectivity across the river will also create a more resilient roadway network, with multiple travel options over the river in case of an emergency, evacuation, or severe congestion on I-5. Emergency vehicles will have a more direct, faster connection to hospitals and resources in the Central City and could utilize the transit-priority lanes to avoid traffic delays.

Active transportation: The bridge will have a protected, Americans with Disabilities Act (ADA)-compliant path for pedestrians and bicyclists to ensure the bridge is safe, comfortable, and accessible for all users. The bridge will integrate with the existing pedestrian and bicycle networks on both sides of the river to create seamless connections for active modes. The City will explore strategies to improve active transportation connectivity between the bridge and the nearby Jedediah Smith Trail and Two Rivers Trail.

Environmental Sustainability

The Truxel Bridge and future HFT service using its transit-priority infrastructure can help the Sacramento region achieve its challenging GHG reduction goal of 19% below 2005 levels by 2035. The project also aligns with the statewide goals established in CAPTI by improving multimodal connectivity, expanding access to affordable modes of transportation, promoting mode shift, and reducing VMT and GHG emissions.

The project will reduce barriers to accessing affordable HFT in an area lacking quality transit and promote mode shift behaviors by creating new transit connections to employment and commercial centers and other amenities. Transit-priority infrastructure on Truxel Bridge and along Truxel Road will improve transit speed and reliability, increasing the attractiveness and convenience of transit services and, in turn, transit ridership. Increasing transit mode share will reduce GHG emissions and air pollutants, creating a more sustainable and healthier region.

The Truxel Bridge project will also support more sustainable and efficient infill development activities along the future HFT corridor. The City has planned transit-supportive land uses along the Truxel Road corridor in Natomas in preparation for the future LRT/BRT expansion and has a Transit-Oriented Development (TOD) Ordinance that incentivizes transit-supportive uses along existing and future LRT corridors. The City's commitment to more sustainable, transit-supportive land uses is emphasized by the approval of Innovation Park in North Natomas, a 183-acre mixed-use development at the former Sleep Train Arena site on the Truxel Road corridor. Mixed-use infill development activities are also ongoing in the River and Railyard Districts in the Central City, where significant population and job growth are projected.

Safety

The City is taking a Complete Streets design approach to ensure the Truxel Bridge maintains a neighborhood bridge character that is safe and accessible for all modes and users with different abilities. The bridge will have dedicated ROWs for transit and active modes, potentially with physical barriers or bollards, to increase a sense of safety for all users and prevent accidental swerving into another mode's ROW. Transit-priority lanes are also associated with slower driving speeds due to the decreased number of general-purpose lanes.

The Truxel Bridge provides a more direct and safe route for active modes than the nearby Jibboom Bridge, which is often flooded in the wet season and has poor public visibility at night. The City will integrate the bridge's active transportation infrastructure with the pedestrian and bicyclist networks on both sides and potentially explore opportunities to improve connections to the nearby Jedediah Smith Trail and Two Rivers Trail.

The bridge will also be an important route for emergency service vehicles. South Natomas lacks hospitals with trauma centers, and the nearest trauma centers are in the Central City. The Truxel Bridge will help reduce transport times for emergency vehicles by creating a more direct and reliable route across the river instead of using the often congested I-5. The City is considering allowing emergency vehicles to access the transit-priority lanes, which will help emergency vehicles avoid traffic on the bridge and reduce the chance of accidental collisions with vehicles.

Equity/Quality of Life

The Truxel Bridge project will improve the quality of life for disadvantaged populations by expanding access to affordable transportation options in Natomas, improving air quality, and creating new multimodal connections to employment opportunities and amenities. The Truxel Bridge project is in a federal Historically Disadvantaged Community and a California SB 535 Disadvantaged Community. The project's benefits will also reach disadvantaged populations in North and South Natomas, the Central City, and other communities with existing access to the light rail and intercity rail network.

Affordable and Accessible Travel Options: The Truxel Bridge will be constructed with a separate, protected ROW for active modes and be ADA accessible, allowing people of all abilities to safely and comfortably cross the bridge to reach opportunities and destinations across the river. The Truxel Bridge will also enable SacRT to expand HFT into Natomas, increasing access to an affordable and convenient mobility option for people who do not drive or would be willing not to drive if transit was a more viable option. Access to affordable mobility options also benefits children, older adults, single-parent households, and people with disabilities who are more likely to experience severe isolation and mobility barriers created by car-centric urban design.

Air Quality: Due to the project's proximity to I-5 and other high-traffic arterials, the project area experiences high air pollution. Most Census Tracts in the project area have high amounts of PM2.5 and diesel particulate matter (note that PM 2.5 pollution is shown much higher on EJ Screen than CalEnviroScreen) and are in the highest percentiles for the proportion of the population with asthma. The Truxel Bridge project can help minimize air pollution impacts in this area by promoting mode shifts to more sustainable, clean modes of transportation, such as HFT and active transportation, and by reducing VMTs due to more direct driving routes.

Access to New Destinations, Opportunities, and Amenities: The Truxel Bridge project will create new connections to destinations that are difficult or impossible to reach for transit riders, pedestrians, and bicyclists. People with disabilities, children, older adults, and people who do not drive or have access to a vehicle will benefit from new transit connections to destinations in Natomas and the Central City. Residents in Natomas will have a direct connection to job opportunities, medical resources, amenities, and popular destinations in the Central City, and since future HFT services on Truxel Road will link to SVS and other light rail lines, they will be able to reach destinations in South Sacramento, Elk Grove, Rancho Cordova, Folsom, Roseville, and even the Bay Area without a vehicle. There are also many social and cultural amenities in the Central City, such as the Downtown Commons (DOCO), Old Sacramento, the Capitol Area, and other popular neighborhoods that will be accessible via the Truxel Bridge. The same is true for residents in Central City, who will have direct access to the growing employment opportunities in North Natomas. In addition, residents in the River and Railyards District will have more direct access to the public parks and shopping centers in South Natomas.

Important Note About Affordable Housing: A common concern with projects that result in transit and rail expansion is gentrification and displacement of existing community members around new station areas. Lower-income households, people of color, and people with disabilities are more likely to rely on transit for commuting, errands, and other day-to-day trips. Therefore, affordable living spaces must be available near transit stations to ensure disadvantaged populations have equitable access to services. The City is taking proactive steps to ensure that future development near the Truxel Bridge and the Truxel Road corridor will support affordable housing options. The City has a Mixed-Income Housing Ordinance that established a citywide Housing Impact Fee, which is used to develop affordable housing in the City. In addition, projects greater than 100 acres, such as Innovation Park on Truxel Road, must meet certain affordable housing production requirements. Residential development in Innovation Park will provide 10% of constructed units as affordable housing units.

Economic Development and Growth

Creating a new multimodal connection between Natomas and the Central City will boost economic activity by improving access to growing employment centers, educational opportunities, shopping and entertainment destinations, and other activity centers. Per The 2025 Blueprint's land use assumptions, North Natomas and Central City are projected to contain some of the region's greatest amount of growth, with thousands of new housing units and jobs by 2050, many of which will become more accessible with a new HFT service between Natomas and the Central City. Future activity centers, such as Innovation Park, the Railyards, and a revitalized SVS, will be connected along an HFT corridor, attracting more people to visit those destinations for work, errands, and play. Truxel Bridge will also improve HFT connectivity to the existing SacRT LRT network and intercity rail service at SVS, expanding access to major employment centers in Roseville, Rancho Cordova, Folsom, Elk Grove, and even the Bay Area.

Extending HFT into Natomas will attract new investment into future station areas, which will enhance the existing commercial areas, promote more economically efficient land uses, create new businesses and jobs, and increase the municipal tax revenues in the long term. As new investments are made in public and commercial spaces, many new station areas will become hubs for shopping, eating, and entertainment.

In the more distant future, expanding LRT service to the airport will make Sacramento a more attractive destination for visitors and businesses. New transit connections between airports and central business districts can catalyze economic activity, such as conferences and other large events, tourism, and businesses opening new downtown offices.

Regional Impact

Communicating the regional benefits of the Truxel Bridge project is critical to pursuing larger federal funding programs and developing wider regional support for the project. Most mobility, environmental, and economic impacts discussed above will also result in regional benefits. Furthermore, the following describes how the Truxel Bridge project will have a regional impact on the transportation network, how people travel, and where people travel.

Network Connectivity: The Truxel Bridge will add redundancy to the existing network, so in the case of severe congestion on I-5 or an emergency, there are additional routes to cross the river to prevent worsening backups on I-5.

A new HFT service expanding into Natomas would impact regional transit and rail connectivity, especially if the new HFT service connects to popular regional destinations like the airport, SVS, and/or employment centers in North Natomas. All SacRT LRT routes could connect to those destinations as well, assuming passengers are comfortable with transferring during the trip. Passengers arriving at SVS from outside Sacramento County could connect directly to employment centers in North Natomas and/or the airport via HFT. Vice versa, travelers arriving at the airport could connect directly to SVS via HFT and take intercity rail to destinations outside of the County.

Travel Behaviors: Creating a more direct route across the American River may have a regional impact on driving patterns by reducing the number of vehicles and increasing throughput on I-5. Expanding HFT connectivity to major destinations in Natomas and the Central City will influence a share of existing drivers to shift to more affordable, convenient transit options. In addition, HFT connectivity with rail services like SacRT's light rail and Capitol Corridor's commuter rail will influence workers' preferences for employment locations.

Access to Regional Destinations: The extension of HFT into Natomas and, eventually, the airport expands access to popular regional destinations for transit and rail passengers. North Natomas and the Central City are projected to have significant job and housing growth by 2050. A new HFT corridor connecting to regional employment centers in North Natomas and the Central City, including SVS, will greatly expand access to employment opportunities for rail and transit passengers within and outside Sacramento County. If SacRT eventually expands HFT to the airport, many travelers will have a lower-cost, convenient connection to the airport; and vice versa, transit connections into the City's core from the airport will be more direct.

Congestion Reduction: The new bridge will re-route a share of vehicle trips between South Natomas and the Central City, reducing vehicles and congestion on the I-5 during peak travel hours. More direct, convenient transit and active mode connections will influence some drivers to shift to transit or bicycling instead of driving on highways. Furthermore, there is a significant amount of residential and job growth planned for North Natomas, and without alternative transportation options in North Natomas, congestion on the I-5 will worsen. Overall, moving trips off the I-5 and other major highways will reduce congestion in the region.

Recommendations/Takeaways:

- Consider what kind of studies or analysis will help broaden the City's understanding of the Truxel Bridge's ultimate impact. For example, project owners often perform an Economic Impact Analysis early in project development to be able to show the public, elected officials, and funding agencies the beneficial economic outcomes of a high-cost infrastructure project. Furthermore, SacRT should be able to provide additional data and information about the Green Line Extension/HFT project, such as projected ridership.
- Given the high-cost of the project, the Truxel Bridge project's ultimate competitive advantage in the funding landscape is that it will be constructed with transit-priority infrastructure and will accommodate the extension of HFT into Natomas (and eventually to the airport). Most of the project strengths identified above rely on SacRT advancing HFT into Natomas. The Truxel Bridge project will need to show that it will result in mode shift (higher transit ridership) and reduced VMT if state funding agencies are going to provide large enough awards for the project to advance, which means integrating the benefits of a new HFT corridor into the project's identity. However, that does not mean the benefits of enabling shorter, more direct vehicle trips and creating new active transportation connections is not meaningful in funding the project.

Alternative Project Financing Models

It can take multiple funding cycles to combine awards from various discretionary grants to fund a large project. Discretionary programs are highly competitive and oversubscribed, with many "Highly Recommended" projects not receiving awards until their second or third time applying. For this reason, it is not uncommon for high-cost projects to explore alternative financing or funding mechanisms to address funding shortfalls, expedite project delivery, and deliver project benefits quickly.

Project financing allows projects to receive cash upfront to advance project delivery, then later pay back the principal amount borrowed with additional interest and debt service to account for lending risks, inflation, and administrative costs. Under certain conditions, interest rates can be favorable and may result in long-term project lifecycle cost savings. However, the City would need to identify a long-term funding source, such as Measure A, to pay the debt obligation.

This funding strategy does not recommend any specific financing options. We present these as options for the City to consider. If the City wants to explore these options, it should consider developing a Project Financing Plan before the PS&E phase begins.

Overall Benefits of Innovative Financing:

- Leverage available funding sources quickly instead of leaving them stagnant and losing purchasing power over time.
- Expedite project delivery for high-cost projects that would typically take many more years to acquire the necessary funding via discretionary sources.
- Financing has a higher ceiling than most discretionary grants, depending on what level of credit the borrower can repay.
- Flexibility in terms of availability of when financing is obtained.
- Spread project cost burden over a more extended period of time.
- Deliver the project's beneficial impacts many years sooner.
- Many discretionary funding programs include "innovative financing" as an evaluation criterion for project selection. Financial assistance can increase a project's chance of being awarded discretionary grants.

Key Considerations for Alternative Financing:

- State infrastructure financing laws.
- Short- and long-term financing costs.
- Local debt capacity.
- Long-term financial risks.
- Availability of local funds or long-term revenues to pay debt obligations, such as future sales tax revenues or value capture mechanisms.
- Timing and availability of new funds.
- Public opinion and government transparency.

Alternative Project Financing Options

Build America Bureau (BAB) Transportation Infrastructure Finance and Innovation Act (TIFIA) Loans

TIFIA provides credit assistance through direct loans, loan guarantees, and standby lines of credit (rather than grants) to projects of national or regional significance. Direct TIFIA loans are made to state and local project sponsors with low interest rates and flexible repayment terms. Loan repayments can start up to five years after substantial completion of projects. The BAB is responsible for administering the TIFIA application processes. They also provide technical assistance and encourage innovative project planning, financing, delivery, and monitoring best practices.

Regional Infrastructure Accelerator (RIA) Program: RIA is a discretionary grant program that aims to assist entities in developing improved infrastructure priorities and financing strategies for the accelerated development of a project eligible for funding under the TIFIA program. Projects are not required to apply for or receive TIFIA credit assistance to be eligible; however, applicants considering the appropriateness of innovative financing methods to accelerate the delivery of eligible projects are strongly encouraged to apply. RIA grants range between $2 and $4 million and have no matching requirement.

Eligibility Requirements: Creditworthiness; Foster partnerships to attract public and private investment; Ability to proceed at an earlier date or reduced lifecycle costs (including debt service costs); Reduces Contribution of Federal Grant Assistance for the Project; and Construction contracting process can commence no more than 90 days from execution of a TIFIA credit instrument.

Project Example - LA Metro Crenshaw 8.5 Mile LRT Corridor: In 2012, the U.S. DOT awarded a $545.9 million TIFIA loan to Los Angeles County Metropolitan Transportation Authority (LACMTA), now LA Metro, to help build a new light rail transit line along the Crenshaw corridor. Revenue from a voter-approved local option sales tax was devoted to paying back the TIFIA loan. The loan interest rate was lower (2.43%) than the market rate. The rest of the project funding came from state general obligation bond proceeds and local voter-approved sales tax measures devoted to transportation.

Financing Capacity	Required Match	Interest Rate	Length of Terms
Must loan $50 million or more to a project	67% non-TIFIA (up to 50% non-TIFIA in some cases)	Equivalent to Treasury Rates	35 Years (up to 75 years in some cases)

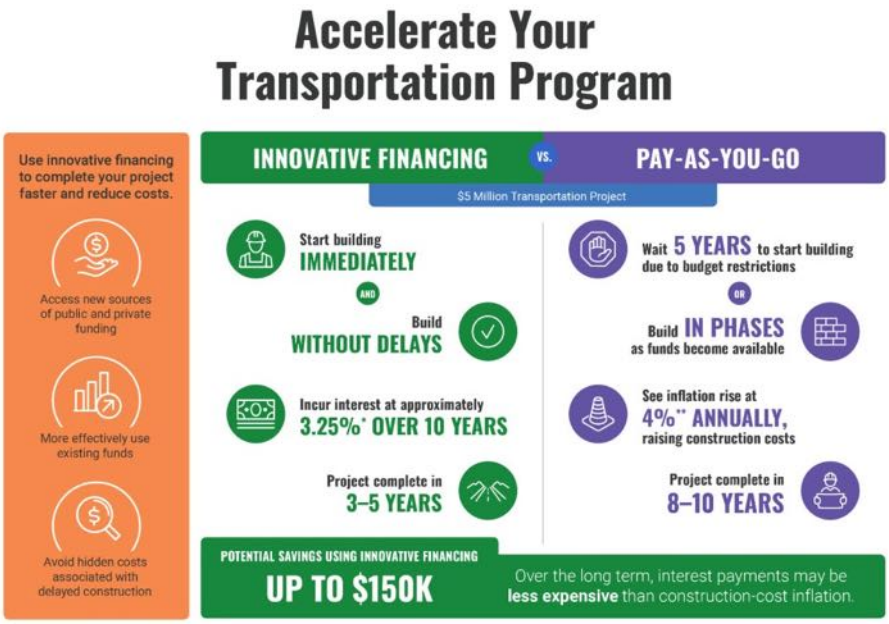


Figure 3. Infographic displaying the potential lifecycle cost savings of partially financing an infrastructure project. Source: BAB.

IBank Infrastructure State Revolving Fund (ISRF) Program

California's State Infrastructure Bank (SIB) is the California Infrastructure and Economic Development Bank (IBank), a state agency that finances economic development and public infrastructure. As a general-purpose conduit bond issuer, IBank issues tax-exempt and/or taxable bonds on behalf of a borrower and then lends those proceeds to that borrower. The bonds are special, limited obligations payable solely by the borrower's payments. The borrower provides security to the bondholder and agrees to repay the bonds.

IBank's ISRF Program is authorized to provide low-cost public financing to state and local government entities directly.

Project Example – City of Encinitas Streetscape Project on Highway 101: In 2022, the City of Encinitas received a $20 million ISRF loan for a segment of the Leucadia Streetscape project on the Coast Highway 101 Corridor. The project includes the construction of roundabouts, new wider sidewalks, buffered bike lanes, increased parking options, additional lighting, and new stormwater infrastructure.

Financing Capacity	Required Match	Interest Rate	Length of Terms
$1-65 Million	No	4.04% to 4.78% (recent years)	30 Years

Bonds

General Obligation (GO) Bonds: GO bonds are issued by governmental entities and backed by the full faith and credit of the issuing government, meaning that the government commits to using its taxing power to repay the debt. GO bonds usually have better credit ratings and are less costly to bond issuers than revenue bonds. For this reason, GO bonds typically offer lower interest rates than other forms of debt because they are considered low-risk investments. The interest rate on GO bonds is determined at the time of issuance and is influenced by factors such as market conditions, the creditworthiness of the issuing government, and the bond's term. Local GO bonds must be approved by two-thirds of voters.

Green Bonds: Green Bonds are a type of GO Bond and are generally issued for projects with positive environmental and social impacts, such as infrastructure projects that reduce GHG emissions or expand affordable mobility options. Green bonds can be useful to attract environmentally and socially conscious investors.

Revenue Bonds: Revenue bonds are typically issued to finance public facilities and are secured by the pledge of defined revenue sources from bond-funded projects, such as tolls, fares, or sales tax. Revenue bonds do not require voter approval, and unlike GO bonds, the government's full faith and credit or its taxing power is not pledged towards the repayment of revenue bonds. For this reason, revenue bonds generally have higher interest rates due to the risk of lower revenues than projected.

Project Example – Bay Area Rapid Transit (BART) Oakland Airport Connector (OAC): BART is partially funded through a 0.5% sales tax levied on the counties where the BART service operates: Alameda, Contra Costa, and San Francisco. In 2012, to fund the $485 million OAC project between the Coliseum BART Station and Oakland International Airport, BART leveraged its future sales tax revenues to issue $130.5 million in revenue bonds.

In 2022, BART issued $700 million in Green Bonds to help fund track replacement, tunnel repair, station improvements, and train control system upgrades.

Financing Capacity	Required Match	Interest Rate	Length of Terms
Varies	No	Varies	Varies

Value Capture

Value capture is a variety of mechanisms that help capitalize on the value created by infrastructure investments, such as increases in property values and economic activity. Value capture mechanisms can sometimes be used to accelerate project delivery by providing revenue for a project before or during construction, leveraging future revenues to receive upfront financing, generating a sustained revenue source for future operations and maintenance, or creating a cost-sharing mechanism with developers and owners who stand to benefit from the transportation investment.

Once again, this funding strategy does not recommend any specific value capture mechanism and only provides options to the City. There are a wide variety of considerations that impact the feasibility of a value capture mechanism and whether it is a right fit for the project area, such as:

- Understand the state-enabling legislation for value capture mechanisms, which influences the process of establishing value capture mechanisms and how funds are collected.
- Value capture is more likely to succeed when considered early in the planning process.
- Community and business support is critical to the success of most value capture mechanisms.
- The location and the geographic boundary of value capture mechanisms will impact revenue generation potential.
- Most value capture techniques depend on value creation through real estate development.
- Consider whether value capture techniques could assist financing or plug a funding gap.

There are many different value capture mechanisms and significant variations in how they are implemented. FHWA's Center for Innovative Finance Support provides resources and case studies on all forms of value capture in the U.S. However, most value capture mechanisms are not well suited for the Truxel Bridge project. The following two value capture mechanisms were selected based on their potential for generating future revenues that could potentially offset long-term debt obligations.

Tax Increment Financing (TIF)

A TIF district is a geographic area administered by a special authority in which incremental property tax value increases from infrastructure investment are captured to fund or finance the infrastructure investment. Under a pay-as-you-go approach, the project is funded only when the TIF revenue is generated, which may result in slower implementation. Under a pay-as-you-use approach, the implementing agency issues bonds to fund capital costs and immediately launch new investments. However, TIF revenues need to be relatively stable to repay the bonds. A local government may create a district with the sole purpose of funding a project. In California, there are two primary TIF mechanisms:

Enhanced Infrastructure Financing District (EIFD): EIFDs can help fund capital projects, including roadways and bridges. Revenues raised from EIFDs can be used to pay debt service on bonds and loans. EIFDs can issue bonds without a public vote if the entity's formation complies with enhanced transparency requirements. To establish an EIFD, an Infrastructure Financing Plan (IFP) must be developed and followed by three hearings. There is potential for a protest election, so it is only recommended that EIFDs be formed if most landowners and residents support it.

Community Revitalization and Investment Authority (CRIA): CRIAs are intended to provide a source of tax increment funding for infrastructure and housing in disadvantaged communities and, therefore, may only be formed in geographic areas that meet specific criteria. Areas deemed "Disadvantaged Communities" per SB 535 also qualify, including the River District. However, CRIAs are less common than EIFDs and have a lot of affordable housing production requirements, making it a less optimal TIF mechanism for a project like the Truxel Bridge.

Special Assessment Districts (SADs)/Benefit Assessment Districts (BADs)

SADs/BADs are commonly used to finance the construction, reconstruction, acquisition, or maintenance of public improvements. SADs/BADs establish a fee paid by property owners within a designated boundary whose properties are expected to benefit and increase in value due to an infrastructure investment. SADs/BADs have the potential to generate substantial revenues to fund and finance projects. Governments can spend assessment funds as they are collected (pay-as-you-go) or use assessment-backed bonds to fund the project (pay-as-you-use). However, SADs can be politically challenging to implement and cannot be formed if a majority of landowners vote against the formation of one.

Recommendations/Takeaways:

- If the City wants to explore financing a portion of the Truxel Bridge project, further analysis is required. A Project Financing Plan would include a more in-depth evaluation of the available financing options, regulatory framework, the City's debt capacity, estimated short- and long-term debt service, revenue streams to pay long-term debt service (such as value capture mechanisms), and other important considerations for determining if project financing is feasible for the Truxel Bridge project.
- Utilize technical expertise at the Build America Bureau (BAB), FHWA's Center for Innovative Finance Support, and California's IBank. Technical assistance could also be available in the form of discretionary grants, such as BAB's Regional Infrastructure Accelerator (RIA) Program.

Alternative Project Delivery Models

A project's delivery model determines the procurement strategy and contractual arrangement through which an infrastructure project is designed, constructed, and delivered to the owner. The choice of project delivery method can significantly influence the project's cost, schedule, ownership, and risk allocation.

This memo does not recommend any specific delivery method, nor does it include an in-depth analysis of which is most likely to reduce costs and expedite delivery for the Truxel Bridge project. Past data may reveal trends in cost and time savings across many infrastructure projects, but not all alternative project delivery projects result in significant costs or time savings, and unique risks are involved with each delivery method.

We recommend that the City pursue a structured approach and consult with internal project delivery resources to determine if there is an optimal delivery method for the Truxel Bridge project. Factors to consider include but are not limited to design complexity, preferred risk allocation, desired level of innovation, in-house experience/comfort, and preferred level of oversight and control. In addition, each state has laws that determine what delivery methods are allowed and/or the regulatory framework project owners need to navigate.

Design-Bid-Build (DBB)

The DBB project delivery method is used for most infrastructure projects in California, and all agencies and municipalities responsible for infrastructure are experienced in delivering DBB projects. DBB's popularity is due to the project owner's ability to perform close oversight and quality control over each phase of project delivery and, for most projects, provides a predictable project delivery timeline (assuming the availability of funding).

However, DBB puts most of the risk on the project owner, and it can be a much slower delivery method as projects get larger and more complex because of the distinct separation between the design and construction phases. Separating design and construction phases may also result in less innovative design and construction practices and may not allow the contractor adequate input on design. DBB is a reliable delivery method for more straightforward projects that do not call for much innovation or creativity.

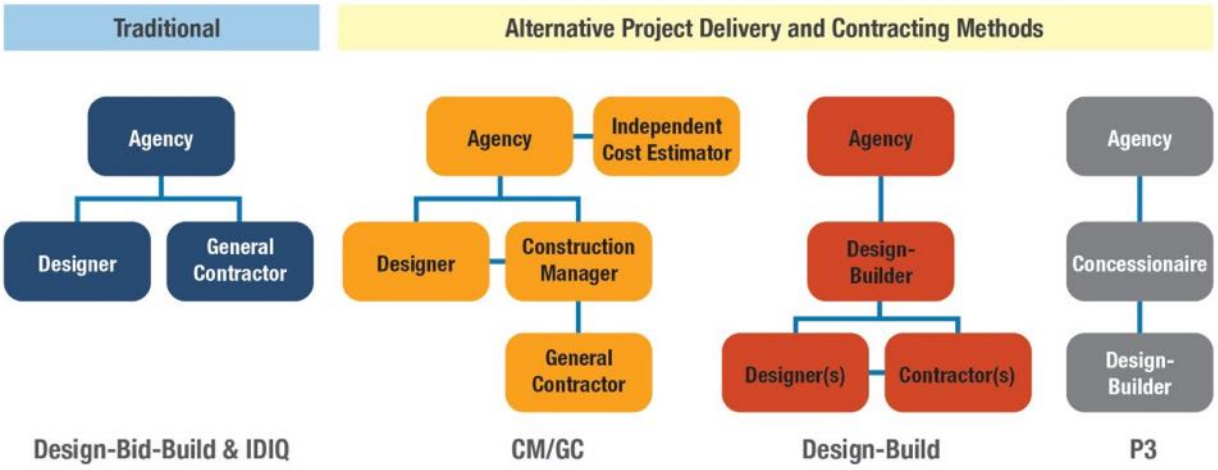


Figure 4. Structure of different delivery models. Source: FHWA.

Construction Manager/General Contractor (CM/GC)

The CM/GC project delivery method is an integrated team approach to the planning, design, and construction of the project. Owners, designers, and contractors work collaboratively to develop the project scope, optimize the design, improve quality, manage costs, and share risks. With this method, the project owner can maintain control of the design process, provide constructability reviews by the actual contractors, and potentially secure state and federal construction dollars earlier in the process.

After completing the preliminary design, the project owner procures a final designer and Construction Manager (CM) separately. The CM is selected based on qualifications, experience delivering similar projects, and its strategic approach to risk, schedule, and pricing. The successful CM applies its professional construction management capabilities throughout the design and pre-construction phases. The CM provides expertise and assistance in constructability, pricing, scheduling, staging, phasing, means and methods, efficiencies, material procurement, risk identification and mitigation, early work packages, and partner concerns. The project owner may also hire an independent cost estimator (ICE) to provide checks and balances for the CM-provided construction costs, production rates, material supplier/subcontractor costs, and phasing/schedule. The CM is not authorized to proceed with construction unless the agency agrees that the price and schedule provided are fair, reasonable, and defensible.

With CM/GC, a project owner can custom-build its entire team, including its subcontractors, to properly fit the project's specific needs and objectives. A unique partnership is formed with the project owner, CM, subcontractors, ICE, and the design and inspection professionals.

Design-Build (DB)

The DB project delivery method procures one entity, the design-builder, to perform engineering and construction under a single contract. The design-builder is usually a joint project team between a general contractor and a designer. The DB procurement process is typically two-phased: 1) qualifications and 2) "best value" design and construction. The first phase considers the qualifications of the design-builder and the history of the design-builder working together. The second phase is a "best value" competition, considering the proposed schedule, design, and cost estimate. The selected design-builder is contractually obligated to meet project performance requirements.

The project owner has reduced oversight and control with DB, but more risk is transferred to the design-builder. The contractor is responsible for the design and any flaws in the design and for completing the project within the contracted price, regardless of cost increases.

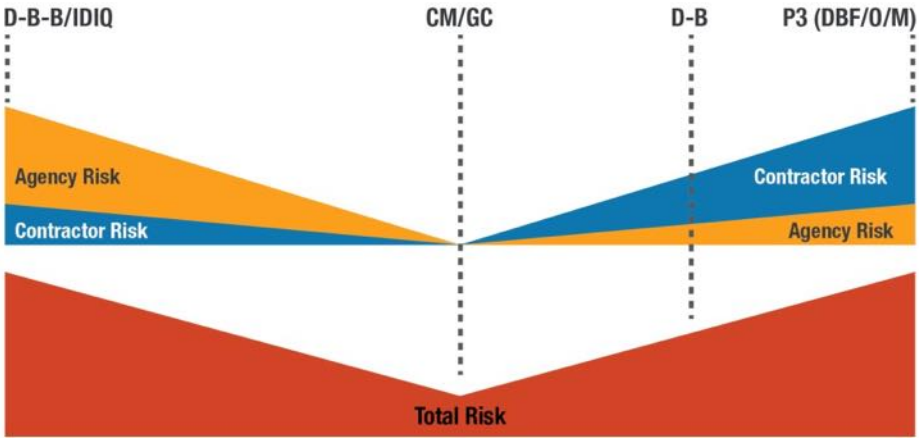


Figure 5. Risk allocation comparison between project delivery models. Source: FHWA.

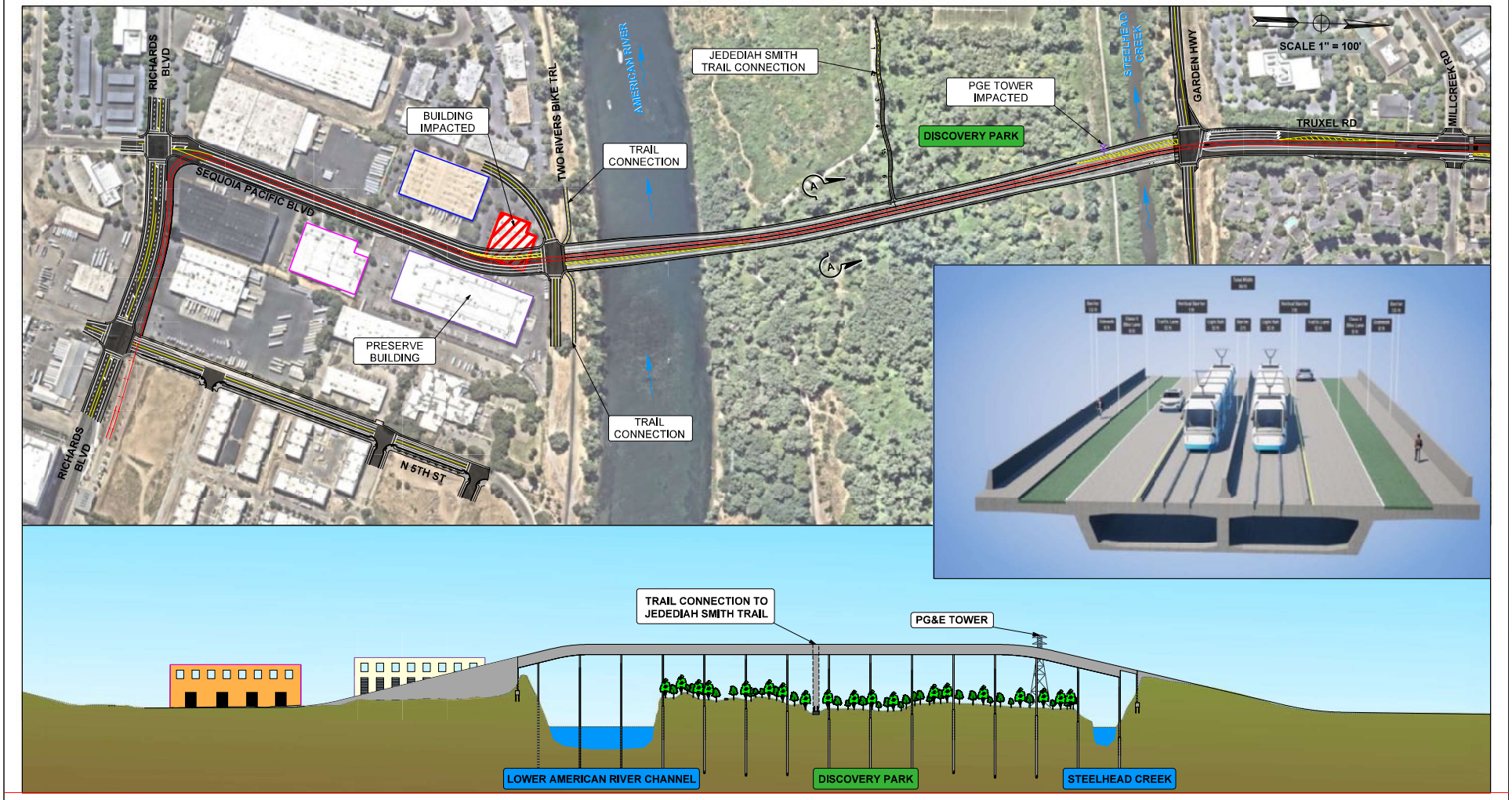
City of SACRAMENTO Department of Public Works

Truxel Bridge

DOKKEN ENGINEERING

Concept and Feasibility Study

ALIGNMENT ALTERNATIVE 1



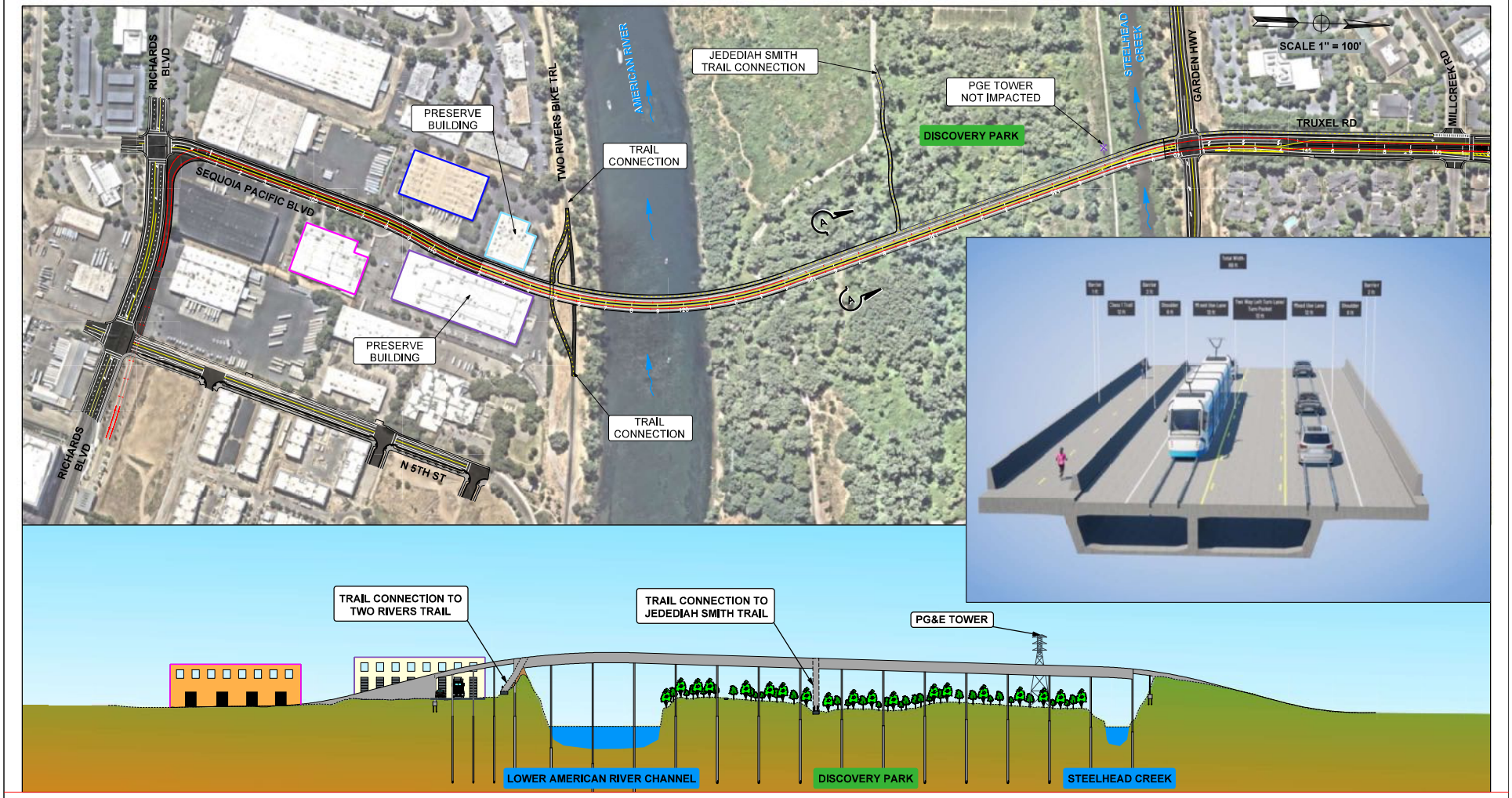
City of SACRAMENTO
Department of Public Works

Truxel Bridge

Concept and Feasibility Study

ALIGNMENT ALTERNATIVE 2

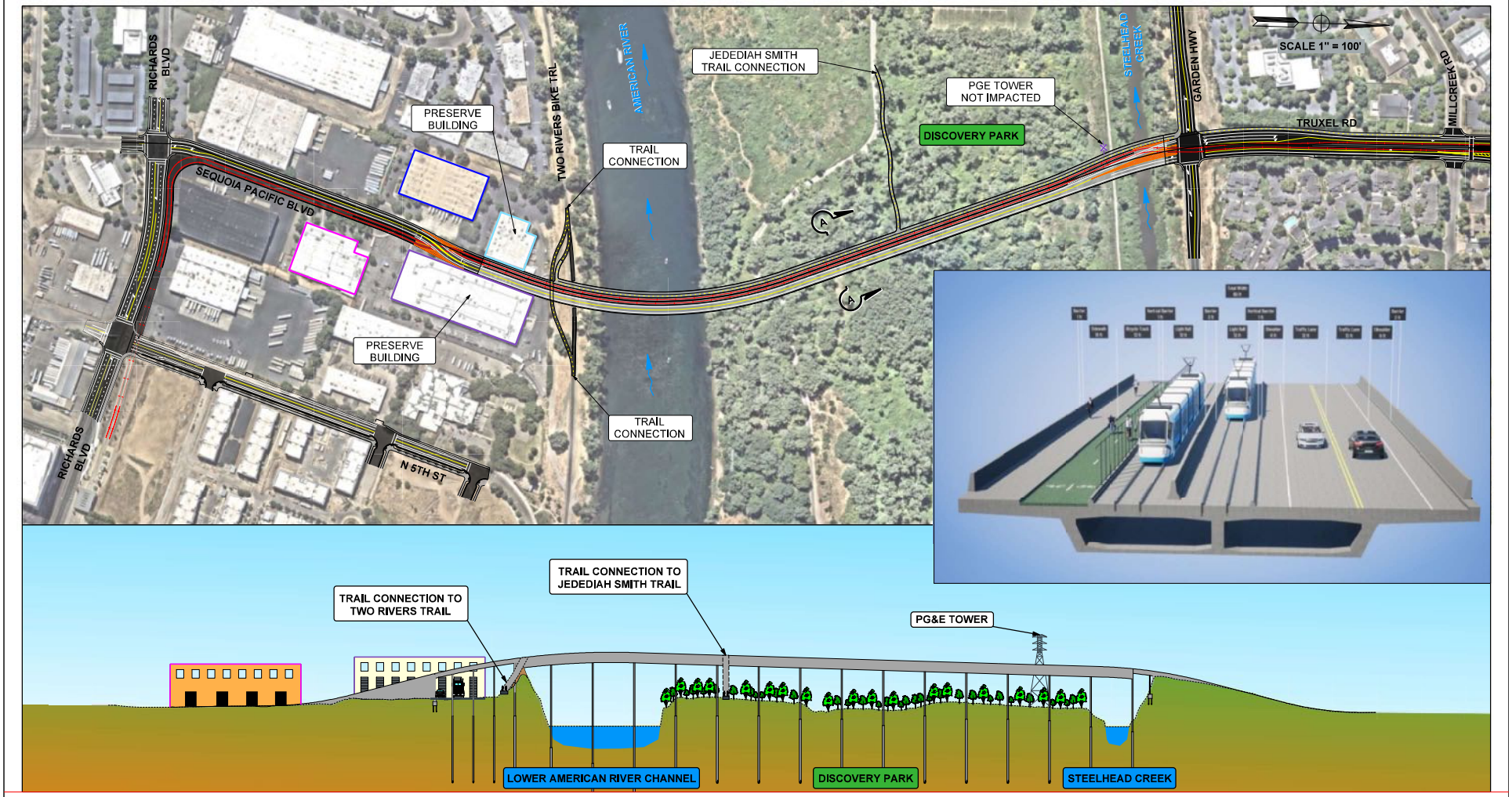
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ALIGNMENT ALTERNATIVE 3A

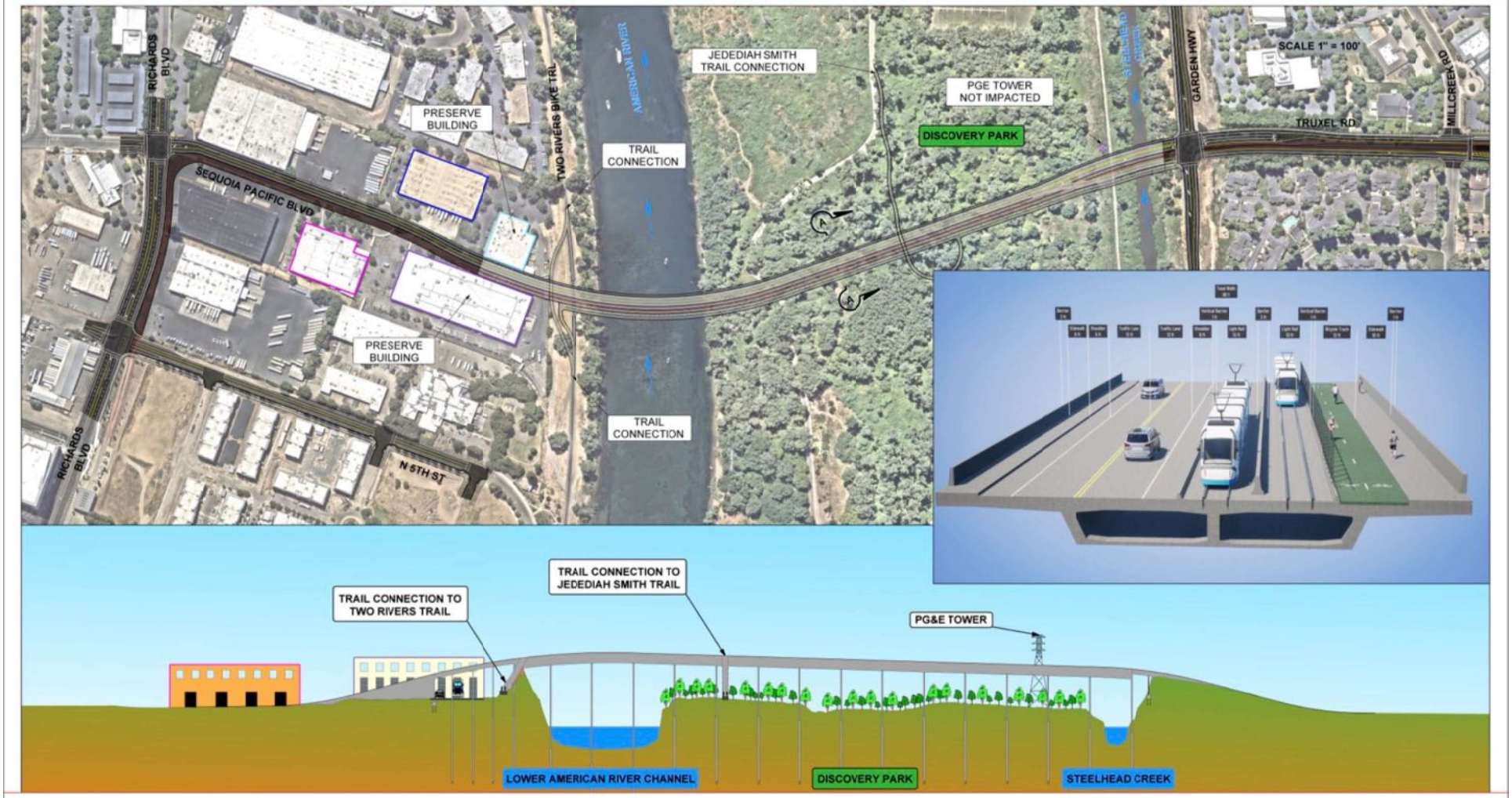
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ALIGNMENT ALTERNATIVE 3B

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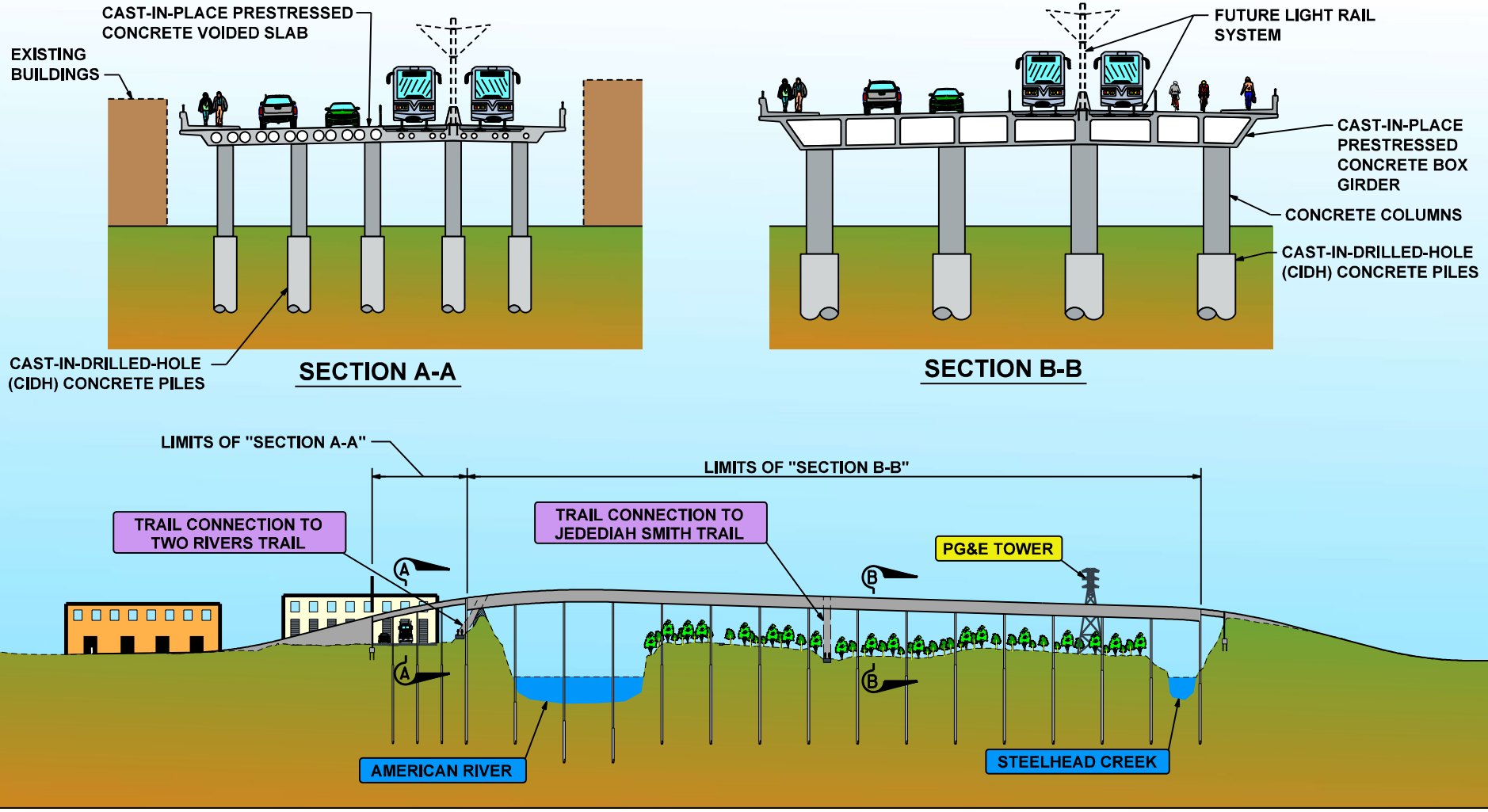
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BRIDGE STRUCTURE



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Truxel Bridge
Concept & Feasibility Study

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PROJECT COSTS

Cost Category	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B
Total Roadway Cost	$40.3M	$22.2M	$22.9M	$22.8M
Total Structures Cost	$182.0M	$149.5M	$188.5M	$197.6M
Subtotal Construction Cost	$222.3M	$171.7M	$211.4M	$220.4M
Total Right of Way Cost	$73.0M	$7.5M	$8.0M	$8.0M
Total Capital Costs	**$295.3M**	**$179.2M**	**$218.4M**	**$227.4M**