DRAFT FINAL
ALTERNATIVES ANALYSIS REPORT

MANTECA DRYLAND LEVEE PROJECT

March 2022

Prepared for

San Joaquin Area Flood Control Agency (SJAFCA)

California Department of Water Resources (DWR)

Prepared by

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BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

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1. INTRODUCTION

In August of 2020, Wood Rodgers, Inc. (Wood Rodgers) was contracted by the San Joaquin Area Flood Control Agency (SJAFCA) to conduct an alternatives analysis of levee alignment, length, and improvements south of Manteca necessary to provide a 200-year level of flood protection (a 200-year flood has a 1-in-200 (0.5%) chance of occurring in any given year) to Reclamation District 17 (RD 17), also known as Mossdale Tract.

Wood Rodgers' Scope of Work primarily consisted of building on the preferred alternative known as "Alternative 2A" (Alt 2A), identified through a Drake Haglan study commissioned by the City of Manteca in 2016. In the Drake Haglan effort, Alt 2A was developed largely from community input, without detailed technical (i.e. geotechnical, environmental and hydrologic/hydraulic) analyses. The Wood Rodgers team evaluated Alt 2A through a more technical lens in order to confirm that there were no technical fatal flaws with that alternative. During the analysis, additional alignments were developed with input from community stakeholders.

This report was prepared to summarize the Manteca Dryland Levee Project (Project) Alternatives Analysis effort, present recommendations for a preferred alignment, and identify next steps for the implementation of the Project.

1.1. Project Location/Regional Setting

This Project is located at the southern end of the Mossdale Tract area, on the south side of the City of Manteca, with elements of the project both within and outside of the Manteca city limits, bounded to the west by the San Joaquin River and to the east by Tinnin Road. The Mossdale Tract Area that would be protected by this project contains 22,400 acres of land with a current population of approximately 45,000 and includes urban portions of Manteca, Stockton, Lathrop, and areas of unincorporated San Joaquin County. These areas are protected by RD 17 levees. The Mossdale Tract Area also includes a large rural subarea which has not been planned for development.

An overview of the Project area is shown on **Figure 1** (attached).

1.2. Project Need

As noted above, the goal of this effort is to identify a plan to modify or extend the dryland levee in the southern portion of Manteca in order to provide a 200-year urban level of flood protection to the Mossdale Tract Area. This is necessary for the cities within the protected area to be in compliance with Senate Bill 5 (SB 5), legislation which requires that urban and urbanizing areas provide a 200-year level of protection by the year 2028.

1.3. Stakeholders and Other Consulted Parties

Stakeholders for the Alternatives Analysis include:

- The City of Manteca
- The City of Lathrop
- California Department of Water Resources (DWR)

- San Joaquin County

Other Consulted Parties for this Alternatives Analysis include:

- The City of Stockton
- Reclamation District 17
- SSJID
- Landowners

Each of the above parties were engaged in the preparation of this Alternatives Analysis. All were invited to participate in monthly/semi-monthly conference calls held throughout the duration of the Project.

Further, three community meetings were held to keep both the stakeholders and the local landowners informed during the Alternatives Analysis process, with the first taking place on August 2nd 2021, the second on October 4th, 2021, and the third on December 16th, 2021. The objectives of the meetings included introducing SJAFCA as the project lead, providing an overview of the study's purpose and scope, sharing data being used to formulate alternatives, and developing avenues for landowner engagement and two-way communication.

1.4. Document Purpose and Scope

This report provides a feasibility-level assessment of the flood hazards and risks in the Project area. Alternatives that could be implemented in order to address these risks are also described, as well as the approach and methodology used to evaluate the alternatives in an effort to identify a preferred alternative. Based on this, a preferred alternative is presented in this report with recommended next steps.

2. BACKGROUND

2.1. Previous Local Studies and Relationship to Regional Plans

To achieve 200-year flood protection and to demonstrate "adequate progress", in 2014 the Cities of Lathrop and Manteca jointly funded agreements with Peterson Brustad, Inc. (PBI) to: 1) provide 200-year water surface profiles in the San Joaquin River; 2) develop 200-year floodplains (and depths); and 3) complete an Urban Levee Design Criteria (ULDC) Analysis and Identification of Deficiencies required to provide an urban level of flood protection (ULOP) for RD 17 levees within their respective cities. These efforts provided Lathrop and Manteca with the critical information necessary to make a "finding of adequate progress" (Adequate Progress) toward providing ULOP 200-year flood protection for the urbanized and urbanizing areas of the cities.

On July 5, 2016, the Manteca City Council adopted the Findings of Adequate Progress toward providing a 200-year ULOP in RD 17. As part of this effort, PBI developed a multi-phase levee improvement plan, which included the extension of the dry land levee in the southern portion

of Manteca. A preliminary alignment was developed for the dryland levee extension and Adequate Progress Findings that extended the dry land levee to the east. Although this alignment achieves the Project goal of providing 200-year flood protection, there were a number of concerns voiced by the property owners in the vicinity of the proposed improvements.

In response to these concerns, the Manteca City Council approved a Professional Services Agreement with Drake Haglan and Associates. The Scope of Work for this contract included public outreach, project management, and developing conceptual alignments for the purpose of working with stakeholders to build consensus on the preferred alignment for the dryland levee extension.

Drake Haglan and Associates developed seven alternatives for evaluation based upon the following criteria:

- Meet DWR criteria for "wise use of floodplains"
- Minimize impacts to farmland
- Minimize impacts to property owner access
- Stay on property lines as much as possible
- Utilize existing easements
- Accommodate entitled properties
- Reach consensus among stakeholders
- Cost

The final recommended alternative (called Alternative 2A) met all criteria with a projected cost of approximately $12.1 million at the time of the recommendation (2016). Other alternatives that were explored in that study were deemed either non-compliant or cost-prohibitive.

In 2018, the Cities of Lathrop and Manteca became members of SJAFCA. As a result, SJAFCA became the sole Local Flood Management Agency (LFMA) for the Mossdale Tract Area (the area protected by RD 17 levees) with the responsibility to prepare the adequate progress report. Most recently, in June 2019, Larsen Wurzel & Associates prepared the "*Mossdale Tract Area: 2019 Annual Adequate Progress Report (APR) for Urban Level of Protection Final Report*". The APR is available on SJAFCA's website at (https://www.sjafca.com/pdf/mossdale/Report0418.pdf). It has been determined that the existing levees protecting the Mossdale Tract Area do not meet the updated DWR ULDC standards adopted in May 2012, and the existing levees are not currently certified to provide 200-year protection. Accordingly, SJAFCA, in close coordination with its member agencies, is pursuing efforts to achieve ULOP by 2025.

The LFMA's plan for flood protection through the year 2025, as described in the APR, consists of two components: 1) RD 17's ongoing Levee Seepage Repair Project (LSRP); and 2) SJAFCA Levee Improvements to achieve ULDC 200-year requirements, which includes an extension of the existing dryland levee.

2.2. Flood Hazards, Challenges, and Risks

2.2.1. Sources of Flooding

The purpose of the Manteca Dryland Levee is to provide flood protection to RD 17 in the event of a failure of existing upstream levees along the right bank of the Stanislaus River and/or the right bank of the San Joaquin River between the MDL and the Stanislaus River.

In order to determine the location of the breach(es) along those rivers that would result in the highest depth of flooding against the MDL, a sensitivity analysis was performed, with the results used to inform the alternatives analysis effort. See Attachment 1 for detailed information on the sources of flooding the sensitivity analysis that we performed.

2.2.2. Climate Change

The RD 17 levees protecting the Mossdale Tract Area do not meet the ULDC required by SB 5 and, therefore, do not provide an urban level of protection for the current climate conditions. This problem is exacerbated by the potential for increased flood magnitudes in the future due to climate change. The 2017 Central Valley Flood Protection Plan (CVFPP) estimated significant late 21st Century climate change impacts on the hydrology of the San Joaquin River System with potentially significant increases in flood stages. The ULDC does not require the current design to be based on anticipated climate change hydrology, but does recommend evaluating the potential effects based on available information to inform options for building resiliency into the design.

In response to the climate change projection from the CVFPP, SJAFCA adopted a Climate Change Adaptation Policy in 2019, with the intent to incorporate additional project resiliency. The Policy requires a factor of safety to address uncertainty in climate change flood flow projections and in sea level rise and includes plans to acquire real estate necessary to support potential future levee raises and extensions based on the 2065 climate change hydrology. The Policy also provides for periodic review and update as the accuracy of projections improves. See Attachment 1 for more information on climate change assumptions.

2.2.3. Existing and Future Floodplains

Due to the potential effects of climate change, both the Existing 200-year floodplain and Future 200-year floodplain were analyzed for this effort, with the Future 200-year based on the 2017 CVFPP late 21st Century horizon. See Attachment 1 for more information on the methodology for developing these floodplains.

A summary of the Existing and Future design water surface elevations (WSEs) is provided below in **Table 1**.

Table 1
Existing and Future 200-Year Design Water Surface Elevations

Item	Existing 200-year WSE	Future 200-year WSE

Base 200-year WSE (ft., NAVD 88)	31.5	35.4
Uncertainty Adjustment (ft.)	1.0	1.0
Adjusted DWSE (ft., NAVD 88)	32.5	36.4

Note: For reference, the crown elevation of the existing dryland levee is approximately 34.5 ft. (NAVD 88).

2.2.4. Geotechnical Challenges

The near surface soil in the Project area predominantly consists of loose to medium dense, and in some areas dense, silty sand (SM), clayey sand (SC), and poorly-graded sand (SP) underlain mainly by medium dense to dense poorly-graded sand (SP), intermittent layers of silty sand (SM) and sandy silt (ML), and lean clay (CL) to depths of over 100 feet. Based on the stratigraphy of the subsurface soils, underseepage and settlement due to liquefaction are considered to be the major geotechnical challenges that will need to be addressed.

Groundwater in the Project area is typically encountered at depths ranging from approximately 10 to 20 feet below existing site grade. Logs of borings in 2008 indicate that groundwater was detected at depths ranging between 15 and 26 feet. More recently, drilled boring performed by DWR in 2014 encountered groundwater at depths ranging between 7 and 12 feet below existing site grade.

See **Attachment 2** for more detailed information on the geotechnical evaluations and recommendations included in this analysis

2.3. Land Use and Critical Infrastructure

2.3.1. Land Use

The land use in the analysis area is a mixture of agricultural parcels intermixed with low-density residential parcels and urbanized land.

2.3.2. Critical Infrastructure

The following critical infrastructure is located within the Mossdale Tract area:

- San Joaquin General Hospital
- Kaiser Permanente Manteca Medical Center
- San Joaquin County Jail
- San Joaquin County Honor Farm
- San Joaquin County Juvenile Hall
- 32 schools
- Four fire stations
- Two police stations
- Two wastewater treatment plants
- Interstate 5
- State Route 120
- Two major railroads

2.4. Environmental Constraints Analysis

A desktop analysis was performed in order to determine potential environmental, biological, and cultural constraints in the Project area, and to compare the various Project alternatives included in this alternatives analysis for how they might result in environmental impacts. The desktop analysis found that there are some potential impacts that could require mitigation for

a variety of environmental resources; however, there was no substantial difference between the proposed alternatives as they relate to the natural environment. Each alternative would impact the human environment differently; however, those impacts would be more directly associated with the need for public right-of-way to build the proposed levee facility and not directly connected with traditional environmental resources. It is recommended that an Environmental Site Assessment be conducted in future Project phases to confirm the findings of the desktop study.

For detailed information on the analyses performed, the results and the recommendations, please see the Environmental Analysis Report, which can be found as **Attachment 3** to this report.

3. EVALUATION CRITERIA

Each alternative developed was evaluated against specific criteria and was subjectively assigned a rating. The ratings identified for each element of the analysis consisted of "Poor", "Fair", "Good", or "Excellent" based on how well each alternative achieved the desired objective. A description of the criteria and the basis for the ratings applied to each are described below.

3.1. Flood Risk Reduction Benefits

This criterion applies to the extent to which an alternative would reduce flood risk to people and property within the 200-year floodplain. Specifically, the total number of residences, businesses, economic assets, and critical infrastructure protected by each alternative were used as metrics to compare the flood risk reduction benefits between alternatives.

In order to provide a metric to evaluate and compare the flood risk reduction benefits associated with each of the alternatives considered in this analysis, each alternative was qualitatively assessed based on its ability to provide flood protection for events up to a 200-year event.

Alternatives that are expected to provide flood risk reduction against 200-year flood events were rated as "Good". Alternatives that are expected to provide flood risk reduction and are resilient against flood events equal to a 500-year flood event were rated "Excellent".

Since all alternatives are designed to provide protection from the 200-year flood event and not the 500-year event, all alternatives were assigned a "Good" rating. While it is recognized that a criterion that assigns all alternatives the same rating does not have an effect on the comparison in this alternatives analysis, this criterion was included because it is an important aspect of any flood control project and it should be recognized that it was considered.

3.2. Flood System Resiliency

Flood system resiliency is the ability of the flood management system to continue to function and recover quickly after damaging floods.

In order to provide a metric to evaluate the resiliency of each alternative, each alternative was qualitatively assessed based on its ability to remain resilient for events up to a 200-year event. Alternatives that are expected to remain resilient against flood events up to a 200-year flood event were rated "Good". Alternatives that would sustain significant damage for flood events up to a 200-year flood event were rated as "Poor".

Since all alternatives were designed to protect from a 200-year flood event and therefore, would not sustain damage from a 200-year event (or smaller), all alternatives were assigned a rating of "Good" While it is recognized that a criterion that assigns all alternatives the same rating does not have an effect on the comparison in this alternatives analysis, this criterion was included because it is an important aspect of any flood control project and it should be recognized that it was considered.

3.3. Hydraulic Impacts/Transfer of Risk Considerations

This consideration is beyond the scope of this document and is currently being analyzed by SJAFCA in a separate effort. It has been included as a discussion item because it is an important consideration and the information should be added in future phases when more data is available.

3.4. Floodplain Management/Wise Use of the Floodplain

The 2017 CVFPP Update describes Wise Use of Floodplains (Wise Use) as enjoying the benefits of floodplain lands and waters while still minimizing the loss of life and damage from flooding and, at the same time, preserving and restoring the natural resources of floodplains as much as possible. Wise Use, thus, is any activity or set of activities that are compatible with both the risks to the natural resources of floodplains and the risks to human resources (life and property). For example, opportunities for habitat restoration and passive recreation to be introduced in the protected area are considered Wise Use of the floodplain. Therefore, the extents to which an alternative would not increase urbanization in undeveloped areas and in areas of deep or rapid flooding were used as metrics to evaluate each alternative's Floodplain Management performance.

Alternatives that were thought to minimize development in areas within the existing 200-year floodplain were rated as "Good". Alternatives that would be expected to promote comparatively more development within the existing 200-year floodplain were rated "Fair". These were the only two rating classifications.

3.5. Improve Operation and Maintenance

Each of the alternatives considered in this analysis have different Operation and Maintenance (O&M) requirements. The degree to which an alternative is believed to impact O&M requirements was used to qualitatively assess each alternative. Each of the alternatives was assigned a rating of "Excellent", "Good", "Fair", or "Poor" depending on the expected impact to O&M requirements. The criteria used to rate the O&M impact for each alternative is shown below in **Table 2**.

Table 2
O&M Rating Criteria

	Reduce Current O&M Activities	**No Change to Current O&M Activities**	**Slight/Moderate Increase to O&M Activities**	**Moderate/Significant Increase to Current O&M Activities**
Rating Assigned	Excellent	Good	Fair	Poor

3.6. Stakeholder Support

It is important that any alternative selected to move forward be supported by local agencies, including the SJAFCA, the City of Manteca, the City of Lathrop, DWR, San Joaquin County and RD 17, as well as the landowners that make up the local community.

It should be noted that during the coordination efforts with the local agencies (as described in Section 1.3), it was determined that the seepage berm option would be preferred to the cutoff wall, as berms have historically been the seepage mitigation choice for RD 17 in the Project area. Maintaining consistency throughout the levee system was an important consideration, as it allows for ease of operations and maintenance. It was also noted that Alignment 2 is preferred to Alignment 1, because Alignment 2 would involve the removal of 5,400 feet of existing dryland levee from service (see Figure 1), replacing it with a more direct alignment and ultimately resulting in an overall shorter length of levee embankment.

Similarly, feedback received during public outreach meetings indicated that the local landowners also preferred the seepage berm mitigation option versus the cutoff wall, due to concerns over the possible effects a cutoff wall may have on groundwater levels. It was also noted that alignments that would minimize impacts to existing structures would be preferred to those that did not.

This criterion was developed to quantify how well each alternative aligned with the preferences of both the local agencies and landowners as stated above. As such, each of the alternatives was qualitatively assigned a rating of "Good", "Fair", or "Poor" depending on how closely it aligned with those preferences.

3.7. Real Estate Impacts

In order to assign ratings for this criterion, the expected real estate impacts of the alternatives were compared to one another, with each being qualitatively assigned a rating of "Fair" or "Poor", depending on their performance. The quantity of land required for each alternative and the number of residences impacted were both taken into account in these comparisons. As such, cutoff wall alternatives were rated higher than seepage berm alternatives due to their relative impact on adjacent landowners. Also, alignment alternatives that are expected to impact fewer existing structures and residences were rated higher than others that impacted more structures and residences. Using these two criteria as a guide, alternatives that were expected to minimize real estate impacts were given a rating of "Fair", while alternatives that would have relatively more impact were given a rating of "Poor".

3.8. Overall Rating

After ratings were designated for each of the individual criteria, an overall rating was developed for the purpose of ranking the alternatives in relation to each other. The overall ratings were developed by assigning numerical values to the "Excellent", "Good", "Fair", "Poor", and "Unacceptable" individual criteria ratings and summarizing the values associated with each alternative.

"Excellent" ratings were assigned a value of four points; "Good" ratings were assigned a value of three points; "Fair" ratings were assigned a value of two points; and "Poor" ratings were assigned a value of one point. An overall rating was then determined based on the total points associated with each alternative, as shown in **Table 3**.

Table 3
Overall Rating Criteria

	24 – 20	**19 – 15**	**14 – 10**	**≤ 9**
Rating Assigned	Excellent	Good	Fair	Poor

3.9. Estimated Costs

An estimate of the probable construction cost was prepared for each alternative. Cost was not an explicit evaluation criterion; however, the estimated construction cost was used to compare alternatives with similar overall ratings. The approach used to develop cost estimates is discussed in more detail later in this document.

4. BASIS FOR PRELIMINARY DESIGN

4.1. General

The guidance of the DWR ULDC was used to determine the required geometry and height of the alternatives evaluated in the Alternatives Analysis, with 20-foot crown widths and 3:1 slopes on both the landside and waterside. The determination of the levee height will be discussed later in this report. The ULDC was also used to ensure that appropriate seepage and stability criteria were achieved with each alternative. Each of the specific criterion used to develop the alternatives are described below.

4.2. Topographic Mapping

Topographic mapping was obtained from the DWR Central Valley Floodplain Evaluation and Delineation (CVFED) Program LiDAR data set. This data was collected in the spring of 2008, but is considered sufficient for use in this level of analysis. The horizontal accuracy of the post-processed LiDAR data is 3.5 feet at the 95-percent confidence level. Vertical accuracy is 0.6 foot at the 95-percent confidence level. This accuracy is sufficient for developing 1-foot contour mapping.

The mapping is presented in the NAVD 88 datum. This datum is also the basis for elevations reported within this report.

4.3. Design Water Surface Elevation and Minimum Top of Levee

The approach to develop the Design Water Surface Elevation (DWSE) was based on guidance provided in the DWR ULDC. The ULDC offers two options for determining the appropriate DWSE and the Minimum Top-of-Levee (MTOL). These are the Federal Emergency Management Agency (FEMA) deterministic approach and the United States Army Corps of

Engineers (USACE) combined deterministic and probabilistic approaches. The FEMA approach was used as the basis for the DWSE and MTOL in this AA effort. The FEMA approach was selected because it frequently results in higher and, therefore, more conservative water surface elevations than does the USACE approach.

The ULDC recommends that the DWSE be adjusted to consider potential increases associated with climate change, updated hydrology, updated hydraulic modeling, and sea level rise. To meet this recommendation, two climate change scenarios were analyzed for this effort: the "current" climate change and the "future" climate change. Section 2.2.3 of this report contains more information on these scenarios.

The MTOL in the ULDC is defined as the DWSE plus a freeboard of three feet. However, the freeboard is to be increased if the anticipated wind setup and wave run-up exceed three feet. Based on the wind setup and wave run-up analysis prepared by Peterson Brustad in 2019, a freeboard adjustment of five feet was used west of Airport Way and an adjustment of three feet was used east of Airport Way.

An additional adjustment of one foot was added to the base 200-year DWSE to account for uncertainty in climate change and geotechnical factors. Please note that detailed information on the development of the DWSE and the associated adjustment factors is described in Attachment 1.

Based on the information presented in Attachment 1, the recommended MTOL is 37.5 feet (31.5+1+5) west of Airport Way and 35.5 feet (31.5+1+3) east of Airport Way. It should be noted that this MTOL is higher than the "future" climate change WSE, which was determined to be 35.4 ft.

Table 4
Minimum Top of Levee Summary

Item	West of Airport Way	East of Airport Way
Base 200-year DWSE (ft., NAVD88)	31.5	31.5
Uncertainty Adjustment (ft.)	1	1
Adjusted DWSE (ft., NAVD88)	32.5	32.5
Freeboard Adjustment (ft.)	5	3
Minimum Top of Levee Elevation (ft., NAVD88)	37.5	35.5

4.4. Geotechnical Considerations

To determine the geotechnical conditions for the Project area, existing data was reviewed for the area in the vicinity of the proposed improvements. A site visit was also performed to observe surficial conditions. These efforts concluded that seepage and settlement due to

liquefaction were the primary challenges that would need to be considered in the development of the alternatives. In order to account for these concerns, the alternatives include two options for seepage mitigation, a seepage berm and a cutoff wall, as well as a one-foot MTOL adjustment for uncertainty to account for possible settlement due to liquefaction. More detailed information on the geotechnical investigation methodology, findings, and recommendations can be found in **Attachment 2**.

4.5. Land Acquisition/Right of Way

Minimization of real estate impacts was one of the guiding principles of the preliminary design. All possible effort was made to route alignments that the least amount of land and fewest structures possible would be impacted.

5. PRELIMINARY ARRAY OF ALTERNATIVES

The Alternatives Analysis considered an array of potential alternatives to meet the stated goals of the Project. Each of the specific flood protection alternatives for these areas are described below.

5.1. Alternatives Not Included in this Analysis

In the preliminary stages of this analysis, a preliminary array of alternatives was developed; and as the study progressed, it was determined that some of the alternatives should not be included in the detailed analysis because it was clear that they would not meet Project objectives by simple inspection. Below is a brief description of each alternative that was considered part of the preliminary array, but was not ultimately included in the detailed alternative analysis.

5.1.1. No Action Alternative

As the name implies, this alternative proposes that no action be taken. This alternative was not included because it is not considered relevant for evaluation at this time by the Project proponent.

5.1.2. Drake Haglan Alt 2A Alignment

The Drake Haglan Alt 2A alignment was removed from the detailed analysis because the alignment results in approximately the same length of new embankment as Alt 2 (discussed later in this report), but does not have the benefit of removing any existing levee from service. This would result in construction costs that are similar to the Alt 2 alignments costs but would provide less benefit.

5.1.3. Other Drake Haglan Alternatives

The remaining alternatives from the Drake Haglan study were reviewed and found to be infeasible due to direct issues with cost, Wise Use of the floodplain, stakeholder support, or one of the other criteria with which the alternatives were to be evaluated. As such, it was found to be unnecessary to bring these alternatives into this more detailed analysis.

5.2. Alternatives Included in the Alternatives Analysis

The four alternatives included in this analysis are based on two distinct alignments, Alignment 1 and Alignment 2; and each alignment would have two separate seepage mitigation options, a cutoff wall or a seepage berm. A detailed description of each of the resulting alternatives can be found below. Figure 1 provides a high-level overview of the two alignments.

5.2.1. Alt 1C

This alternative consists of a levee embankment with a top elevation of 37.5 feet west of Airport Way and 35.5 feet east of Airport Way. The levee embankment follows Alignment 1, which begins at the termination point of the existing dryland levee and extends east, jogging north as necessary to minimize real estate impacts and ending at the high ground located at Tinnin Road. This results in the levee embankment having an approximate total length of 8,700 feet.

To provide seepage mitigation, this alternative includes a soil-bentonite cutoff wall with an approximate depth of 85 feet from existing ground. This cutoff wall will run from the beginning of the new levee embankment (at the eastern terminus of the existing dryland levee) and end where the hydraulic loading of the levee is less than two feet (which is between Oleander Avenue and Union Road), for a total cutoff wall length of 4,700 feet.

This alternative will also require raising the roads where they cross the new levee alignment in order to bring them up and over the levee. Airport Way, Oleander Avenue, and Union Road will all require raising under this alternative.

Modifications to existing irrigation supply infrastructure would also be required where crossings exist. This alternative proposes to install positive closure devices at each of these crossings, which would total two for this alternative.

A graphical depiction of this alternative is included as **Figure 2** (attached).

5.2.2. Alt 1S

This alternative consists of a levee embankment with a top elevation of 37.5 feet west of Airport Way and 35.5 feet east of Airport Way. The levee embankment follows Alignment 1, which begins at the eastern terminus of the existing dryland levee, extends east while jogging north as necessary to minimize real estate impacts, and ends at the high ground located at Tinnin Road. This results an approximate total length of levee embankment of 8,700 feet.

To provide seepage mitigation, this alternative includes a 100-foot-wide, five-foot-tall (at the landside levee toe) seepage berm. This seepage berm will run from the beginning of new levee embankment (at the termination of the existing dryland levee) and end where the hydraulic loading of the levee is less than two feet (which occurs between Oleander Avenue and Union Road), for a total berm length of 4,700 feet.

This alternative would also require raising the roads where they cross the new levee alignment in order to bring them over the levee. Airport Way, Oleander Avenue, and Union Road would all require raising under this alternative.

Modifications to existing irrigation supply infrastructure would also be required where crossings exist. This alternative proposes to install positive closure devices at irrigation crossings, of which two are expected for this alternative.

A graphical depiction of this alternative is included as **Figure 3** (attached).

5.2.3. Alt 2C

This alternative consists of a levee embankment with a top elevation of 37.5 feet west of Airport Way and 35.5 feet east of Airport Way. The levee embankment follows Alignment 2, which begins at Station 853+50 of the existing dryland levee, continuing eastward to Airport Way and then jogs northeast to avoid impacts to the residences on Fig Avenue. The alignment then continues east until turning southeast and tying into high ground near the intersection of Fig Avenue and Union Road. This results an approximate total length of levee embankment of 12,100 feet.

To provide seepage mitigation, this alternative includes a soil-bentonite cutoff wall with an approximate depth of 85 feet from existing ground. The cutoff wall would begin at the new levee embankment (at Station 853+50 of the existing dryland levee) and end where the hydraulic loading of the levee is less than two feet at the intersection with Oleander Avenue, for a total cutoff wall length of 9,200 feet.

This alternative would also require raising the roads where they cross the new levee alignment in order to bring them over the levee. Airport Way and Oleander Avenue would require raising under this alternative.

Modifications to existing irrigation supply infrastructure would also be required where crossings exist. This alternative proposes to install positive closure devices at irrigation crossings, of which one is expected for this alternative. Relocation of an existing drainage ditch would also be required east of Airport Way. This ditch would be relocated south of the new levee embankment, tying into the existing ditch at both the upstream and downstream ends.

A graphical depiction of this alternative is included as **Figure 4** (attached).

5.2.4. Alt 2S

This alternative consists of a levee embankment with a top elevation of 37.5 feet west of Airport Way and 35.5 feet east of Airport Way. The levee embankment follows Alignment 2, which begins at Station 853+50 of the existing dryland levee, continues eastward to Airport Way and then jogs northeast to avoid impacts to the residences on Fig Avenue. The alignment then continues east until turning southeast and tying into high ground near the intersection of Fig Avenue and Union Road. This results an approximate total length of levee embankment of 12,100 feet.

To provide seepage mitigation, this alternative includes a 100-foot-wide, five-foot-tall (at the landside toe) seepage berm. This seepage berm would run from the beginning of the new levee embankment (at Station 853+50 of the existing dryland levee) and end where the hydraulic loading of the levee is less than two feet at the intersection with Oleander Avenue, for a total berm length of 9,200 feet.

This alternative would also require raising of the roads where they cross the new levee alignment in order to bring them over the levee. Airport Way and Oleander Avenue will require raising under this alternative.

Modifications to existing irrigation supply infrastructure will also be required where crossings exist. This alternative proposes to install positive closure devices at irrigation crossings, of which one is expected for this alternative. Relocation of an existing drainage ditch would also be required east of Airport Way. This ditch will be relocated south of the new levee embankment, tying into the existing ditch at both the upstream and downstream ends.

A graphical depiction of this alternative is included as **Figure 5** (attached).

6. BASIS FOR ESTIMATED COSTS

6.1. General

To estimate the Project costs, unit prices were developed and material quantities were calculated for the Project features associated with each alternative. Unit prices for typical floodwall and levee construction (such as site clearing, embankment fill, cutoff wall, and seepage berm fill) were determined based upon recent contractor bid summaries for applicable improvement projects in Northern California. Where recent bid tabulations were not available, cost-determination publications (such as RS Means' *Heavy Construction Cost Data*) were used to develop costs. Costs are presented in 2021 dollars.

Due to the uncertainty associated with site conditions and the pre-planning level of the design formulation, a 30-percent contingency has been included in the cost estimate for each line item. Planning, Engineering, and Design were included at 8 percent; Environmental Mitigation was included at 7 percent; and Construction Management was included at 6 percent. Cost estimates are contained in **Attachment 5** (attached).

6.2. Land Acquisition

The Project area is comprised of both agricultural land and residential parcels. While the alternatives were designed to minimize the impact on residential parcels, some impacts are unavoidable. In order to properly quantify the land acquisition need of each alternative, the land was separated into two cost categories: Residential and Agricultural.

The acreage of agricultural land was determined for each alternative footprint, and an estimated unit cost for this land type was applied to those acreages in order to determine a high-level estimate of acquisition costs. While it is recognized that variations in crop type can have a significant effect on the value of agricultural land, development of land value for each parcel was beyond the scope of this report. It is recommended that detailed parcel costs be developed as part of future phases of the project.

For residential areas, research on home values was performed on sites such as Redfin.com and Zillow.com to determine approximate home values in the area. Individual prices for each affected property were added together to determine the acquisition cost for each alternative.

It should be noted that the proposed road raisings included in the alternatives are expected to have an impact on many of the adjacent residences. For this analysis, it was conservatively assumed that if access would be impacted, the parcel would be acquired. In future phases of design, accommodations for providing access to the impacted parcels, such as adding ramps or other site grading, may be plausible for some of the less-impacted parcels.

6.3. Cost Implications for Decommissioning Existing Levees

Alternatives 2C and 2S would both result in the removal of approximately 5,400 feet of the existing RD 17 levee from service. This would provide a cost benefit due to that length of existing levee no longer requiring rehabilitation. In order to make a fair comparison between the alternatives that do result in this length of existing levee being removed (Alts 2C and 2S) and the ones that do not (Alts 1C and 1S), it was determined that the cost of remediation of that 5,400 feet of levee would be added to the costs of Alternatives 1C and 1S. See Figure 1 for a graphical representation of the length of existing levee to be removed.

The cost of this remediation was determined by using the total cost for the remediation of the existing dryland levee to calculate a unit cost on a per-foot basis, and applying that to the 5,400 feet that would be removed. This resulted in a cost adjustment amount of $19.7 million (2021 dollars). It should be noted that the total cost for the remediation of the existing dryland levee was referenced from the KSN Technical Memorandum entitled "*San Joaquin Area Flood Control Agency, Mossdale Tract Area ULDC Climate Change Adjustment - Consolidated Cost Estimate*".

7. ALTERNATIVES ANALYSIS

7.1. Alt 1C

7.1.1. Flood Risk Reduction Benefits

This Alternative would provide 200-year flood protection benefits for the Project area, but would not provide protection above the 200-year flood event. For that reason, this alternative was assigned a Flood Risk Reduction rating of "Good".

7.1.2. Flood System Resiliency

This Alternative would remain resilient against flood events up to the 200-year event, but may sustain damage for larger events. Therefore, the Flood System Resiliency rating is "Good".

7.1.3. Hydraulic Impacts/Transfer of Risk Considerations

This consideration is currently being studied by SJAFCA in an effort separate from this analysis and, as such, is considered beyond the scope of this document. It has been included as an evaluation criterion because it is anticipated that information will be added in future phases.

7.1.4. Floodplain Management/Wise Use of the Floodplain

This alternative would not remove a significant amount of land from the 200-year floodplain. For that reason, it was assigned a Floodplain Management rating of "Good".

7.1.5. Operations and Maintenance Considerations

Each of the alternatives analyzed will result in additional length of levee embankment that will require O&M effort; however, given that the Alternative 1 alignment is longer than the Alternative 2 alignment (12,100 feet in length versus 8,700 feet), this would result in comparatively more additional effort. Furthermore, the Alternative 1 alignment does not result in the removal of any of the existing RD 17 dryland levee, which also requires O&M.

In terms of seepage mitigation measures, the cutoff wall would not require additional O&M effort.

For those reasons, this alternative was given an Operations and Maintenance Considerations rating of "Fair".

7.1.6. Stakeholder Support

Given that this alternative does not include either of the stakeholder's preferred elements, it was assigned a Stakeholder Support ranking of "Poor".

7.1.7. Real Estate Impacts

This alternative is based on Alignment 1, which is longer than Alignment 2. Therefore, real estate impacts would be higher for alternatives based on Alignment 1 than for those based on Alignment 2.

Alignment 1 also results in more residential land impacts, as Union Road will need to be raised as part of the alternatives based on that alignment.

For seepage mitigation measures, this alternative includes a cutoff wall, which has no impact on adjacent parcels.

For the reasons given above, this alternative was assigned a Real Estate Impacts rating of "Fair".

7.1.8. Overall Rating

Based on the information and the individual ratings above, this alternative has three "Good" ratings, two "Fair" ratings, and one "Poor" rating, for a total of 14 points. Therefore, an overall rating of "Fair" was assigned.

7.1.9. Estimated Costs

This alternative would have an estimated cost of approximately $31.1 million, with an additional $19.7 million to be added to account for the remediation of the 5,400 feet of existing dryland levee (as explained in Section 6.3), for a total of $50.8 million. For more details regarding the estimated construction cost, see Attachment 5.

7.2. Alt 1S

7.2.1. Flood Risk Reduction Benefits

This alternative would provide 200-year flood protection benefits for the Project area, but would not provide protection above the 200-year flood event. For that reason, this alternative was assigned a Flood Risk Reduction rating of "Good".

7.2.2. Flood System Resiliency

This alternative would remain resilient against flood events up to the 200-year event but could sustain damage for larger events. Therefore, the Flood System Resiliency rating is "Good".

7.2.3. Hydraulic Impacts/Transfer of Risk Considerations

This consideration is currently being studied by SJAFCA in a separate effort from this analysis and, therefore, is considered beyond the scope of this document. It has been included as an evaluation criterion because it is anticipated that information will be added in future phases.

7.2.4. Floodplain Management/Wise Use of the Floodplain

This alternative would not remove a significant amount of land from the 200-year floodplain. For that reason, it was assigned a Floodplain Management rating of "Good".

7.2.5. Operations and Maintenance Considerations

Each of the alternatives analyzed will result in additional length of levee embankment that will require O&M effort; however, given that the Alternative 1 alignment is longer than the Alternative 2 alignment (12,100 feet in length versus 8,700 feet), factoring in O&M considerations would result in comparatively more additional effort. Furthermore, the Alternative 1 alignment does not result in the removal of any of the existing RD 17 dryland levee, which also requires O&M.

In terms of seepage mitigation measures, the seepage berm would require additional O&M efforts, similar to the O&M efforts for the levee embankment.

For those reasons, this alternative was given an Operations and Maintenance Considerations rating of "Poor".

7.2.6. Stakeholder Support

Given that this alternative has only one of the stakeholder's preferred elements (seepage berm), it was assigned a Stakeholder Support ranking of "Fair".

7.2.7. Real Estate Impacts

This alternative is based on Alignment 1, which is longer than Alignment 2. Therefore, real estate impacts would be higher for alternatives based on Alignment 1 than those based on Alignment 2.

Alignment 1 also results in more residential land impacts, because Union Road will need to be raised as part of the alternatives based on that alignment.

For seepage mitigation measures, this alternative includes a seepage berm, which results in a larger real estate impact than the cutoff wall.

For the reasons given above, this alternative was assigned a Real Estate Impacts rating of "Poor".

7.2.8. Overall Rating

Based on the information and the individual ratings above, this alternative had three "Good" ratings, one "Fair" rating, and two "Poor" ratings, for a total of 13 points. Therefore, an overall rating of "Fair" was assigned.

7.2.9. Estimated Costs

This alternative would have an estimated cost of approximately $35.1 million, with an additional $19.7 million to be added to account for the remediation of the 5,400 feet of existing dryland levee (as explained in Section 6.3), for a total of $54.8 million. For more details regarding the estimated construction cost, see Attachment 5.

7.3. Alt 2C

7.3.1. Flood Risk Reduction Benefits

This alternative would provide 200-year flood protection benefits for the Project area, but would not provide protection above the 200-year flood event. For that reason, this alternative was assigned a Flood Risk Reduction rating of "Good".

7.3.2. Flood System Resiliency

This alternative would remain resilient against flood events up to the 200-year event, but could sustain damage for larger events. Therefore, the Flood System Resiliency rating is "Good".

7.3.3. Hydraulic Impacts/Transfer of Risk Considerations

This consideration is currently being studied by SJAFCA in a separate effort from this analysis and, therefore, is considered beyond the scope of this document. It has been included as an evaluation criterion because it is anticipated that information will be added in future phases.

7.3.4. Floodplain Management/Wise Use of the Floodplain

In comparison with the other alternatives, this alternative would result in more land being added to the protected area. For that reason, it was assigned a Floodplain Management rating of "Fair".

7.3.5. Operations and Maintenance Considerations

Each of the alternatives analyzed will result in an additional length of levee embankment that will require O&M effort; however, given that the Alternative 1 alignment is longer

than the Alternative 2 alignment (12,100 feet in length versus 8,700 feet), Alternatives 1C and 1S would result in comparatively more additional effort. Furthermore, the Alternative 2 alignment results in the removal of approximately 5,400 feet of the existing RD 17 dryland levee, realigning it to an overall shorter length which would result in less O&M effort.

In terms of seepage mitigation measures, the cutoff wall would not require additional O&M effort.

For those reasons, this alternative was given an Operations and Maintenance Considerations rating of "Good".

7.3.6. Stakeholder Support

Given that this alternative has only one of the stakeholder's preferred elements (Alignment 2), it was assigned a Stakeholder Support ranking of "Fair".

7.3.7. Real Estate Impacts

This alternative is based on Alignment 2, which is shorter than Alignment 1. Therefore, real estate impacts will be lower for alternatives based on Alignment 2 than for the alternatives that are based on Alignment 1.

Alignment 2 also results in fewer residential land impacts, because Union Road is not affected by the alternatives based on this alignment.

For seepage mitigation measures, this alternative includes a cutoff wall, which has no impact on adjacent parcels.

For the reasons given above, this alternative was assigned a Real Estate Impacts rating of "Fair".

7.3.8. Overall Rating

Based on the information and the individual ratings above, this alternative had three "Good" ratings and three "Fair" ratings, for a total of 15 points. Therefore, an overall rating of "Good" was assigned.

7.3.9. Estimated Costs

This alternative would have an estimated cost of approximately $41.3 million. For more details regarding the estimated construction cost, see Attachment 5.

7.4. Alt 2S

7.4.1. Flood Risk Reduction Benefits

This alternative would provide 200-year flood protection benefits for the Project area, but would not provide protection above the 200-year flood event. For that reason, this alternative was assigned a Flood Risk Reduction rating of "Good".

7.4.2. Flood System Resiliency

This alternative would remain resilient against flood events up to the 200-year event, but could sustain damage for larger events. Therefore, the Flood System Resiliency rating is "Good".

7.4.3. Hydraulic Impacts/Transfer of Risk Considerations

This consideration is currently being studied by SJAFCA in a separate effort from this analysis and, therefore, is considered beyond the scope of this document. It has been included as an evaluation criterion because it is anticipated that information will be added in future phases.

7.4.4. Floodplain Management/Wise Use of the Floodplain

In comparison with the other alternatives, this alternative would result in more land being added to the protected area. For that reason, it was assigned a Floodplain Management rating of "Fair".

7.4.5. Operations and Maintenance Considerations

Each of the alternatives analyzed will result in an additional length of levee embankment that will require O&M effort; however, given that the Alternative 1 alignment is longer than the Alternative 2 alignment (12,100 feet in length versus 8,700 feet), Alternatives 1C and 1S would result in comparatively more additional effort. Furthermore, the Alternative 2 alignment results in the removal of approximately 5,400 feet of the existing RD 17 dryland levee, realigning it to an overall shorter length, which would result in less O&M effort.

In terms of seepage mitigation measures, the seepage berm would require additional O&M efforts, similar to the O&M efforts for the levee embankment.

For those reasons, this alternative was given an Operations and Maintenance Considerations rating of "Fair".

7.4.6. Stakeholder Support

Given that this alternative has both of the stakeholder's preferred elements (Alignment 2 and seepage berm), it was assigned a Stakeholder Support ranking of "Good".

7.4.7. Real Estate Impacts

This alternative is based on Alignment 2, which is shorter than Alignment 1. Therefore, real estate impacts will be lower for alternatives based on Alignment 2 than for the alternatives that are based on Alignment 1.

Alignment 2 also results in fewer residential land impacts, because Union Road is not affected by the alternatives based on this alignment.

For seepage mitigation measures, this alternative includes a seepage berm, which results in a larger real estate impact than the cutoff wall.

For the reasons given above, this alternative was assigned a Real Estate Impacts rating of "Fair".

7.4.8. Overall Rating

Based on the information and the individual ratings above, this alternative had three "Good" ratings, three "Fair" ratings, for a total of 15 points. Therefore, an overall rating of "Good" was assigned.

7.4.9. Estimated Costs

This alternative would have an estimated cost of approximately $50.5 million. For more details regarding the estimated construction cost, see Attachment 5.

8. RESULTS AND DISCUSSIONS

8.1. Results

A performance summary of the alternatives considered in this analysis is shown below in **Table 5**.

Table 5
Performance Summary

Alternative Ratings for Individual Project Objectives	**Alternatives**			
	1C	**1S**	**2C**	**2S**
Flood Risk Reduction Benefits	Good	Good	Good	Good
Flood System Resiliency	Good	Good	Good	Good
Hydraulic Impacts/Transfer of Risk Considerations	N/A	N/A	N/A	N/A
Floodplain Management / Wise Use of the Floodplain	Good	Good	Fair	Fair
O&M Considerations	Fair	Poor	Good	Fair
Stakeholder Support	Poor	Fair	Fair	Good
Real Estate Impacts	Fair	Poor	Fair	Fair
Overall Rating	**Fair (14/24)**	**Fair (13/24)**	**Good (15/24)**	**Good (15/24)**

Estimated Cost	$31,113,800	$35,140,100	$41,312,900	$50,534,800
Cost Adjustment	$19,700,000	$19,700,000	$ -	$ -
Adjusted Cost	**$50,813,800**	**$54,840,100**	**$41,312,900**	**$50,534,800**

9. CONCLUSIONS AND RECOMMENDATIONS

9.1. Preferred Plan

Based on the results of this Alternatives Analysis, the preferred plan is Alternative 2C. It is the highest rated alternative and has the lowest overall estimated cost once adjustments are factored in.

Alternative 2S should also be considered a viable option moving forward. It shares the same rating as Alternative 2C and, while it has a higher estimated cost, is the preferred alternative of RD 17.

Community meetings were held to engage with landowners on potential alternatives, but those meetings did not result in landowner consensus on or support for any particular alternative.

9.2. Next Steps

Overall, this Alternatives Analysis should be used to inform the ongoing basin-wide planning efforts. This will allow for a cohesive plan for flood control on a basin-wide level.

Completion of the Transfer of Risk assessment that is currently underway will be a major step toward being able to move this Project forward. It is recommended that, once the assessment is complete, the findings of this analysis be revisited to ensure that they are still valid in light of any new information coming from the Transfer of Risk assessment.

Once the validity is confirmed, SJAFCA can make an informed decision on a locally preferred alternative in coordination with stakeholders and the community. Funding sources for final design and construction will also need to be identified.

Once a locally-preferred alternative has been identified for construction and funding is secured, the next major Project phase would be preparation of the preliminary design, environmental studies, and an environmental document. Additional outreach to and engagement with landowners will continue during this phase. After completion of the environmental documentation, the Project would advance to the final design phase and local property owners would be engaged for negotiating property acquisition.

Finally, once the design is complete and the necessary properties have been acquired, the Project could advance to construction.

10. REFERENCES

1. (DWR, 2012). Urban Levee Design Criteria. May 2012. Available at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Urban-Levee-Design-Criteria--2012.pdf
2. (Drake Haglan Associates, 2016) Dryland Levee Alignments – City Council Presentation
3. (MBK Engineers, 2021) H&H Report – *TITLE TO BE UDPATED WHEN AVAILABLE*
4. (Kleinfelder, 2021) Preliminary Geological and Geotechnical Assessment, Alternative Levee Alignments, Proposed Manteca Dryland Levee Alignments, Manteca California
5. (Wood Rodgers Inc., 2021) Environmental Constraints Analysis, Manteca Dryland Levee Project
6. (United States Army Corps of Engineers, 2018) USACE Lower San Joaquin River Feasibility (LSJRFS)
7. (Peterson Brustad, Inc. 2014) Lower San Joaquin and Delta South Regional Flood Management Plan
8. (California Department of Water Resources, 2017) The 2017 Central Valley Flood Protection Plan
9. (California Department of Water Resources, 2017) DWR draft Basin-Wide Feasibility Study (BWFS) San Joaquin Basin
10. (Peterson Brustad Inc., 2014) 200-year Freeboard Analysis and Floodplain Mapping within RD017
11. (Peterson Brustad, Inc., 2016) ULDC Evaluation of the RD-17 Levee
12. (Larsen Wurzel & Associates, Inc., 2016) 200-yr Urban Level of Protection Adequate Progress Study
13. (Peterson Brustad Inc., 2019) Appendix B: Mossdale Tract Area Urban Flood Risk Reduction, Wind Wave Analysis Technical Memorandum
14. (Kjeldson Sinnock Neudeck Inc., 2021) San Joaquin Area Flood Control Agency, Mossdale Tract Area ULDC Climate Change Adjustment, Consolidated Cost Estimate Technical Memorandum

FIGURES

FIGURE 1
ALIGNMENT ALTERNATIVES
MANTECA DRYLAND LEVEE
CITY OF MANTECA, CA
JANUARY 2022

Reclamation District No. 17 - Mossdale Tract

EXISTING RD 17 DRYLAND LEVEE TO BE REMOVED FROM SERVICE AS PART OF ALIGNMENT 2 ALTERNATIVES.

TIE IN TO EXISTING DRYLAND LEVEE AT APPROXIMATE STATION 853+50.

TIE IN TO EXISTING DRYLAND LEVEE AT APPROXIMATE STATION 959+00 (END OF EXISTING DRYLAND LEVEE).

TIE IN TO HIGH GROUND (ABOVE CURRENT 200 YEAR FLOODPLAIN)

TIE IN TO HIGH GROUND (ABOVE CURRENT 200 YEAR FLOODPLAIN)

WOODWARD AV
MCKINLEY AV
MADEN GRASS AV
SEPHOS ST
MACEDO ST
ALFONSECA LN
LAVENDER ST
TINNIN
PEACH AV
PEACH AV
UNION RD
TINNIN RD
FIG AV
AIRPORT WY
OLEANDER AV
NILE AV
NILE AV

Legend

- Alignment 1
- Alignment 2
- Existing RD 17 Levee
- Existing RD 17 Levee Removed in Alignment 2 Alternatives
- Reclamation District No. 17 - Mossdale Tract
- City Limits
- Transportation Corridor
- River/Stream

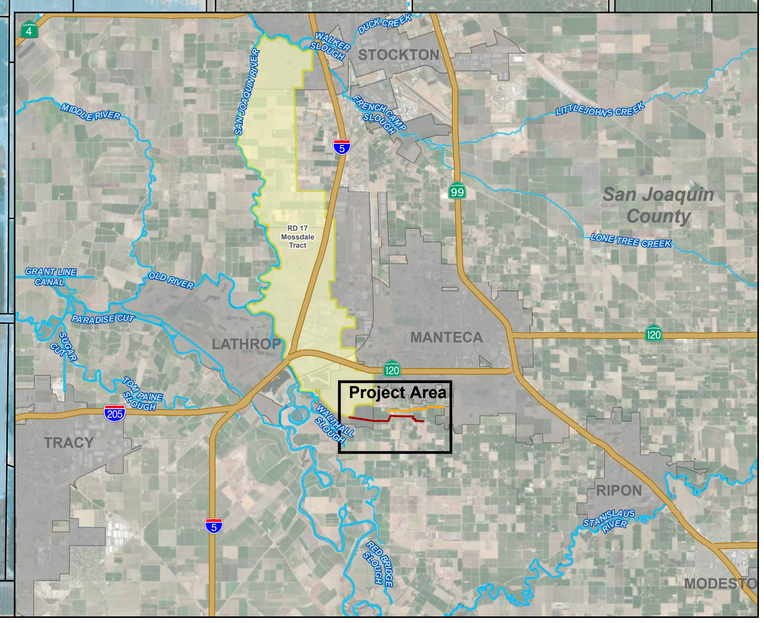
Current 200 Year Flood Depth

- <1ft
- 1ft - 3ft
- >3ft
- Future 200yr Flood Extent

0 250 500 1,000
Feet

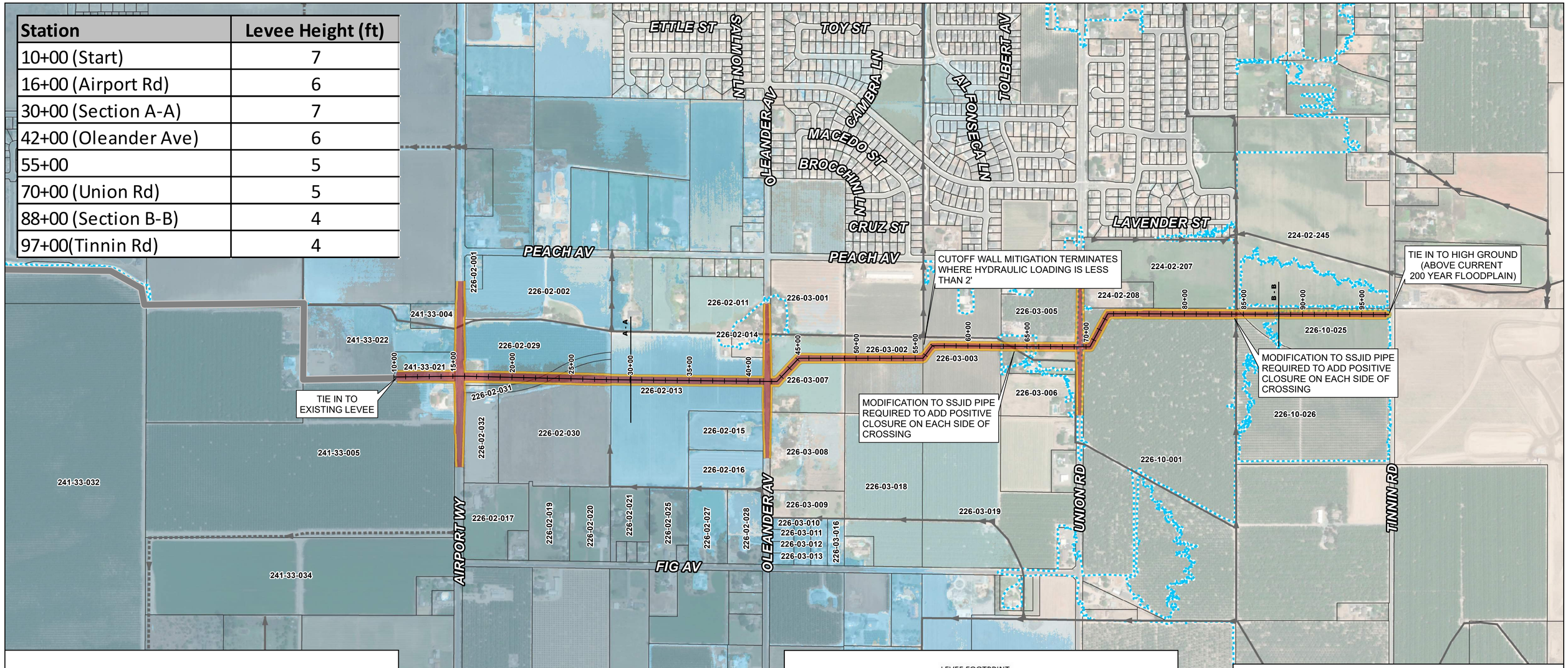
NORTH

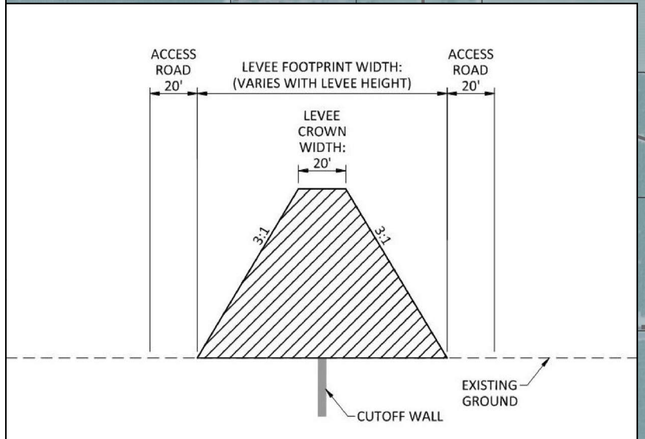
WOOD RODGERS



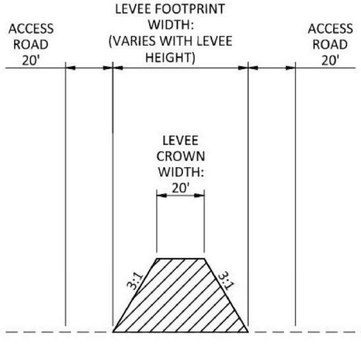
\\woodrodgers.loc3\Production\Data\Jobs\6820_SJAF\CA6820001_Manteca_DLL_Alts\GIS\Tasks\Alternatives_Analysis\2021\0299\Figure 1 Alignment Alternatives.mxd 1/25/2022 3:45:56 PM jfaoro

Station	Levee Height (ft)
10+00 (Start)	7
16+00 (Airport Rd)	6
30+00 (Section A-A)	7
42+00 (Oleander Ave)	6
55+00	5
70+00 (Union Rd)	5
88+00 (Section B-B)	4
97+00(Tinnin Rd)	4





TYPICAL CROSS SECTION A-A
NOT TO SCALE
VERTICAL EXAGGERATION: 5X



TYPICAL CROSS SECTION B-B
NOT TO SCALE
VERTICAL EXAGGERATION: 5X

FIGURE 2
ALTERNATIVE 1-C
CUTOFF WALL
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
JANUARY 2022

Legend

- Levee Centerline
- Levee Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Parcel

SSJID Facilities
- Drainage Ditch
- Supply Pipeline

Current 200 Year Flood Depth
- <1ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

0 200 400 800
Feet

NORTH

WOOD RODGERS

Station	Levee Height (ft)
10+00 (Start)	7
16+00 (Airport Rd)	6
30+00 (Section A-A)	7
42+00 (Oleander Ave)	6
55+00	5
70+00 (Union Rd)	5
88+00 (Section B-B)	4
97+00(Tinnin Rd)	4

GARY OWENS ST
MAEHL DR
AL FONSECA LN
MACEDO ST
BROCCHINI LN
CRUZ ST
SEPHOS ST
LOVEJOY AV
PACOLA AV
LAVENDER ST
PEACH AV
PEACH AV
224-02-245
224-02-207
224-02-208
226-02-001
226-02-002
226-02-011
226-03-001
226-03-005
241-33-004
241-33-022
226-02-014
226-03-002
226-02-029
241-33-021
226-03-003
226-03-007
226-02-031
226-02-013
226-03-006
226-10-025
226-10-026
226-02-032
226-02-030
226-02-015
226-03-008
241-33-005
226-02-016
226-10-001
AIRPORT WY
OLEANDER AV
UNION RD
TINNIN RD
FIG AV
NILE AV
A - A
B - B
10+00
15+00
20+00
25+00
30+00
35+00
40+00
45+00
50+00
55+00
60+00
65+00
70+00
80+00
85+00
90+00
95+00

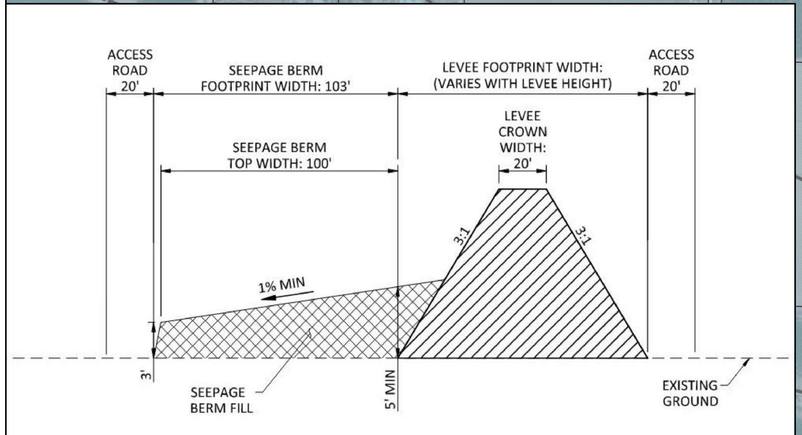
TIE IN TO HIGH GROUND (ABOVE CURRENT 200 YEAR FLOODPLAIN)

MODIFICATION TO SSJID PIPE REQUIRED TO ADD POSITIVE CLOSURE ON EACH SIDE OF CROSSING

MODIFICATION TO SSJID PIPE REQUIRED TO ADD POSITIVE CLOSURE ON EACH SIDE OF CROSSING

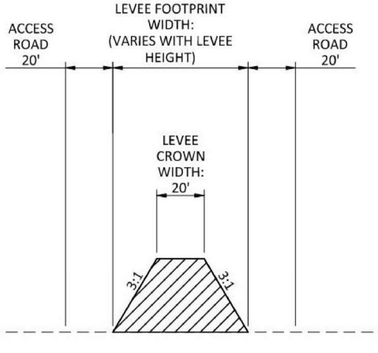
TIE IN TO EXISTING LEVEE

SEEPAGE MITIGATION TERMINATES WHERE HYDRAULIC LOADING IS LESS THAN 2'



TYPICAL CROSS SECTION A-A

NOT TO SCALE
VERTICAL EXAGGERATION: 5X



TYPICAL CROSS SECTION B-B

NOT TO SCALE
VERTICAL EXAGGERATION: 5X

FIGURE 3
ALTERNATIVE 1-S
SEEPAGE BERM
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
JANUARY 2022

Legend

- Levee Centerline
- Levee Footprint
- Seepage Berm Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Parcel

SSJID Facilities
- Drainage Ditch
- Supply Pipeline

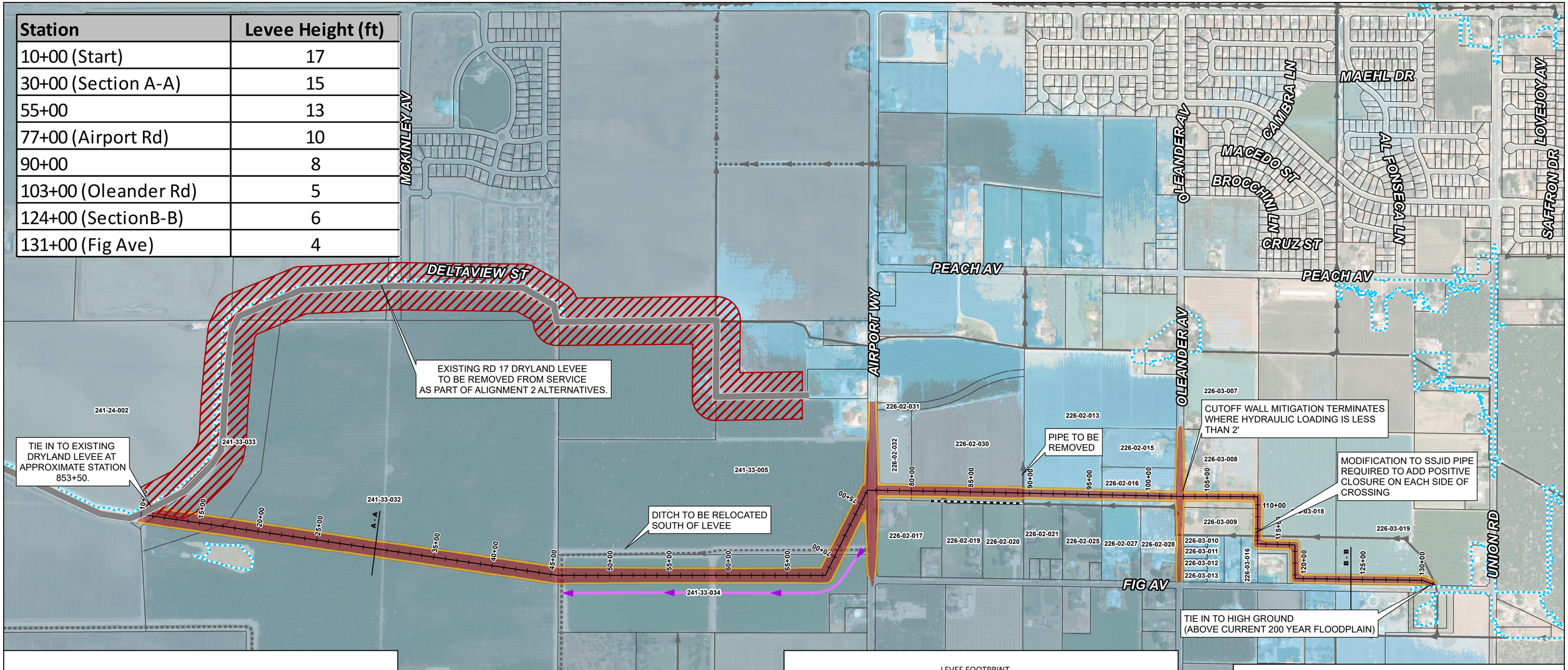
Current 200 Year Flood Depth
- <ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

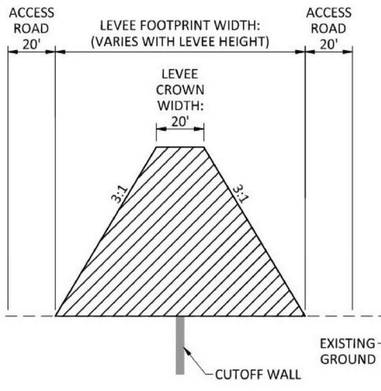
0 200 400 800
Feet

NORTH

WOOD RODGERS

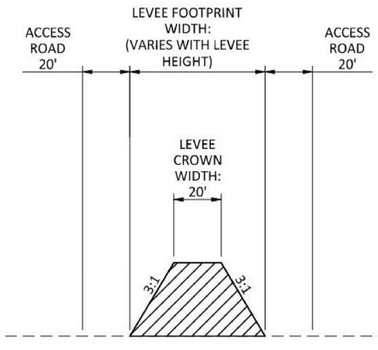
Station	Levee Height (ft)
10+00 (Start)	17
30+00 (Section A-A)	15
55+00	13
77+00 (Airport Rd)	10
90+00	8
103+00 (Oleander Rd)	5
124+00 (SectionB-B)	6
131+00 (Fig Ave)	4





TYPICAL CROSS SECTION A-A

NOT TO SCALE
VERTICAL EXAGGERATION: 5X



TYPICAL CROSS SECTION B-B

NOT TO SCALE
VERTICAL EXAGGERATION: 5X

FIGURE 4
ALTERNATIVE 2-C
CUTOFF WALL
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
JANUARY 2022

Legend

- Levee Centerline
- Levee Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Existing RD 17 Levee Removed in Alignment 2 Alternatives
- Parcel
- Private Irrigation Pipe

SSJID Facilities

- Drainage Ditch
- Supply Pipeline
- Drainage Ditch Reroute

Current 200 Year Flood Depth

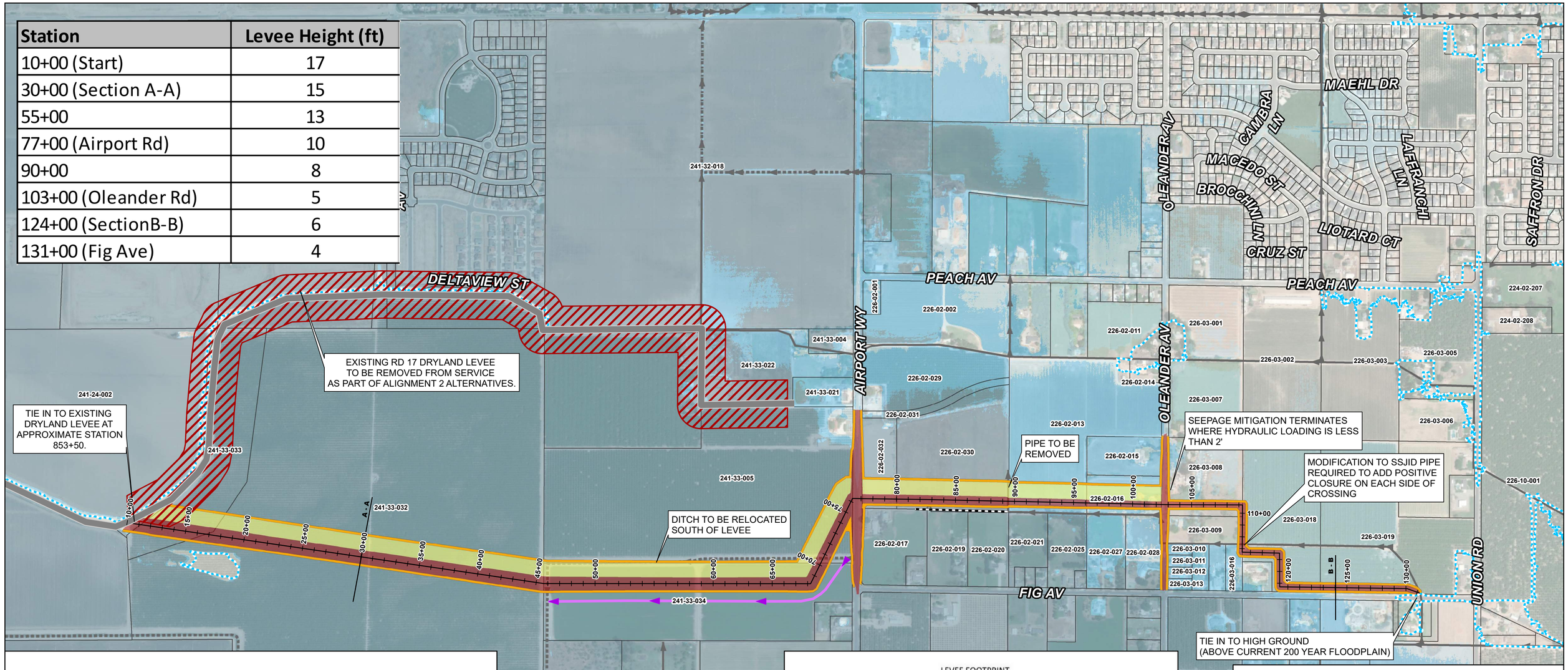
- <ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

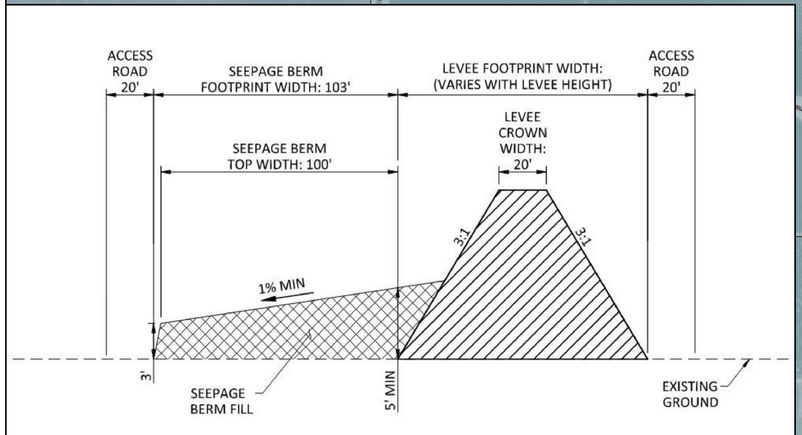
0 200 400 800
Feet

NORTH

WOOD RODGERS

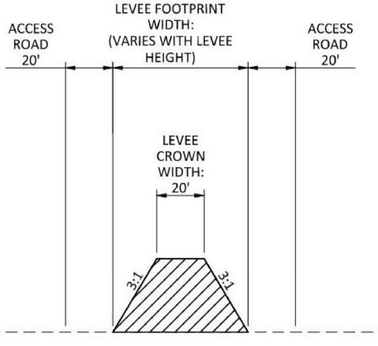
Station	Levee Height (ft)
10+00 (Start)	17
30+00 (Section A-A)	15
55+00	13
77+00 (Airport Rd)	10
90+00	8
103+00 (Oleander Rd)	5
124+00 (SectionB-B)	6
131+00 (Fig Ave)	4





TYPICAL CROSS SECTION A-A

NOT TO SCALE
VERTICAL EXAGGERATION: 5X



TYPICAL CROSS SECTION B-B

NOT TO SCALE
VERTICAL EXAGGERATION: 5X

FIGURE 5

ALTERNATIVE 2-S

SEEPAGE BERM
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
JANUARY 2022

Legend

- Levee Centerline
- Levee Footprint
- Seepage Berm Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Existing RD 17 Levee Removed in Alignment 2 Alternatives
- Parcel
- Private Irrigation Pipe

SSJID Facilities

- Drainage Ditch
- Supply Pipeline
- Drainage Ditch Reroute

Current 200 Year Flood Depth

- <1ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

0 200 400 800
Feet

NORTH

WOOD RODGERS

ATTACHMENTS

Attachment 1: Determination of the Urban Levee Design Criteria for the Manteca Dryland Levee, Manteca Dryland Levee Project

Attachment 2: Preliminary Geological and Geotechnical Assessment, Alternative Levee Alignments, Proposed Manteca Dryland Levee

Attachment 3: Environmental Constraints Analysis, Manteca Dryland Levee Project

Attachment 4: Quantity Estimate Cross Sections, Manteca Dryland Levee Project Alternatives Analysis

Attachment 5: Opinion of Probable Project Costs, Manteca Dryland Levee Project, Alternatives Analysis

ATTACHMENT 1

Determination of the Urban Levee Design Criteria for the Manteca Dryland Levee, Manteca Dryland Levee Project

MBK ENGINEERS
Water Resources ◆ Flood Control ◆ Water Rights

TECHNICAL MEMORANDUM

DATE: February 7, 2022

PREPARED BY: Michael Archer, P.E.

REVIEWED BY: Don Trieu, P.E.

SUBJECT: Determination of the Urban Levee Design Criteria Design Water Surface Elevation for the Manteca Dryland Levee

Purpose

The Manteca Dryland Levee (MDL) is part of the Reclamation District (RD) 17 levee system and provides protection from potential overland flooding to the urban areas of Lathrop and Stockton. The MDL ties into the east levee of the San Joaquin River near Weatherbee Lake, and extends about 3 miles to the east where it ties into high ground near Airport Way (Figure 1). The San Joaquin Area Flood Control Agency (SAJFCA) is developing plans for achieving an urban level of flood protection (ULOP) in accordance with the State of California's Urban Level of Flood Protection Criteria (DWR, 2013). Hydraulic analysis criteria for the determination of the design water surface elevation (DWSE) and other hydraulic parameters required to make an ULOP finding are specified in the State of California Urban Levee Design Criteria (ULDC) (DWR, 2012). This technical memorandum provides documentation of the determination of a ULDC DWSE for the MDL.

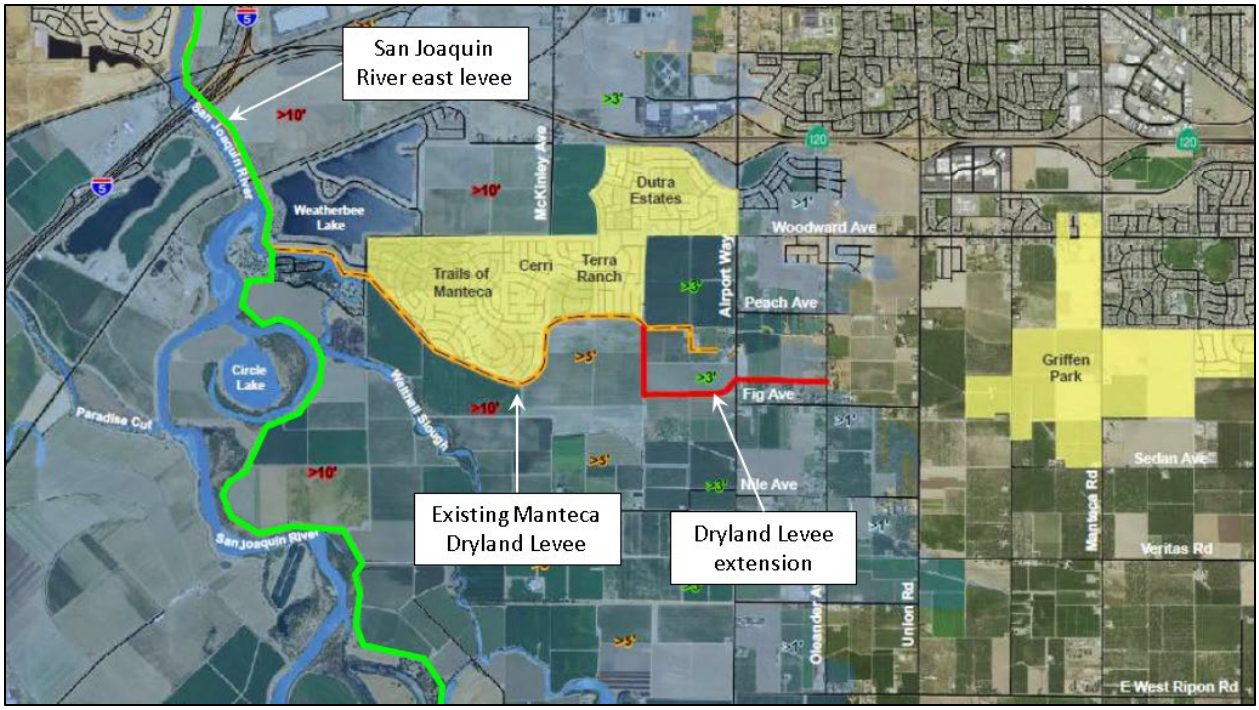


Figure 1. Manteca Dryland Levee Location Map (source: Drake Haglan and Associates)

Urban Levee Design Criteria (ULDC)

The ULDC DWSE is defined as the "200-year stage or water level used to design a levee or floodwall". The ULDC specifies that the hydraulic modeling used to determine the DWSE must use the following assumptions:

- Levees and floodwalls protecting urban areas are assumed to be raised to the median 200-year water surface elevation plus 3 feet.
- Non-urban State-Federal Project levees have a minimum crown elevation no less than the authorized USACE design profiles (1955 Profile).
- Levees do not fail, and act as weirs if overtopped.
- Debris loading on bridges must be considered.
- The effects of sea level rise are to be estimated and addressed for the duration of the urban level of flood control finding.

The ULDC does not require the DWSE to address the potential effects of climate change, but does recommend that the potential effects be evaluated.

Hydraulic Models

Lower San Joaquin River (LSJR) Model

The hydraulic analysis makes use of a HEC-RAS hydraulic model of the lower San Joaquin River (LSJR) developed by Peterson Brustad Inc. (PBI) for the Mossdale Tract Area Urban Flood Risk Reduction Study (PBI, 2020). The PBI LSJR model was developed from the Central Valley Floodplain Evaluation and

Delineation (CVFED) Task Order 25 HEC-RAS model, and was executed using HEC-RAS version 5.0.3. PBI modified the model to use 2-dimensional (2-D) flow areas for floodplains within the study area.

The model domain includes the San Joaquin River, from Vernalis down to the Stockton Deep Water Ship Channel; Paradise Cut; Old River and Grant Line Canal, down to Clifton Court; and Middle River down to Tracy Boulevard. A schematic of the PBI LSJR model is shown in Figure 2.

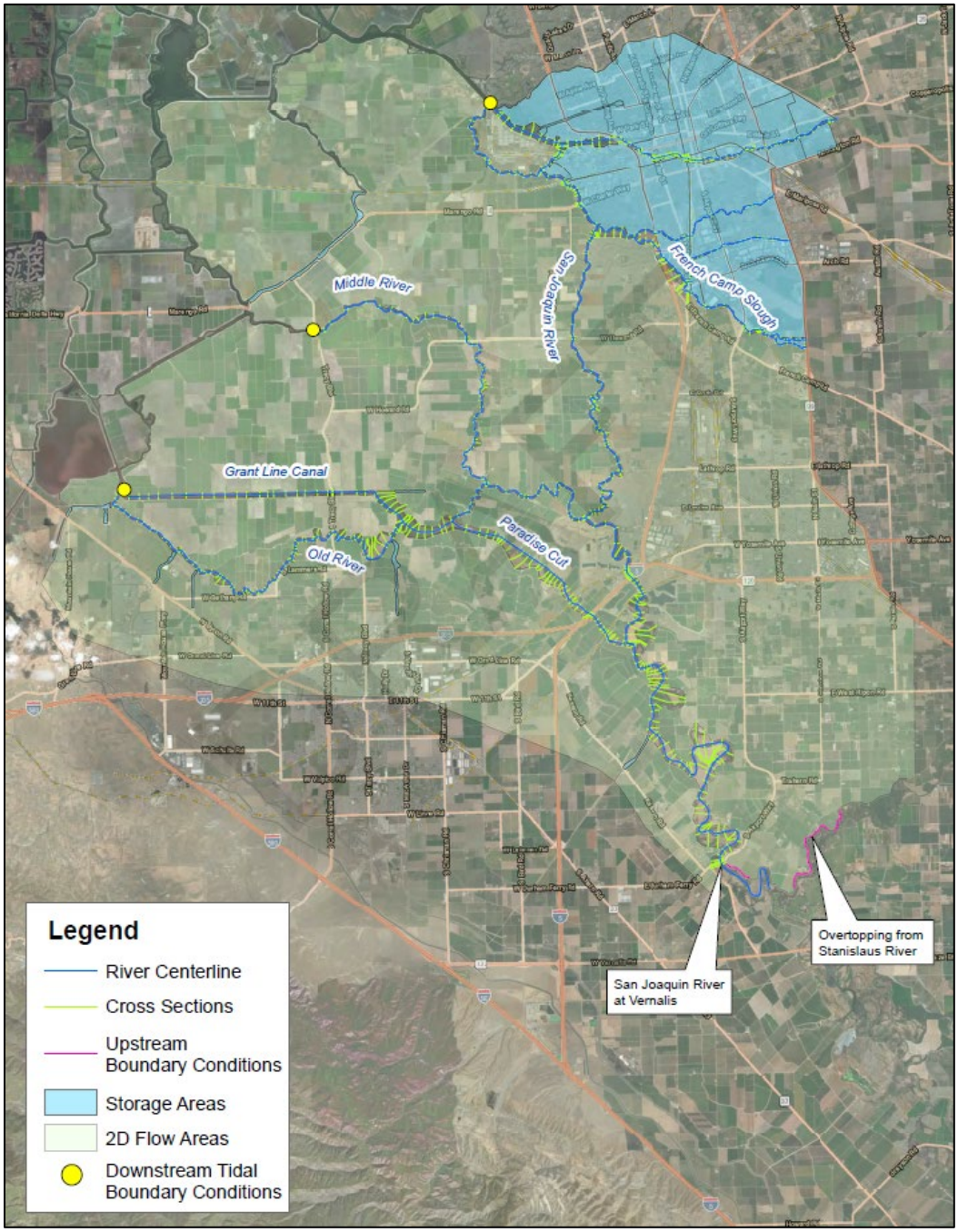


Figure 2. PBI LSJR Model Schematic (source: PBI)

MBK Engineers (MBK) made several modifications and refinements to the PBI LSJR model to improve calibration, stability, and efficiency. The modifications include:

- Refined 2D flow area mesh in floodplain south of the MDL to better reflect terrain features that affect flow conveyance, such as the Trahern and Almondwood dryland levees.
- Updated the land use and associated roughness values used for the 2D flow area south of the MDL. Land use classification and mapping prepared for the Delta Stewardship Council in 2019 was used for the update (California State University, Chico, 2019). MBK assigned Manning's n roughness coefficients to the land use classifications as shown in Table 1.
- Refined the model representation of the San Joaquin River levee in the vicinity of Walthall Slough and the MDL.
- Updated the model to HEC-RAS version 5.0.7.

Table 1. Land Use Classifications and Roughness Coefficients

Land Use Classification	Description	Manning's n
AGS	Annual Grassland	0.04
AGS, ASC	Annual Grassland, Alkali Desert Scrub	0.04
AGS, BAR, ASC	Annual Grassland, Barren, Alkali Desert Scrub	0.04
ASC	Alkali Desert Scrub	0.04
BAR	Barren	0.05
CSC	Coastal Scrub	0.06
DGR	Dryland Grain Crops	0.04
DGR, IRH	Dryland Grain Crops, Irrigated Hayfield	0.04
DOR	Deciduous Orchard	0.05
DOR, EOR, VIN,	Deciduous Orchard, Evergreen Orchard, Vineyard, Irrigated Row and Field Crops	0.05
EOR	Evergreen Orchard	0.07
EUC	Eucalyptus	0.04
FEW	Fresh Emergent Wetland	0.04
FEW, URB	Fresh Emergent Wetland, Urban	0.04
IGR	Irrigated Grain Crops	0.04
IRF	Irrigated Row and Field Crops	0.04
IRH	Dryland Grain Crops, Irrigated Hayfield	0.03
LAC	Lacustrine, Riverine	0.04
PAS	Pasture	0.04
RIC	Rice	0.03
RIV, LAC	Riverine, Lacustrine	0.03
SEW	Saline Emergent Wetland	0.04
URB	Urban	0.07
VIN	Vineyard	0.06
VOW	Valley Oak Woodland	0.08
VRI	Valley Foothill Riparian	0.08
WTM	Wet Meadow	0.04

The PBI LSJR model was calibrated with the January 2017 high flow event, which had a peak flow at Vernalis of 41,000 cfs. The model was verified with the April 2006 high flow event, which had a peak flow at Vernalis of 34,800 cfs. The calibration and verification event simulations were made with the MBK modified model to ensure the model was still reasonably calibrated. The results of the calibration check are shown graphically in Appendix A.

San Joaquin River System-wide Model

PBI used the CVFED San Joaquin River system-wide model developed by the California Department of Water Resources (DWR) for the 2017 Update to the Central Valley Flood Protection Plan (CVFPP) for the upstream boundary inflows for the LSJR model. As seen in the schematic of the San Joaquin River system-wide model in Figure 3, a significant portion of the watershed lies upstream of the LSJR model domain. The conveyance of flow to the latitude of Vernalis is dependent on the assumed performance of the levees upstream of Vernalis.

The original CVFPP system-wide model included levee breaches. PBI used the system-wide model to simulate a condition in which levees overtop without failing for the purpose of producing latitude of Vernalis input flow data for their Mossdale Tract Area LSJR model hydraulic analysis.

As constructed, the CVFPP system-wide model had a run time of about 17 hours for the 1/200 AEP current climate simulation and about 25 hours for the 1/200 AEP future climate simulation. Since the plan was to use the system-wide model to evaluate the effects of several levee performance scenarios on the conveyance of flows to the latitude of Vernalis, MBK made modifications to the system-wide model in order to substantially reduce the execution time, with negligible effects on the computed results. These modifications included:

- Delete Bear Creek 2-D flow area
- Delete several river reaches providing attenuation only, i.e., no gains or losses due to interaction with floodplains
- Deleted model below San Joaquin River river mile 3.23062, just upstream of Burns Cutoff
- Deleted French Camp Slough and tributaries upstream of river mile 1.18426
- Deleted or refined numerous ineffective flow occurrences

The schematic of the MBK modified system-wide model is shown in Figure 4. The modifications, along with shortening the execution time window from 47 days to 26 days, reduced the execution time for the 1/200 AEP current climate simulation to under 4 hours, and for the 1/200 AEP future climate simulation to 4.5 hours.

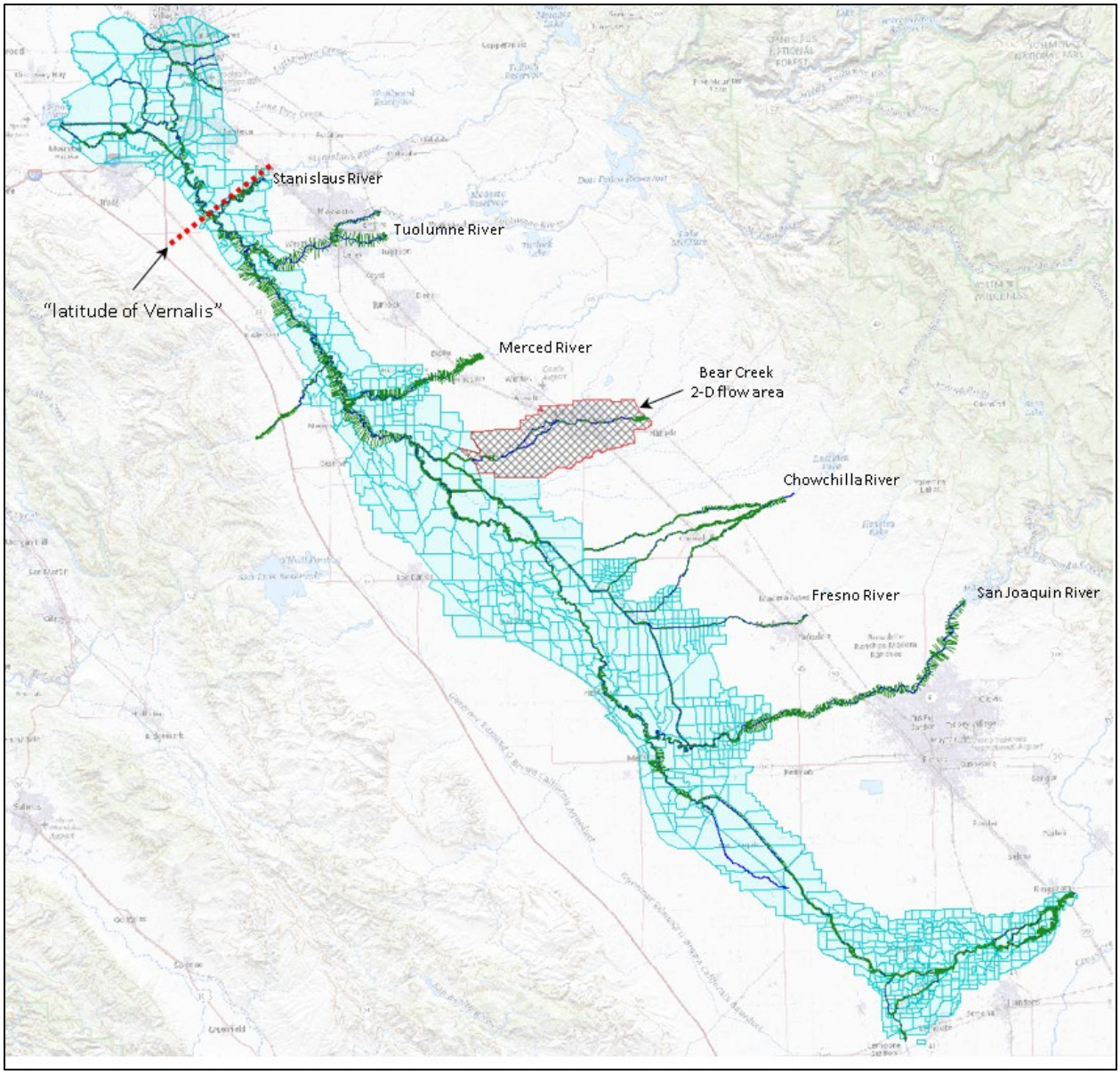


Figure 3. CVFPP San Joaquin River System-wide Model Schematic

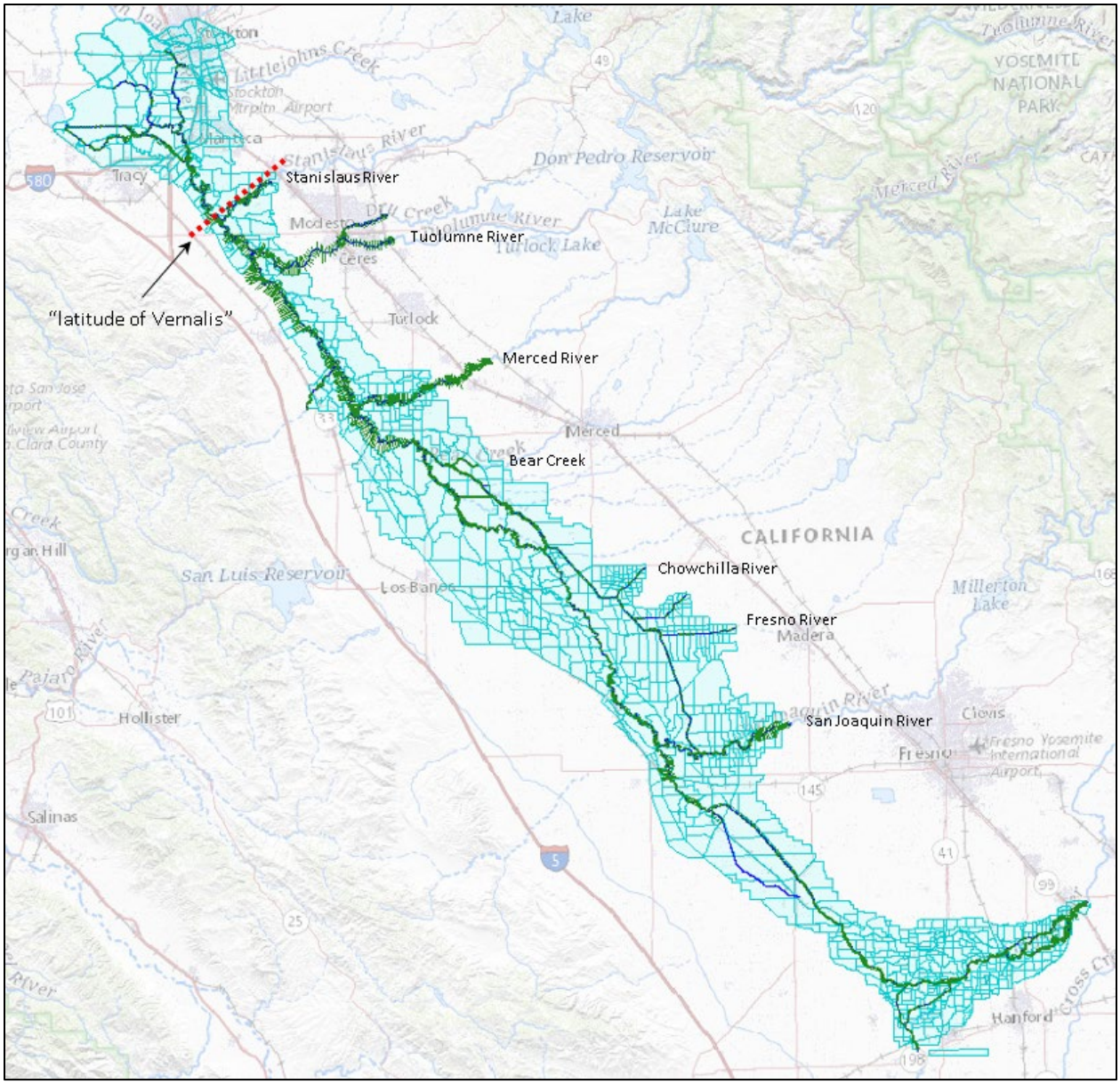


Figure 4. MBK Modified San Joaquin River System-wide Model Schematic

Hydrology

The analysis used Central Valley Hydrology Study (CVHS) procedures and data. The CVHS was commissioned by DWR and prepared by the U.S. Army Corps of Engineers (USACE) (USACE, 2015). The CVHS defines a procedure in which a scaled flood event with a pattern based on a historical flood event is selected to represent the flood of a specific frequency at a specific location.

As previously noted, the ULDC DWSE is the 1/200 AEP (200-year) water surface elevation. The DWSE was computed using hydrology representing the current climate, but a future climate scenario was also evaluated in order to provide information on potential climate change. The analysis uses a CVHS event selection from the CVFPP 2017 Update, which is summarized in Table 2. The CVFPP future climate hydrology is for a late century condition.

Table 2. CVHS Flood Event Selection

Annual Exceedance Probability (AEP)	Climate	CVHS Flood Event	
		Pattern	Scale Factor
1/200	Current	1997	115%
1/200	Future	1997	200%

Upper San Joaquin River Levee Performance Evaluation

The MBK modified San Joaquin River system-wide model was used to route flows from the upper San Joaquin River watershed to the latitude of Vernalis for the levee performance scenarios outlined in Table 3. The handoff from the system-wide model to the LSJR model consists of the flow in the San Joaquin River at Airport Way plus any flow entering the floodplain from the right bank of the Stanislaus River and the right bank of the San Joaquin River between the Stanislaus River and Airport Way, illustrated by the dashed line in Figure 5.

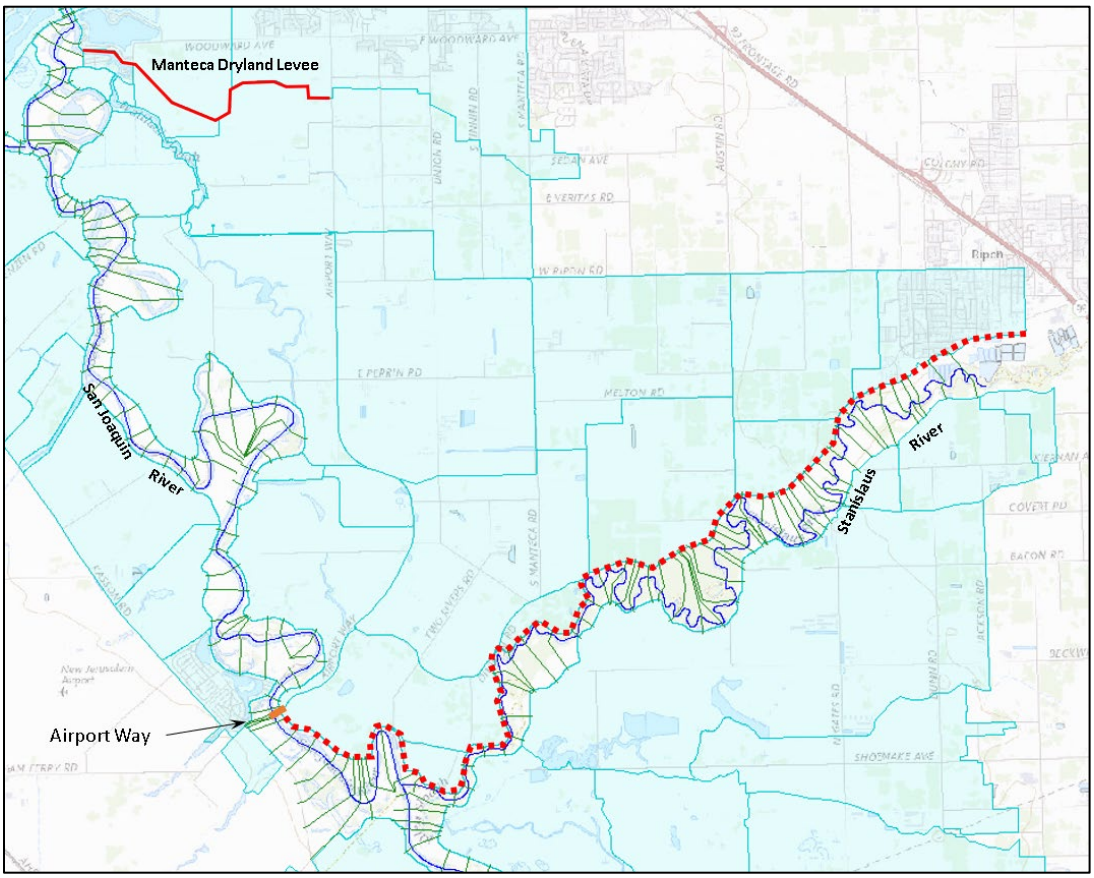


Figure 5. Location of Flow Handoff from System-wide San Joaquin River Model to LSJR Model

The levee performance scenarios are outlined in Table 3. Levee breaches in the ULDC DWSE analysis use the CVFED levee reliability data (URS, 2013) to define levee breach triggers, therefore all levee performance scenario simulations assume the levee reduction height trigger for levees protecting the floodplain on the south side of the MDL.

Table 3. Upper San Joaquin River Watershed Levee Performance Scenarios

Scenario	Description	Breach Trigger
1	No breaches	none
2	Overtopping failures	TOL + 0.5 ft.
3	Freeboard encroachment failures	TOL – 1 ft.
4	CVFED Levee Reliability failures	TOL – LRH
5	Relief breaches only	TOL + 0.5 ft.
TOL = Top of levee elevation		
LRH = Levee reduction height		

Breaches were assumed to fail down to natural ground. The final breach width was estimated as 50 times the depth of water at the levee at the time of the breach, based on guidance developed as part of the CVFED hydraulic analysis. The breach formation time was based on a formation rate of 7 feet per minute, developed by USACE in the Lower San Joaquin River Feasibility Study (USACE, 2017).

The results of the upper San Joaquin levee performance evaluation are summarized in Table 4 and in Table 5. In the current climate scenario, the peak flow shows some sensitivity to the upstream breach assumption, whereas the peak volume shows much less sensitivity. In the future climate scenario, both the peak flow and volume show little sensitivity to the upstream breach assumption.

Table 4. Computed Peak Flows and Volumes at Latitude of Vernalis, 1/200 AEP Current Climate

Scenario	Number of Potential Breaches Upstream of Stanislaus R.	Number of Triggered Breaches	Peak Flow (cfs)	Peak 3-day Volume (1,000 ac-ft)	Peak 7-day Volume (1,000 ac-ft)
1	0	0	104,120	572	1,095
2	130	47	94,800	516	1,037
3	130	58	113,970	566	1,075
4	130	94	99,990	539	1,050
5	40	12	112,030	578	1,106

Table 5. Computed Peak Flows and Volumes at Latitude of Vernalis, 1/200 AEP Future Climate

Scenario	Number of Potential Breaches Upstream of Stanislaus R.	Number of Triggered Breaches	Peak Flow (cfs)	Peak 3-day Volume (1,000 ac-ft)	Peak 7-day Volume (1,000 ac-ft)
1	0	0	303,040	1,515	2,702
2	130	91	311,280	1,542	2,817
3	130	100	322,520	1,540	2,744
4	130	128	319,290	1,537	2,791
5	40	37	301,230	1,526	2,737

Manteca Dryland Levee DWSE

Several potential alignments for the 200-year MDL are being considered by SJAFCA. The analysis assumed the Alternative 2A alignment shown in Figure 1.

Flooding Source

Being that the MDL is a dryland levee, the DWSE at the MDL is dependent on breaching of the Stanislaus River right bank levee and/or the San Joaquin River right bank levee between the MDL and the Stanislaus River. The analysis assumed seven breaches upstream of Airport Way and two breaches downstream of Airport Way. The locations of the breaches are shown in Figure 6. The breaches upstream of Airport Way were simulated in the San Joaquin River system-wide model. The computed breach flows were used as input to the LSJR model. The breach trigger for all breaches was the top of levee elevation minus the CVFED levee reduction height. The breach parameters are summarized in Table 6.

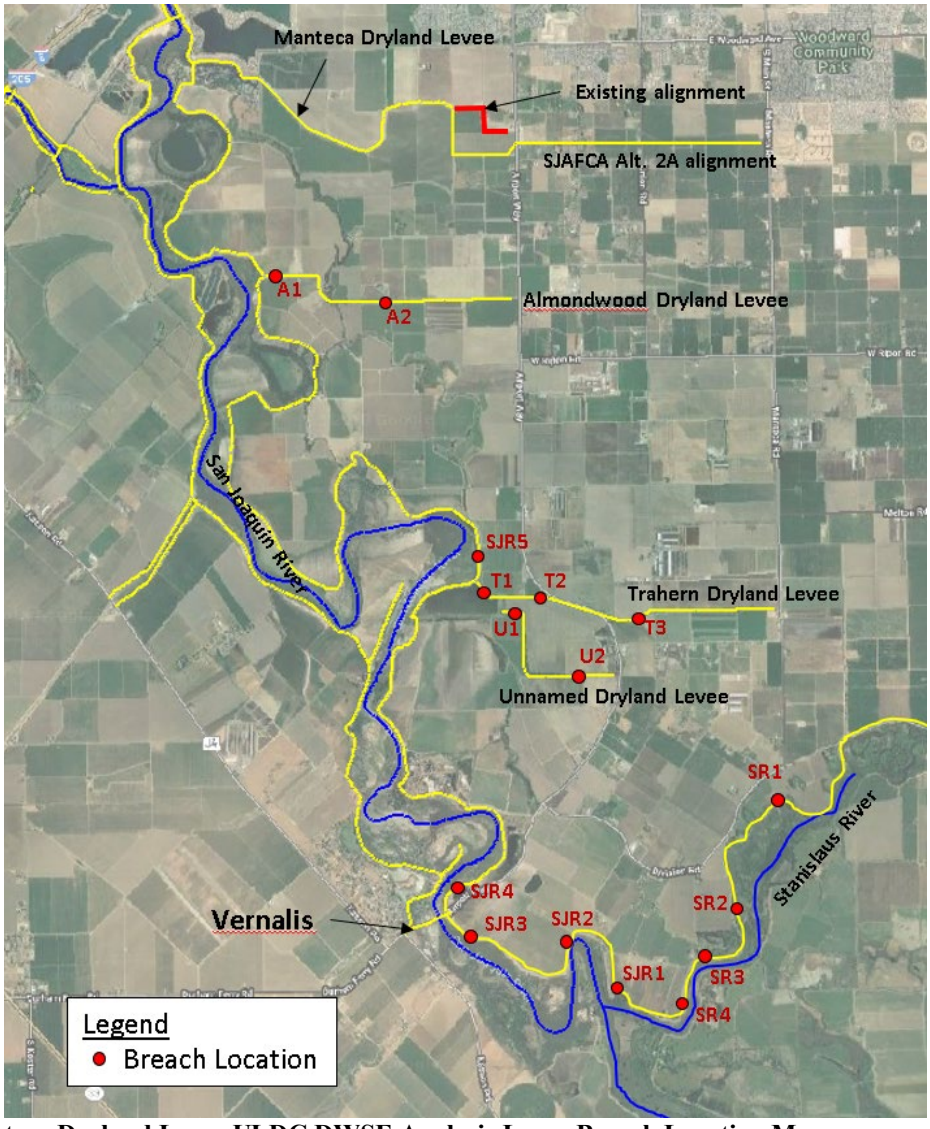


Figure 6. Manteca Dryland Levee ULDC DWSE Analysis Levee Breach Location Map

Table 6. Manteca Dryland Levee ULDC DWSE Analysis Levee Breach Parameters

ID	Levee	CVFED River Mile	LRH (feet)	Final Width (feet)	Formation Time (hours)
SR1	Stanislaus River	3.1	7.5	180	0.4
SR2	Stanislaus River	2.0	7.5	100	0.2
SR3	Stanislaus River	1.3	7.5	110	0.3
SR4	Stanislaus River	0.8	7.5	250	0.6
SJR1	San Joaquin River	35.2	5.8	260	0.6
SJR2	San Joaquin River	34.5	5.8	270	0.6
SJR3	San Joaquin River	32.9	5.8	410	1.0
SJR4	San Joaquin River	32.4	5.8	500	1.2
SJR5	San Joaquin River	28.0	9.6	500	1.2
U1	Unnamed Dryland	na	na	500	[1]
U2	Unnamed Dryland	na	na	400	[1]
T1	Trahern Dryland	na	na	500	[1]
T2	Trahern Dryland	na	na	500	[1]
T3	Trahern Dryland	na	na	400	[1]
A1	Almondwood Dryland	na	na	400	[1]
A2	Almondwood Dryland	na	na	400	[1]

LRH = CVFED Levee Reduction Height
[1] = Hardwired as gap in embankment

Sea Level Rise

The analysis used the same data as was used by PBI in the Mossdale Tract UFRR Study. The downstream boundary stage data was developed as part of the CVFPP 2017 Update (Maendly, Romain (CA DWR), 2018). The sea level rise adjusted data was based on a late century projected sea level rise of 1.27 feet in a 2012 study by the National Research Council (National Research Council, 2012).

Bridge Pier Debris

The ULDC requires the consideration of the effects of bridge pier debris loading in the DWSE determination. Application of bridge pier debris loading was made based on guidance developed by USACE for use in Central Valley Flood Protection Board encroachment analyses (USACE, 2014). Based on this guidance, a debris loading of two times the pier width with a depth of two feet was included in the analysis for the ULDC defined "typical" loading condition, where there is more than 3 feet of clearance between the water surface and the low chord of the bridge. For "extraordinary" loading condition, defined in the ULDC as when clearance between the water surface and the bridge low chord is less than 3 feet, the debris loading is two feet deep for the entire extent where there is less than 3 feet of clearance. A list of bridges in the model and the corresponding debris loading condition is provided in Table 7.

Table 7. Bridge Pier Debris Loading Conditions

River	River Mile	Description	Debris Loading Condition	
			1/200 AEP Current Climate	1/200 AEP Future Climate
Burns Cutoff	3.10619	abandoned RR	extraordinary	extraordinary
Burns Cutoff	3.06509	Port of Stockton Expy	typical	typical
Grant Line Canal	5.70954	S. Tracy Blvd.	typical	typical
Middle River	8.78637	W. Undine Rd.	extraordinary	extraordinary
Middle River	5.09402	Howard Rd.	typical	typical
Old River	10.06078	unnamed	extraordinary	extraordinary
Old River	8.47558	S. Tracy Blvd.	extraordinary	extraordinary
Paradise Cut	5.28322	UPRR-east	extraordinary	extraordinary
Paradise Cut	4.68002	I-205	typical	extraordinary
Paradise Cut	4.61828	I-5 N	typical	extraordinary
Paradise Cut	4.59441	I-5 S	typical	extraordinary
Paradise Cut	4.57225	Manthey Rd.	extraordinary	extraordinary
Paradise Cut	3.98060	UPRR-west	extraordinary	extraordinary
Paradise Cut	2.61264	unnamed	extraordinary	extraordinary
Paradise Cut	1.42914	Paradise Rd.	extraordinary	extraordinary
San Joaquin River	19.35017	UPRR-east	extraordinary	extraordinary
San Joaquin River	18.84468	I-5	typical	typical
San Joaquin River	18.81950	CA-120	extraordinary	extraordinary
San Joaquin River	18.79658	Manthey Rd.	extraordinary	extraordinary
San Joaquin River	18.66476	UPRR-west	extraordinary	extraordinary
San Joaquin River	16.8	River Islands Pkwy	[not in model]	
San Joaquin River	8.77785	Howard Rd.	typical	typical
San Joaquin River	4.75615	CA-4	typical	typical
San Joaquin River	4.32643	unnamed	typical	typical
San Joaquin River	3.97492	unnamed RR	typical	extraordinary
San Joaquin River	2.62987	Navy Dr.	typical	typical
San Joaquin River	2.51680	unnamed RR	typical	typical

Design Water Surface Elevation (DWSE)

The evaluation of the upstream levee performance scenarios did not produce an obvious worst case condition, so all five scenarios were simulated with the LSJR model. Figure 7 shows the computed DWSE profiles at the SJAFCA Alt. 2A MDL for all five scenarios. The maximum DWSE is produced by upstream levee performance Scenario 3, TOL -1 ft. breach trigger. A maximum DWSE profile is shown in Figure 8 with the existing MDL crest profile and ground elevation along the Alt. 2A alignment.

Minimum Top of Levee (MTOL)

The ULDC Minimum Top of Levee (MTOL) is defined as the DWSE plus the greater of 3 feet or wind setup and wave runup. A wind setup and wave runup (wind and wave) analysis made by PBI (PBI, 2019) produces a wind and wave profile along the MDL as shown in Figure 8. The computed wind and wave is less than 3 feet with the exception of two stretches where it approaches 5 feet. The MDL Team has recommended the MTOL west of Airport Way be DWSE plus 5 feet for wind and wave plus 1 foot for

uncertainty and DWSE plus 3 feet plus 1 foot for uncertainty east of Airport Way. Figure 9 shows the DWSE, MTOL, recommended MTOL profiles.

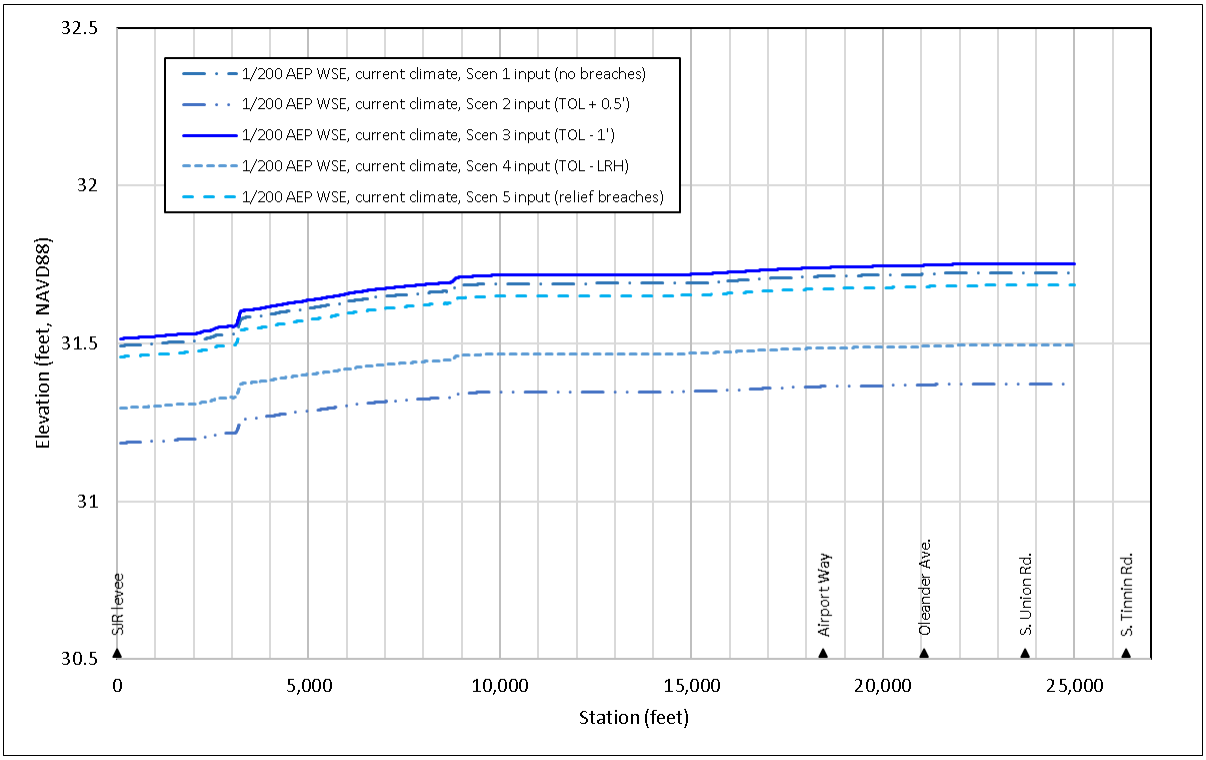


Figure 7. Computed 1/200 AEP WSE at MDL for all Upstream Levee Performance Scenarios

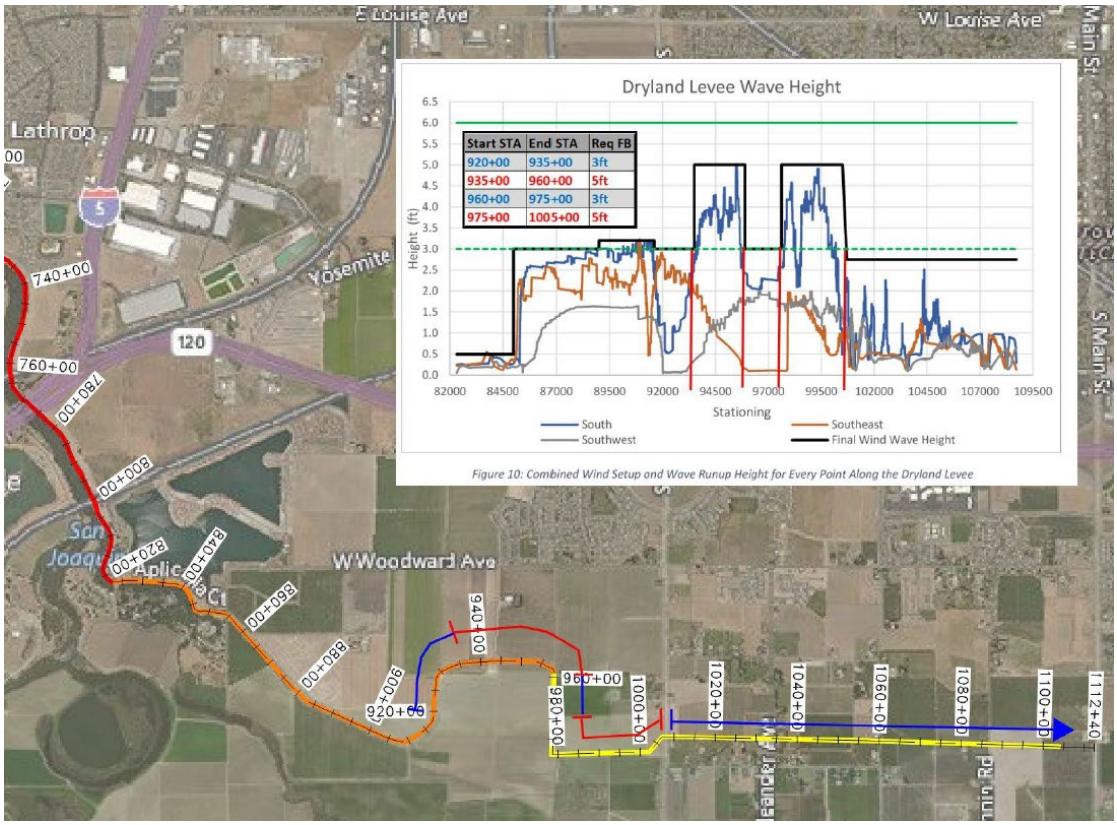


Figure 8. Wind Setup and Wave Runup Profile (PBI, 2019)

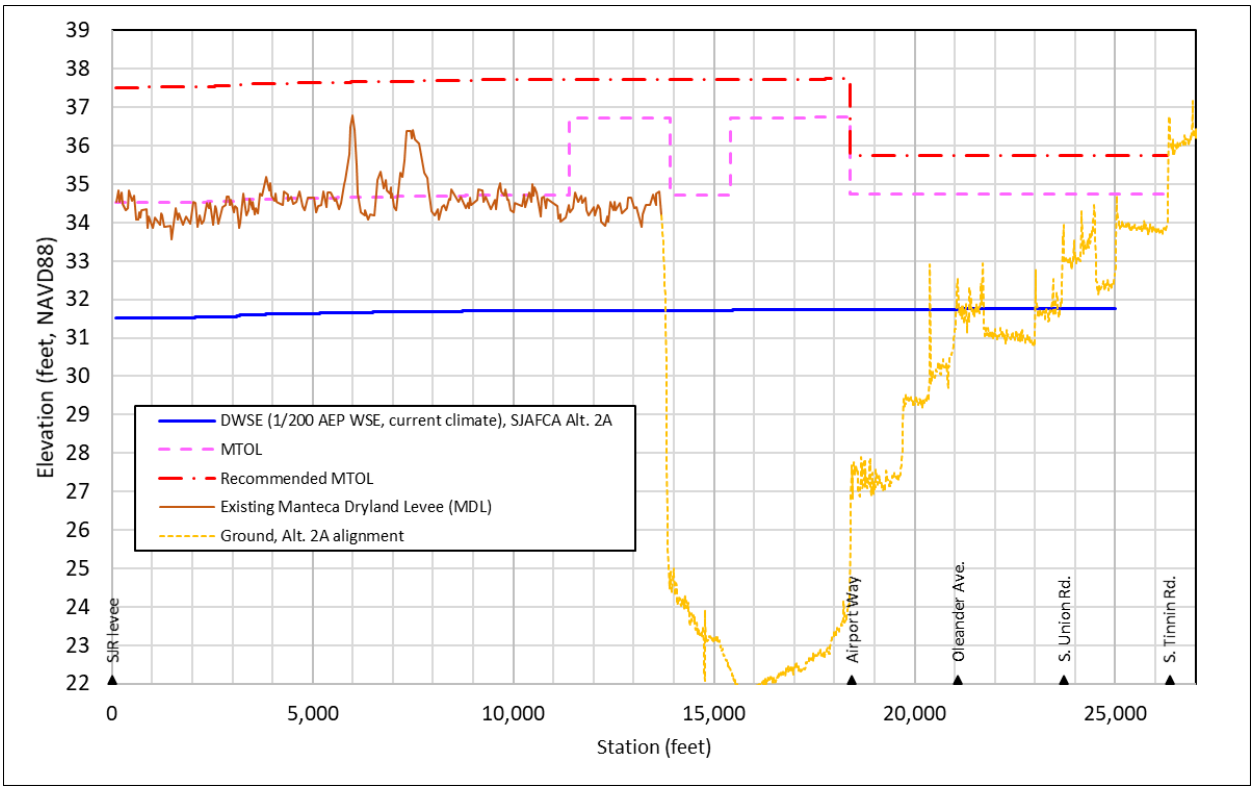


Figure 9. Manteca Dryland Levee DWSE and MTOL Profiles

Potential Effect of Climate Change

The maximum water surface elevation at the MDL was also computed for a future climate condition based on the CVFPP 2017 Update late century climate change hydrology. For reference, the computed peak flow rates and volumes at the latitude of Vernalis for the current and future climate conditions are shown in Table 4 and Table 5. Figure 10 shows the computed 1/200 AEP WSE profile at the MDL under the future climate condition. The current climate 1/200 AEP WSE (ULDC DWSE) is also shown for comparison.

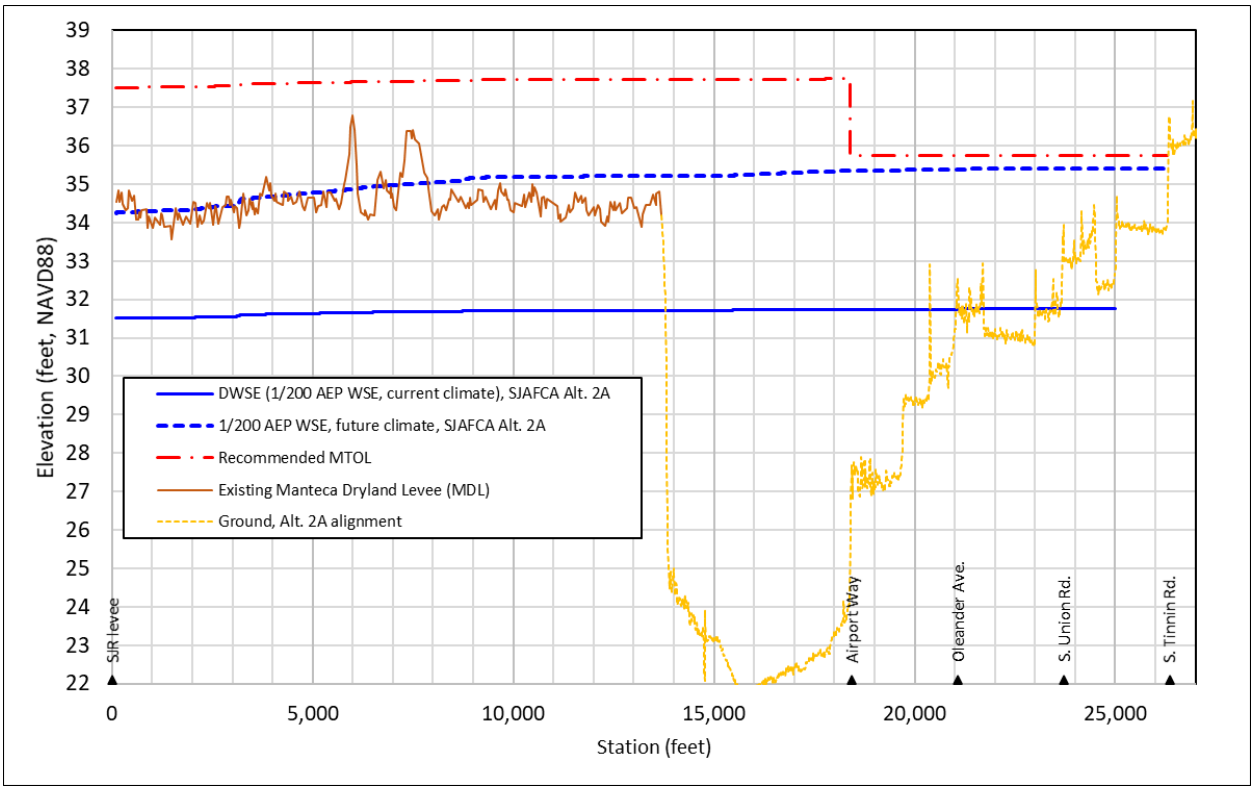


Figure 10. Computed 1/200 AEP WSE at Manteca Dryland Levee, Current and Future Climate Conditions

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Appendix A

Modified Lower San Joaquin River HEC-RAS Model Calibration and Verification Check

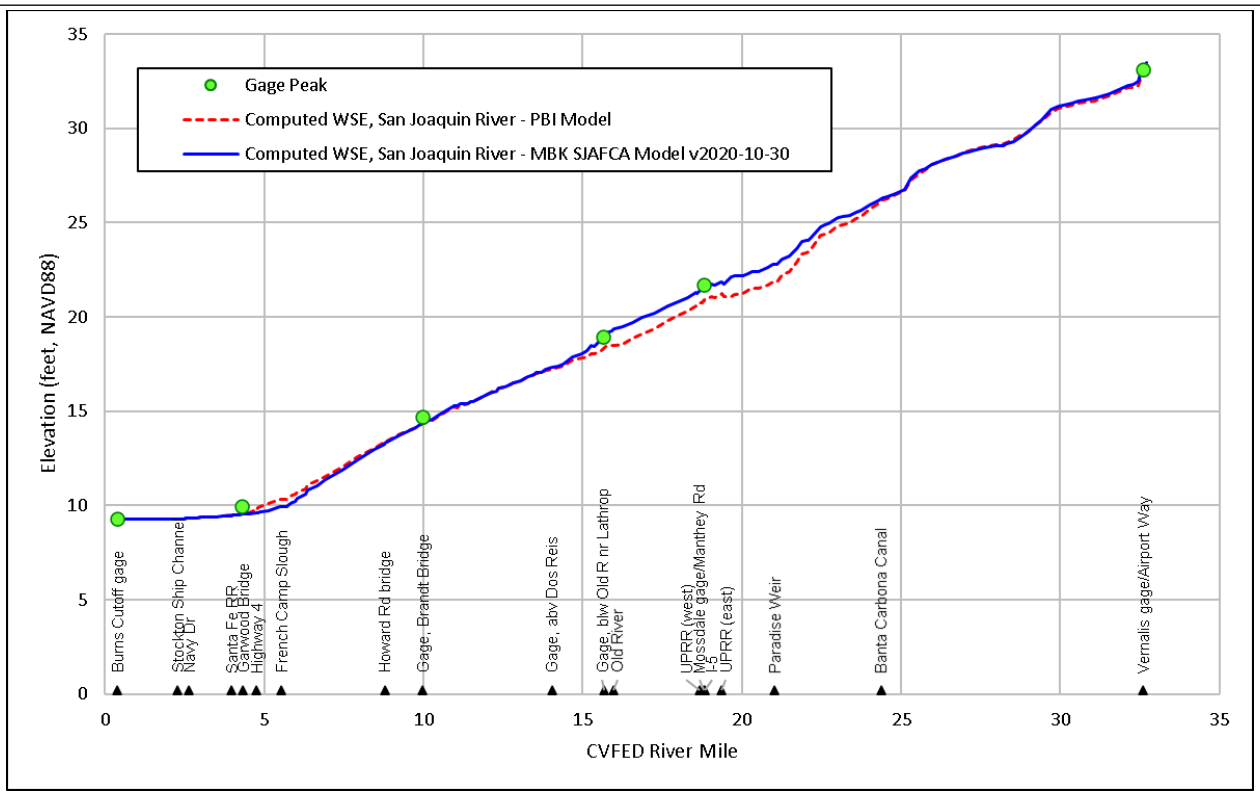

Figure A-1. Maximum Water Surface Elevation Profile, San Joaquin River, Calibration Event - Jan. 2017

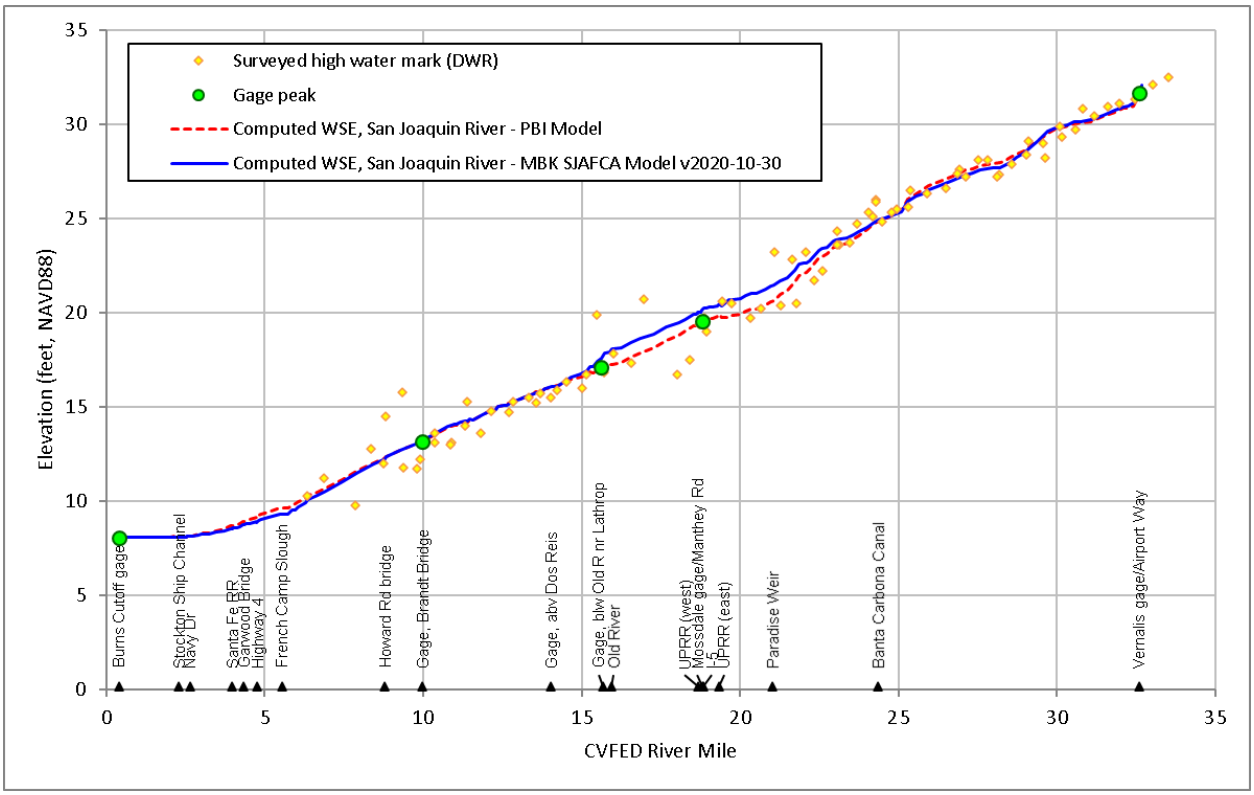

Figure A-2. Maximum Water Surface Elevation Profile, San Joaquin River, Calibration Event - Apr. 2006

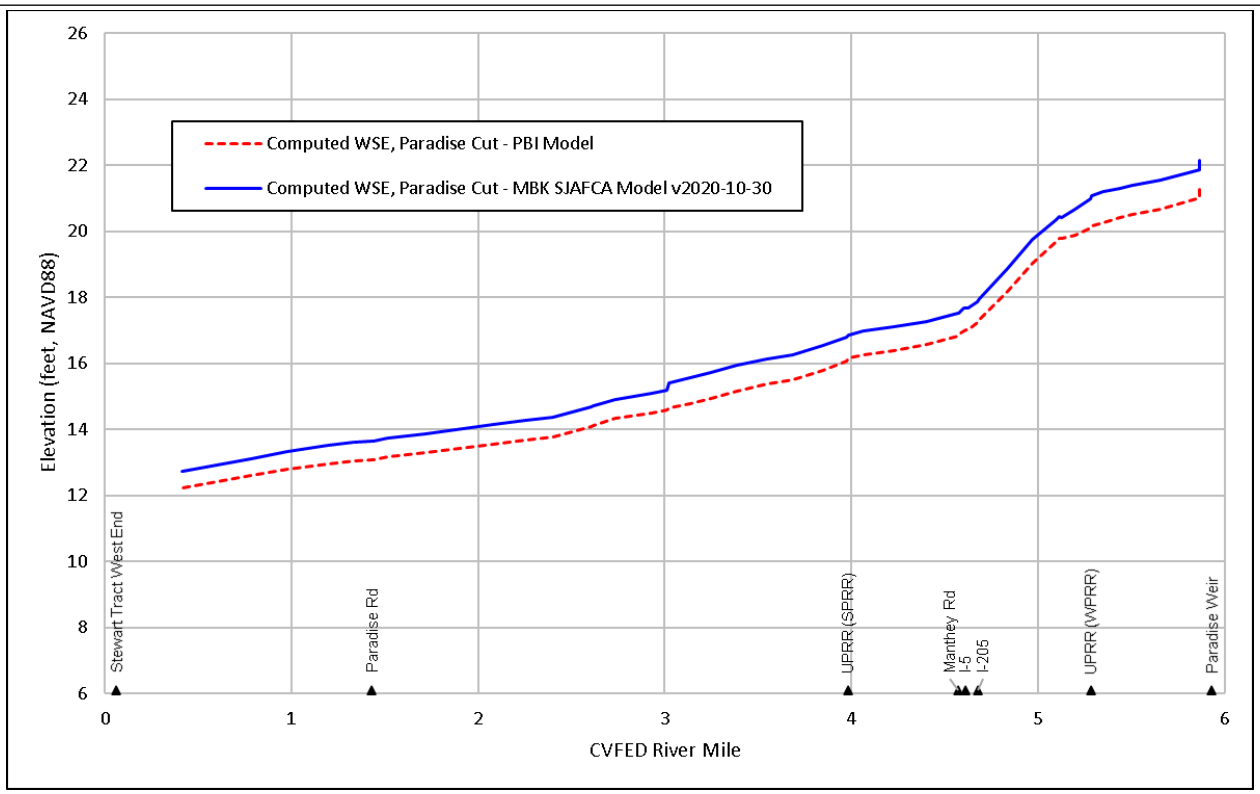

Figure A-3. Maximum Water Surface Elevation Profile, Paradise Cut, Calibration Event - Jan. 2017

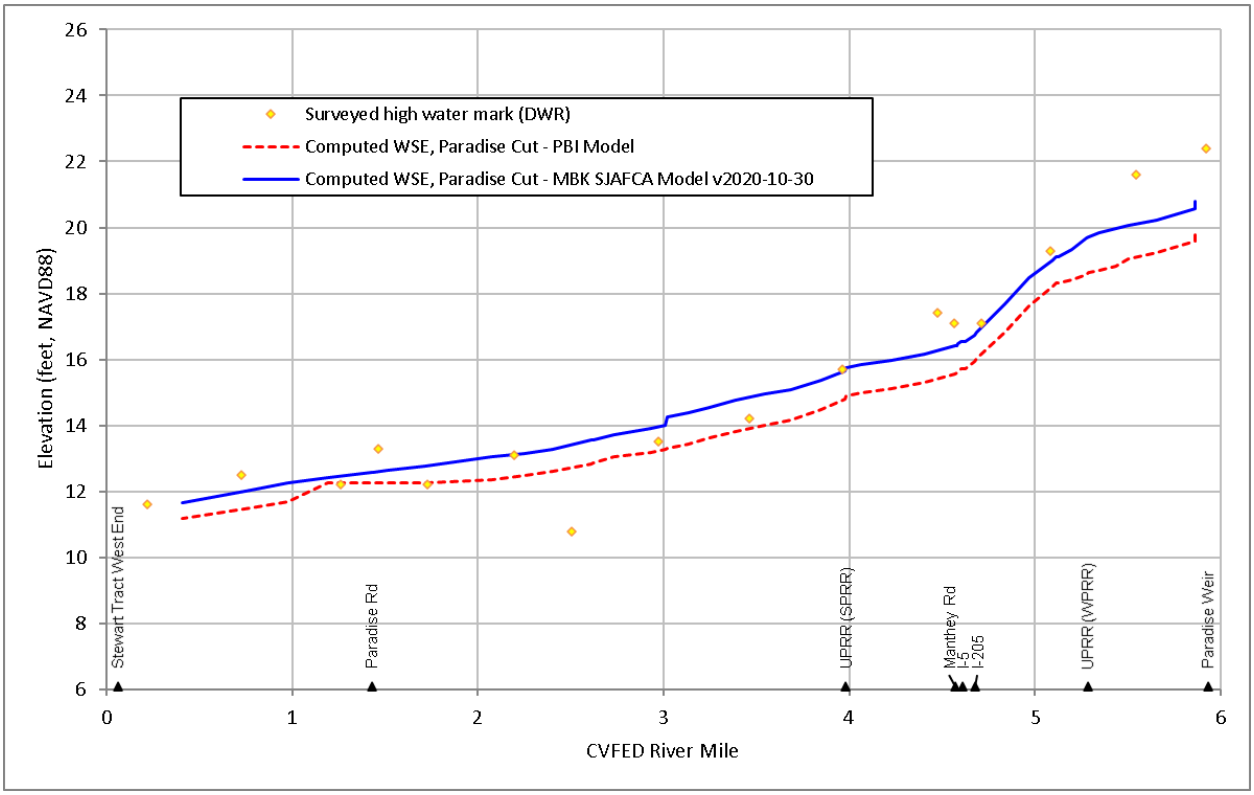

Figure A-4. Maximum Water Surface Elevation Profile, Paradise Cut, Verification Event - Apr. 2006

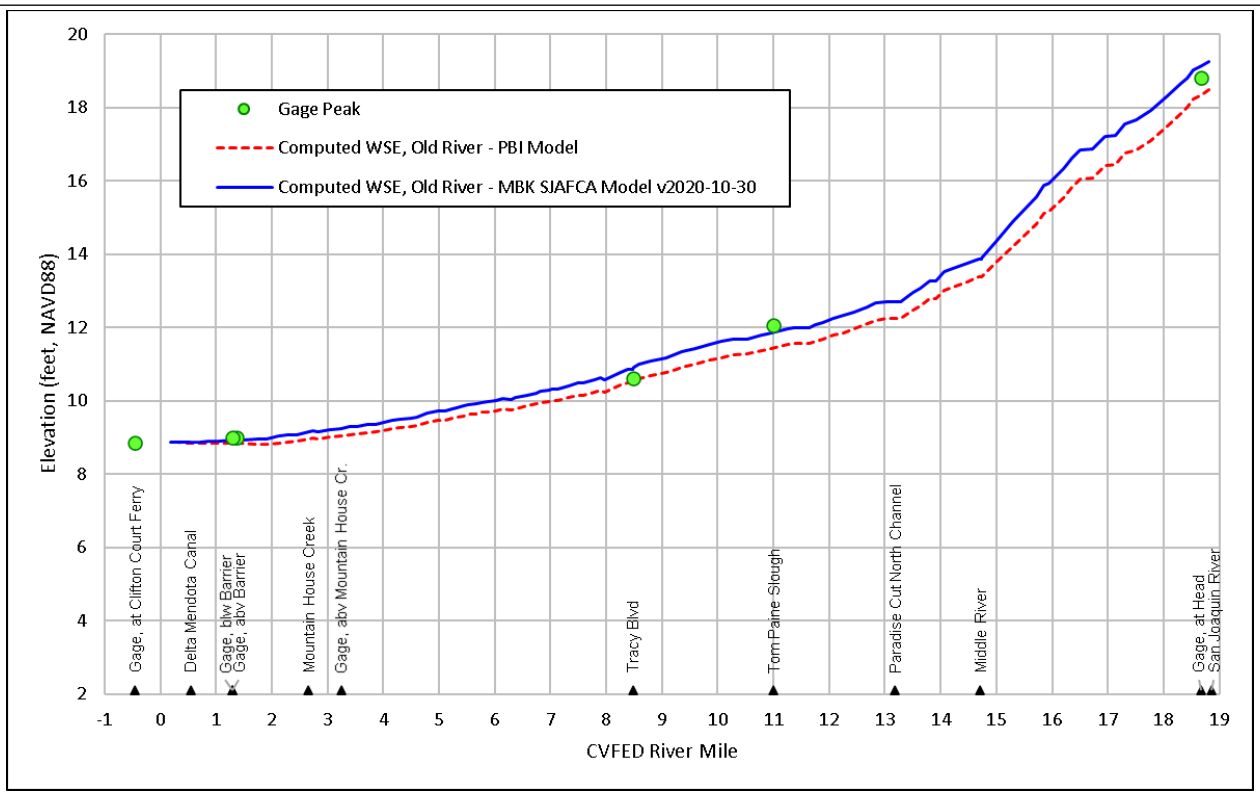

Figure A-5. Maximum Water Surface Elevation Profile, Old River, Calibration Event - Jan. 2017

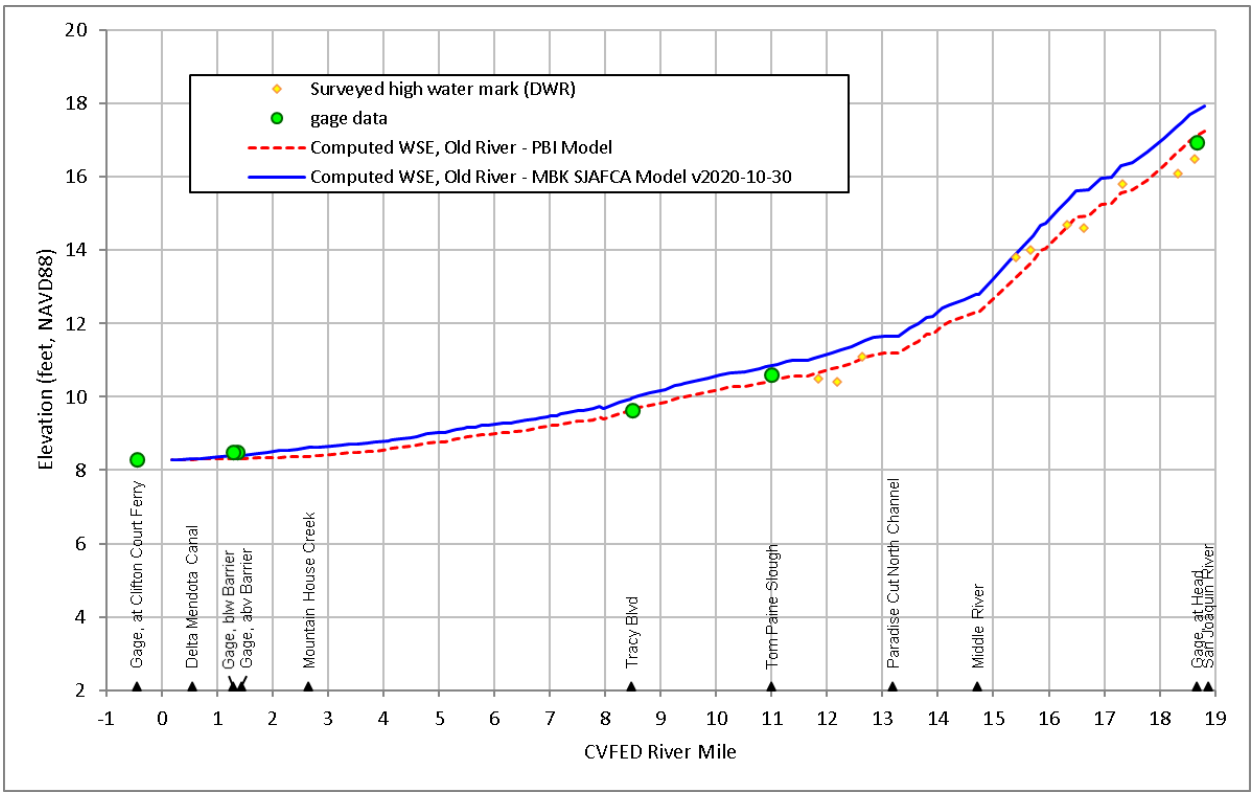

Figure A-6. Maximum Water Surface Elevation Profile, Old River, Verification Event - Apr. 2006

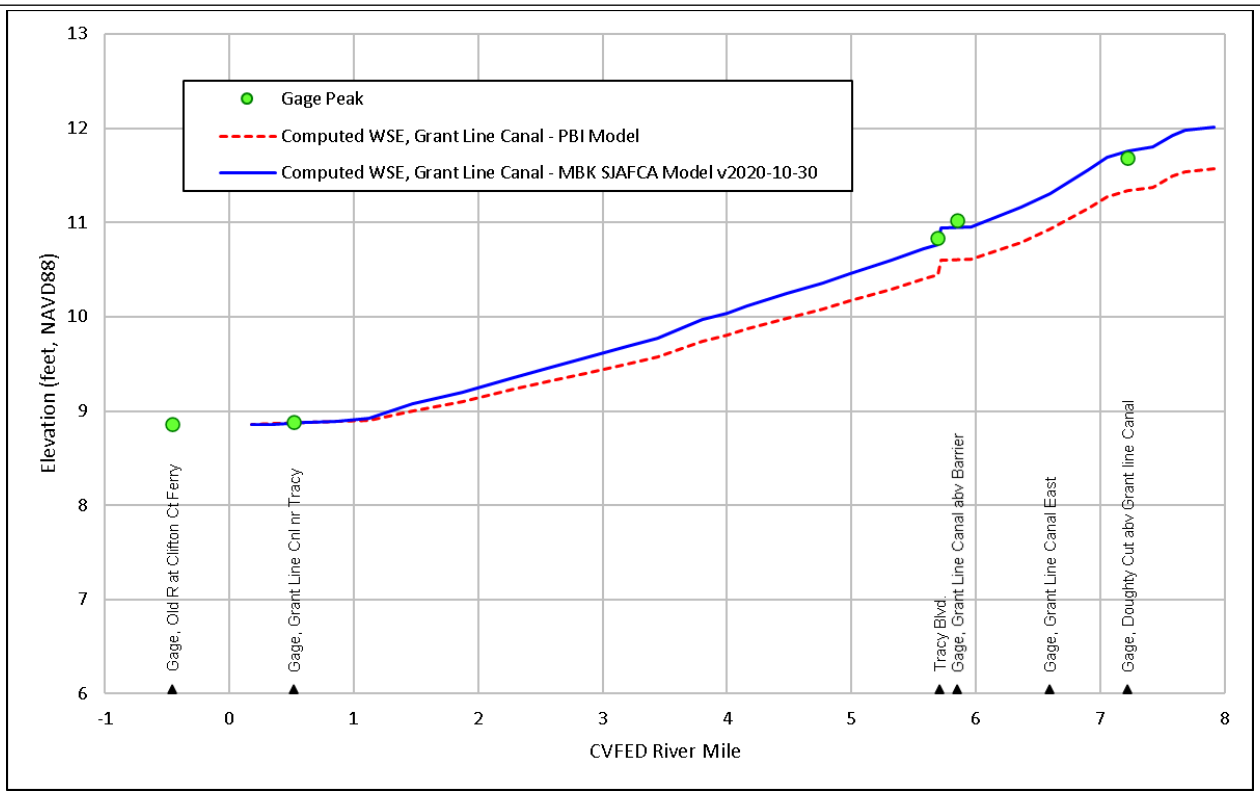

Figure A-7. Maximum Water Surface Elevation Profile, Grant Line Canal, Calibration Event - Jan. 2017

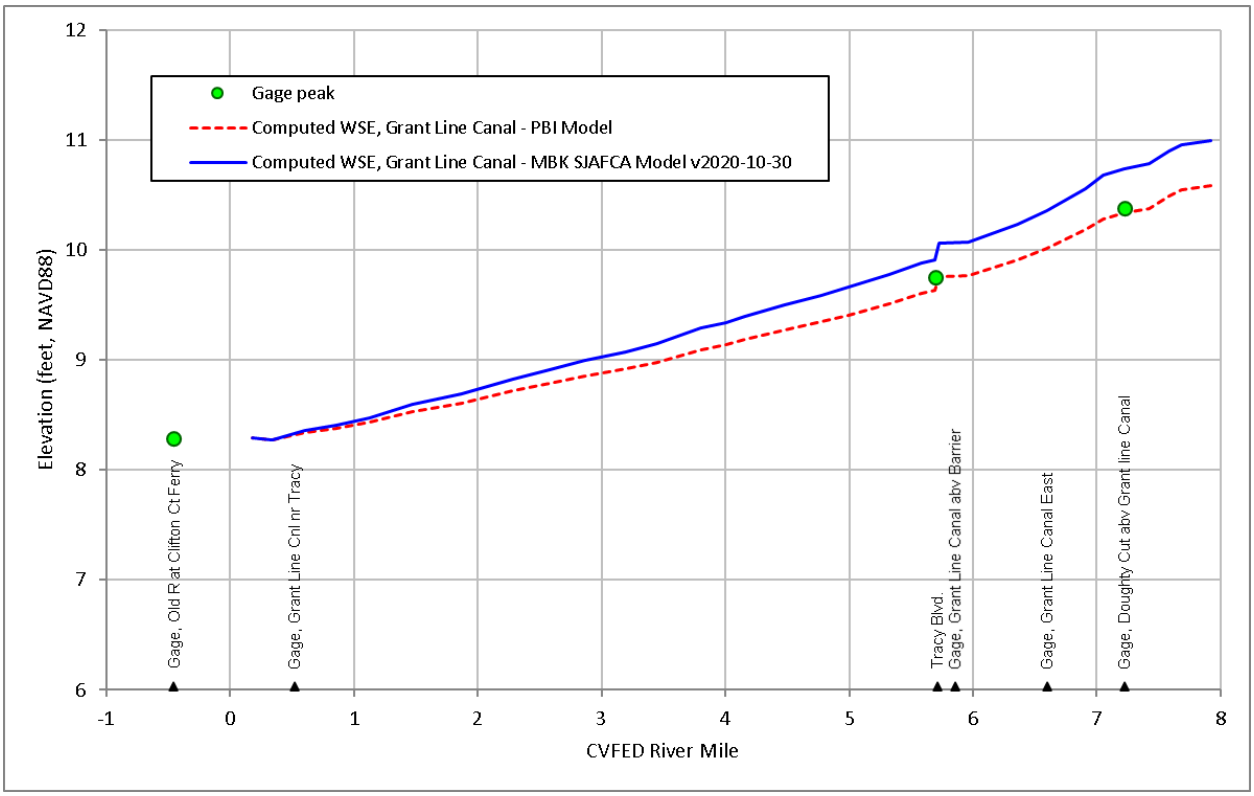

Figure A-8. Maximum Water Surface Elevation Profile, Grant Line Canal, Verification Event - Apr. 2006

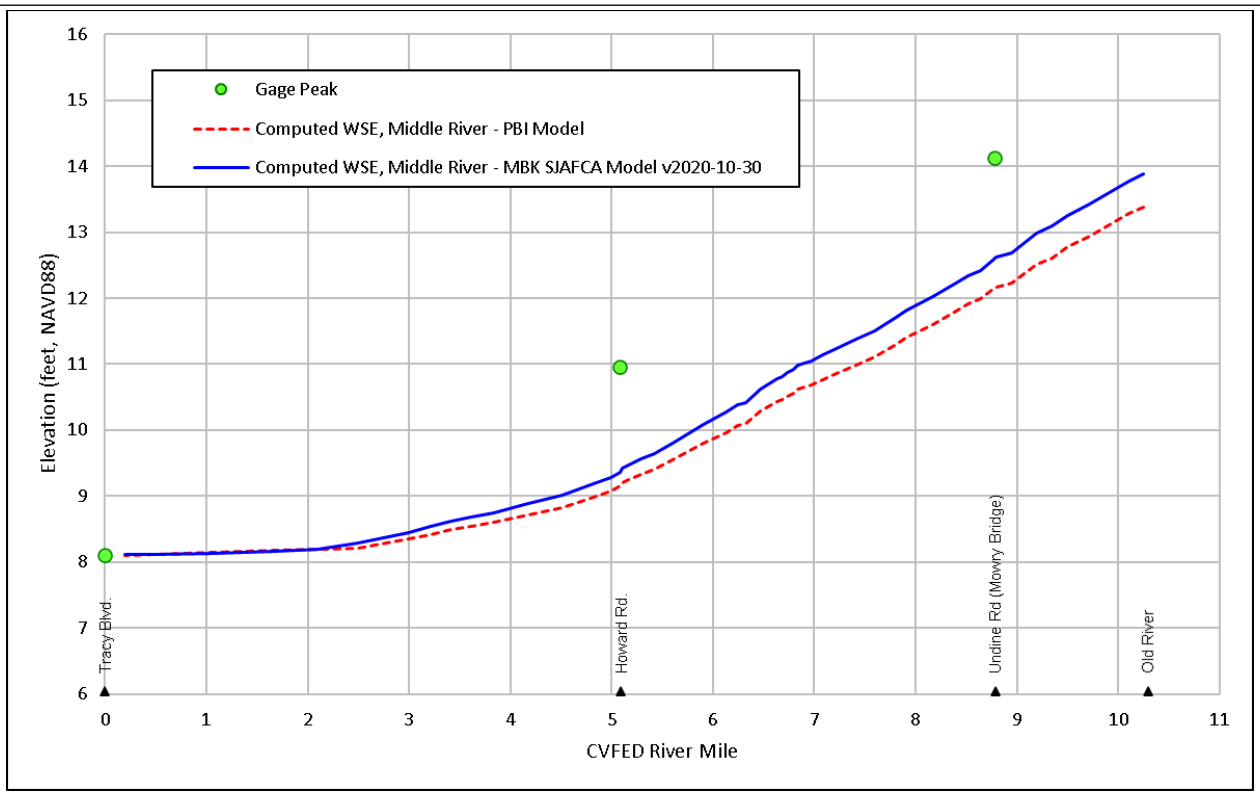

Figure A-9. Maximum Water Surface Elevation Profile, Middle River, Calibration Event - Jan. 2017

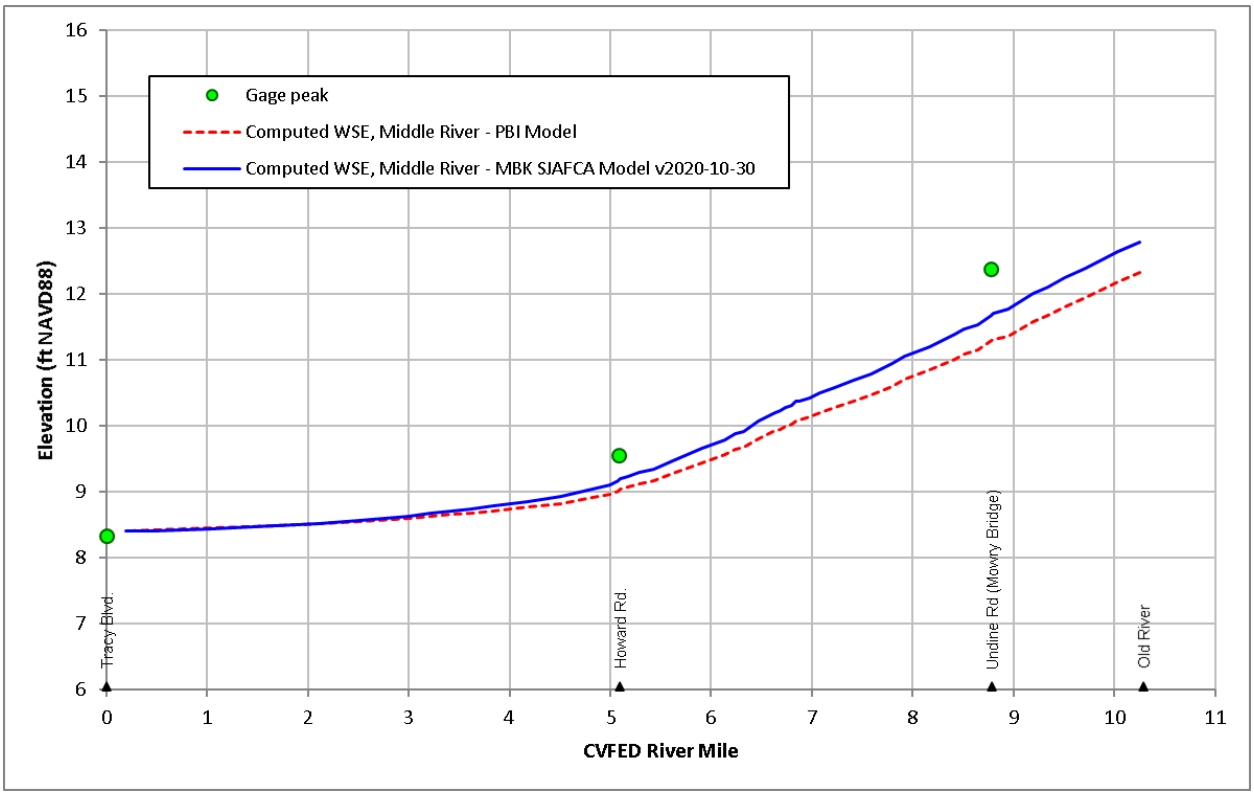

Figure A-10. Maximum Water Surface Elevation Profile, Middle River, Verification Event - Apr. 2006

ATTACHMENT 2

Preliminary Geological and Geotechnical Assessment, Alternative Levee Alignments, Proposed Manteca Dryland Levee

KLEINFELDER
Bright People. Right Solutions.

TECHNICAL MEMORANDUM

Date: November 16, 2021 File No.: 20212453.001A

To: Jonathan Kors, PE
Wood Rodgers, Inc.

From: Steven Wiesner, PE, GE

Subject: Preliminary Geological and Geotechnical Assessment
Alternative Levee Alignments
Proposed Manteca Dryland
Manteca, California

Kleinfelder is pleased to present this memorandum to summarize a preliminary geologic and geotechnical assessment of the proposed dryland levee alternatives for the Manteca Dryland Levee in Manteca, California.

PROJECT BACKGROUND

In 2014 the cities of Lathrop and Manteca jointly funded agreements to achieve protection from a 200-year flood event in the San Joaquin River and to demonstrate “adequate progress” to achieving this protection. This work included developing 200-year water surface profiles in the San Joaquin River, determining the 200-year floodplain (and depths), and completing an Urban Levee Design Criteria (ULDC) analysis, which would identify deficiencies that would require improvement to provide an Urban Level of Flood Protection (ULOP) for the Reclamation District 17 (RD 17) levees within their respective cities. From these efforts, Lathrop and Manteca were able to develop the necessary information to make a “Finding of Adequate Progress” toward achieving ULOP 200-year flood protection for the urbanized and urbanizing areas of the cities.

The City of Manteca adopted the Finding of Adequate Progress showing 200-year urban level of protection in the RD 17 floodplain on July 5, 2016. As part of the Finding of Adequate Progress, a multi-phase levee improvement plan was developed which included an extension of the existing dryland levee to the east in the southern portion of Manteca. However, there were a number of property owner concerns in the vicinity of the proposed improvements to the dryland levee. Through discussions with various stakeholders (local agencies and landowners) and vetting of several levee alignment alternatives, two distinct alignments, Alignment 1 and Alignment 2, have been selected for further consideration. Based upon previous assessments in the area of the proposed levee alignments, remediation for seepage would likely be required. These two alignments include two seepage remediation options, a cutoff wall and a seepage berm. Therefore, a total of four alternatives are being further considered for advancement in design.

In general, the proposed levees will be approximately 15 to 20 feet tall at the western end where the alignments tie into the exiting dryland levee and will run into high ground at the eastern

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terminus. Both alignments will have top elevations of 37½ feet west of Airport Way and 35½ feet east of Airport way.

A Site Vicinity Map showing the approximate alignments is shown on Figure 1. Each alternative is discussed in further detail below.

REVIEW OF EXISTING DATA AND SITE VISIT

Kleinfelder reviewed existing data provided by the San Joaquin Area Flood Control Agency for the project, previous geotechnical exploration logs in the vicinity of the proposed improvements (Figure 6), Geologic map of California prepared by the California Division of Mines and Geology (Figure 7), US Department of Agriculture, Natural Resource Conservation Service (NRCS) soil data (Figure 8a, 8b, and 8c), and other data in the area. Documents reviewed as part of this task included:

- "Preliminary Seepage Evaluation," Reclamation District No. 17, Mossdale Tract, Levee Seepage Project Reaches VIII to XI, San Joaquin County, CA, Prepared by ENGEO, January 18, 2010.
- "Geotechnical Data Report (GDR) for Walthall Slough Study Area," Prepared by Kleinfelder for Department of Water Resources, March 2015.
- "Geotechnical Evaluation Report (GER) for Walthall Slough Study Area," Prepared by Kleinfelder for Department of Water Resources, Marth 2015.
- "Urban Levee Design Criteria Evaluation, Mossdale Tract, Reclamation District No. 17, San Joaquin County, California,' Prepared by ENGEO, Project No 5747.005.000, October 30, 2015.

It should be noted that the California Department of Water Resources (DWR) has previously performed studies of the RD 17 system, including the existing dryland levee. The geotechnical data report (GDR) for the existing levee dated 2015 is referenced above and was reviewed. The geotechnical data included in the GDR was heavily relied upon because the high quality of the field explorations performed as part of the study as well as the comprehensive inclusion of historical geotechnical data along the levee. Additional studies included a geotechnical evaluation report prepared by DWR and geotechnical levee evaluation reports prepared by RD 17 which included additional geotechnical data along the subject levee.

After review of these data sources, Kleinfelder performed a site visit on October 13, 2020 to observe surficial conditions along the proposed levee alignments. The surficial conditions in the area of the proposed alignments were generally flat and consisted of mostly agricultural land with row crops. Scattered homes and farm buildings were observed as well as an irrigation canal that traversed generally from east to west.

GENERAL SUBSURFACE AND GROUNDWATER CONDITIONS

Based on reviewing the previously completed explorations along or near the proposed project alignments, the near surface soil predominantly consists of loose to medium dense, and in some locations dense, silty sand (SM), clayey sand (SC), and poorly graded sand (SP) underlain mainly by medium dense to dense poorly graded sand (SP), intermittent layers of silty sand (SM) and sandy silt (ML), and lean clay (CL) to depths of over 100 feet. The near surface soils are consistent with the publicly available soil maps and databases referenced above and were observed during

the site visit. Table 1 summarizes the subsurface conditions encountered in each of the previous explorations. The conditions encountered in these explorations are consistent with mapped geologic formations by California Division of Mines and Geology shown on Figure 7 and near surface mapped soils provided by NRCS shown on Figure 8a with map legends provided on Figures 8b and 8c.

Table 1 – Summary of Subsurface Conditions

Exploration Number	Exploration Date	Exploration Depth	Groundwater Depth	Blanket Layer Soil Type	Blanket Layer Thickness	Permeable Zone Soil Type	Permeable Zone Thickness	Aquitard Layer Depth
7-B014	10/10/2014	66.5	NA	ML	12 ft	SM/SP	43.5 ft	65
K-B-11	8/19/1986	41.5 ft	25 ft	CL	24 ft	SP/ML	7 ft	NA
7-B020	1/9/2015	116.5 ft	NA	ML	14.5 ft	SM/SP	47.5 ft	70 ft
K-B-10	12/15/1989	31.5 ft	28 ft	SM/ML	5 ft	SP	12 ft	NA
3-B-103	7/23/2008	139.5	25 ft	ML	9.5 ft	SP	82.5 ft	107.5 ft
K-B-9	12/15/1989	31.5 ft	No	SM	5 ft	SP	18 ft	NA
K-B-8	12/15/1989	30 ft	27 ft	ML	5 ft	SP	7 ft	NA
K-B-7	8/14/1986	41.5 ft	21 ft	ML/CL	13 ft	SP/SM	23.5 ft	NA
K-B-6	12/15/1989	31.5 ft	24 ft	SM	19 ft	SP	10 ft	29 ft
3-B-104	7/24/2008	121.5 ft	21 ft	ML/SM	12 ft	SP	51 ft	91 ft
K-B-5	12/15/1989	31.5 ft	17.5 ft	ML	0.5 ft (end of boring)	NA (boring not deep enough)	NA	NA
K-B-4	8/13/1986	41.5 ft	20 ft	ML	9 ft	SP/SM	12 ft	31 ft
K-B-3	12/15/1989	31.5 ft	18 ft	SM	14 ft	SP	16.5 ft	NA
7-B018	1/5/2015	66.5 ft	NA	SM/ML	3.5 ft	SP	5 ft	25 ft
K-B-2	12/15/1989	31.5 ft	16.5 ft	SM	18 ft	SP	13.5 ft	NA
3-B-105	7/25/2008	89.5 ft	15.5 ft	CL/ML/SM	9 ft	SP	6 ft	26 ft
K-B-1	8/12/1986	41.5 ft	24 ft	ML/CL	30 ft	SP	3 ft	NA
WR0017_202B	2/22/2012	52 ft	NA	ML/CL	14 ft	SP-SM/ SP	28 ft	NA
WR0017_203B	2/21/2012	51 ft	NA	SM	8.5 ft	SP-SM/ SP	19 ft	30.5 ft
B-2	12/14/1987	40 ft	26 ft	CL/ML	16 ft	SW	16 ft	NA
B-3	12/14/1987	40 ft	21 ft	ML/SM	15 ft	SW	21 ft	NA
B-4	12/14/1987	40 ft	18 ft	SM	10 ft	SW/SP	30 ft	NA
B-5	12/14/1987	40 ft	13 ft	ML/CL/SM	12 ft	SW/SP	18 ft	NA
WR0017_304A	2/11/2014	14 ft	8.5 ft	SM/ML	8.5 ft	SP-SM	5.5 ft	NA
WR0017_305A	2/12/2014	11.5 ft	9 ft	ML/SM	10 ft	SP	1.5 ft	NA
WR0017_306A	2/12/2014	14 ft	9 ft	ML/SM	14 ft	NA	NA	NA
WR0017_307A	2/12/2014	11.5 ft	9.5 ft	SM/ML	7.5 ft	SP	4 ft	NA
WR0017_308A	2/12/2014	16.5 ft	9.5 ft	SM	12.5 ft	SP	4 ft	NA
WR0017_309A	2/12/2014	11.5 ft	10 ft	SM	11.5 ft	NA	NA	NA
WR0017_310A	2/12/2014	11.5 ft	7.5 ft	SP-SM	7.5 ft	SP	4 ft	NA

Exploration Number	Exploration Date	Exploration Depth	Groundwater Depth	Blanket Layer Soil Type	Blanket Layer Thickness	Permeable Zone Soil Type	Permeable Zone Thickness	Aquitard Layer Depth
WR0017_311A	2/12/2014	11.5 ft	7 ft	SM	5 ft	SP	6.5 ft	NA
WR0017_312A	2/13/2014	11.5 ft	7 ft	SM	7.5 ft	SP	4 ft	NA
WR0017_313A	2/13/2014	11.5 ft	7 ft	SM	7.5 ft	SP-SM	4 ft	NA
WR0017_314A	2/13/2014	14 ft	10 ft	SM	6 ft	SP	8 ft	NA
WR0017_315A	2/13/2014	14 ft	9.5 ft	ML	12.5 ft	SP	1.5 ft	NA
WR0017_316A	2/13/2014	14 ft	12 ft	SM/ML	12.5 ft	SP-SM	1.5 ft	NA

Based on review of well information provided on the California Department of Water Resources website, groundwater in the project area is typically encountered at depths ranging from about 10 to 20 feet below existing site grade. Logs of borings prior to 2008 indicate the groundwater was detected at depths ranging between 15 and 26 feet. More recently drilled borings performed by Department of Water Resources in 2014 encountered groundwater at depths ranging between 7 and 12 feet below existing site grade.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

It is Kleinfelder's conclusion that the geotechnical risks for any levee extension to the west of the existing dryland levee will be similar for the proposed alternative alignments. Accordingly, any extensions of the existing dryland levee, including the levee alternatives identified as noted above, will be subject to the same geotechnical constraints. For this reason, it is Kleinfelder's opinion that from a geotechnical standpoint, there is not a proposed alignment that is favorable over the others; therefore, any of the two alignments and remediations discussed below will remain a viable alternative to move forward.

Since the levee will be retaining assumed water heights up to about 17 feet, seepage is considered the major geotechnical and geological hazard of concern that will need to be addressed. Additionally, liquefaction from near surface saturated loose sands is also considered a major hazard of concern. A review of the available geotechnical and geological data, soil maps, exploration logs, and laboratory testing indicate that both of the alignments are located in similar geologic units with near surface (blanket) soils consisting of fine to coarse grained materials (silt, clay, and silty sand) underlain predominately by coarse-grained sandy soil with some interbedded fine-grained silt and lean clay layers. The following section provides additional preliminary geological and geotechnical recommendations and conclusions related to future levee design with the understanding that a detailed geotechnical investigation will be completed once a design alignment is finalized.

Geotechnical and Geologic Hazards

Seepage – Levee seepage (underseepage and through seepage) is the predominant risk to the proposed levee extension. Both failure modes were identified in the geotechnical evaluation report for the existing dryland levee prepared by DWR.

Seepage is a concern regarding two potential modes of failure (1) blowout/erosion (piping) at the landside toe due to excess seepage pressure that is evaluated by calculating a seepage gradient and (2) increased seepage pressures that decrease the factor of safety of landside slope stability. The potential for seepage is considered high due to the presence of near surface and deep

coarse-grained sands. Sandy soils convey water during flood events that can cause an increase in pore water pressures and lead to increase through seepage, underseepage, piping, and potential destabilization of embankment slopes.

Underseepage is evaluated by calculating the average vertical exit gradient at the levee toe and/or some distance from the levee toe. The average vertical exit gradient is calculated as the change in head over the thickness of the blanket (if present). The blanket is considered a surficial soil layer consisting of soils with a lower permeability (i.e. clay, silt, or sandy clay) than the underlying soil layer (i.e. sand, silty sand, or gravel). If gradients exceed the allowable criteria set forth by ULDC, then underseepage mitigation will be needed.

Through seepage is evaluated by evaluating the exit point of the phreatic surface within a seepage model and the composition of the levee embankment materials. When seepage is evaluated and the phreatic surface breakout point on the landside slope is above the toe and the levee embankment consists of erodible material, such as sand, the levee is judged to have a through seepage deficiency and mitigation is needed.

Liquefaction – Liquefaction describes a phenomenon in which saturated soil loses shear strength and deforms as a result of increased pore water pressure induced by strong ground shaking during an earthquake. Dissipation of the excess pore pressure will produce volume changes within the liquefied soil layer, which causes settlement of the levee. Shear strength reduction combined with inertial forces from the ground motion may result in lateral migration (lateral spreading), extensional ground cracking of liquefied material, and slope failure. Factors known to influence liquefaction include soil type, structure, grain size, relative density, confining pressure, depth to groundwater, and the intensity and duration of ground shaking. Soils most susceptible to liquefaction are saturated, loose sandy soils and low plasticity clays and silts. Loose sandy soils are present at the site with relatively shallow groundwater. Additionally, predicted ground motions during a design seismic event are such that the potential for liquefaction in the saturated, loose sandy soils in the project area is considered high. Liquefaction should be considered in the levee design by increasing levee height to account for potential settlement of the embankment. The quantity of settlement should be evaluated and calculated during future design tasks.

Levee Design Considerations

The standard levee geometry template for minor stream levees outlined by the ULDC should be applied to this project. The levee will be approximately 20 feet in height where it ties into the existing levee and the levee height will gradually decrease as the levee progresses to the east and eventually ties into high ground. However, due to the presence of sandy soil discussed above, an additional mitigation feature may be needed to mitigate seepage due to the presence of sandy soils in the existing levee embankment, in the blanket layer, and at depth. Mitigation alternatives may include a seepage berm or a seepage cutoff wall. These issues are discussed below and it is our understanding that these mitigations are being incorporated into the design alternatives as discussed above.

Levee Embankment – Seepage through the levee embankment can be remediated by constructing the new levee embankment with fine grained material (cohesive silts, clays, and clayey sands) that meet ULDC and State of California Title 23 requirements.

Seepage Berm – Potential seepage under the levee may be mitigated through construction of a seepage berm. The minimum width of a seepage berm is four times the levee height and the maximum width seepage berm is 300 feet wide. A 100-foot width berm should be considered

during preliminary design to mitigate underseepage due to the anticipated presence of near surface and deep sands. Berm thickness should be 5 feet at the levee toe and taper to 3 feet thick at the berm toe. Seepage berm width and thickness will need to be evaluated with additional explorations during future design tasks. Explorations should be performed to depths at least three times the maximum levee height into the foundation at least every 1,000 linear feet of levee being evaluated. Accordingly, for a 20-foot tall levee, the explorations should be performed at least 60 feet into the levee foundation and to a depth to fully characterize the subsurface conditions along the proposed alignment.

Seepage Cutoff Wall – Potential seepage may also be mitigated through construction of a seepage cutoff wall in lieu of a seepage berm. Based upon review of existing explorations potential key in depths for the cutoff wall may vary between 20 feet and 100 feet below existing site grade in the area of the proposed dryland levee extension. There may be other discontinuous key in layers at 45 feet and 70 feet below existing site grade. However, we understand as noted above that a wall depth of 85 feet is being considered as part of preliminary design. Wall depths will need to be evaluated with additional explorations during future design tasks. Explorations should be performed to depths at least three times the maximum levee height into the foundation at least every 1,000 linear feet of levee being evaluated. Accordingly, for a 20-foot tall levee, the explorations should be performed at least 60 feet into the levee foundation and to a depth to fully characterize the subsurface conditions along the proposed alignment. Special consideration may be given to exploring deeper depths should an aquitard layer not be identified within the planned exploration depth.

Levee Geometry – A typical levee prism consisting of minimum side slopes of 3 horizontal to 1 vertical (3H:1V) waterside slope and 3H:1V landside slope with a minimum crest width of 20 feet for an urban levee should be considered per ULDC. Freeboard requirements, per ULDC, suggest an additional 3 feet be added above the design water surface elevation. In order to account for potential liquefaction and settlement of the levee crest, the freeboard should be increased by approximately 6 inches during design. The quantity of settlement shall be evaluated and calculated during future design tasks. In addition to ULDC, these geometry requirements will generally meet or exceed federal requirements for levees.

ALTERNATIVE ALIGNMENT DISCUSSION

Each alignment alternative is discussed below. The alignment number followed by a C (cutoff wall) or S (seepage berm) designates each alternative.

Alternative 1C

Alternative 1C consists of a levee embankment that follows Alignment 1, which begins at the termination point of the existing dryland levee, extends east, jogging north as necessary to minimize real estate impacts, and ends at the high ground located at Tinnin Road. The approximate total length of the levee embankment for Alternative 1C is 8,700 feet.

To account for seepage mitigation, Alternative 1C includes a soil-bentonite, open trench cutoff wall with an approximate depth of 85 feet from existing ground. This cutoff wall will run from the beginning of the new levee embankment (at the termination of the existing dryland levee) to where the hydraulic loading of the levee is less than two feet, which is between Oleander Avenue and Union Road, for a total cutoff wall length of approximately 4,700 feet.

Alternative 1C will also require raising existing roads which the levee crosses in order to bring them up to the top of levee elevation. Airport Way, Oleander Avenue, and Union Road will all require raising as part of this alternative.

Modifications to existing irrigation supply infrastructure will also be required where crossings exist. Installation of positive closure structures and devices will be required at each one of these crossings, of which two are expected for this alternative.

A graphical depiction of this alternative is included as Figure 2.

Alternative 1S

Alternative 1S consists of a levee embankment that follows Alignment 1, which begins at the termination point of the existing dryland levee, extends east, jogging north as necessary to minimize real estate impacts, and ends at the high ground located at Tinnin Road. This results in an approximate total length of levee embankment of 8,700ft.

To account for seepage mitigation, this alternative includes a 100-foot wide, five-foot-tall (at the landside levee toe) seepage berm. This seepage berm will run from the beginning of the new levee embankment (at the termination of the existing dryland levee) to where the hydraulic loading of the levee is less than two feet, which is between Oleander Avenue and Union Road, for a total berm length of approximately 4,700 feet.

Alternative 1S will also require raising existing roads which the levee crosses in order to bring them up to the top of levee elevation. Airport Way, Oleander Avenue, and Union Road will all require raising as part of this alternative.

Modifications to existing irrigation supply infrastructure will also be required where crossings exist. Installation of positive closure structures and devices will be required at each one of these crossings, of which two are expected for this alternative.

A graphical depiction of this alternative is included as Figure 3.

Alternative 2C

Alternative 2C consists of a levee embankment that follows Alignment 2, which begins at station 853+50 of the existing dryland levee, continues eastward to Airport Way, and then jogs north-east to avoid impacts to the residences on Fig Avenue. The alignment then continues east until turning south-east and ties into high ground near the intersection of Fig Avenue and Union Road. This results an approximate total length of levee embankment of 12,100 feet.

To account for seepage mitigation, this alternative includes a soil-bentonite, open trench cutoff wall with an approximate depth of 85 feet from existing ground. This cutoff wall will run from the beginning of the new levee embankment (at station 853+50 of the existing dryland levee) to where the hydraulic loading of the levee is less than two feet, which was found to be at the intersection with Oleander Avenue, for a total cutoff wall length of approximately 9,200 feet.

Alternative 2C will also require raising existing roads which it crosses in order to being them up to the top of levee elevation. Airport Way and Oleander Avenue will require raising as part of this alternative.

Modifications to existing irrigation supply infrastructure will also be required where crossings exist. This alternative proposes to install positive closure structures and devices at each one of these crossings, of which one is expected for this alternative. Relocation of an existing drainage ditch will also be required east of Airport Way. This ditch will be relocated south of the new levee embankment, tying into the existing ditch at both the upstream and downstream ends.

A graphical depiction of this alternative is included as Figure 4 (attached).

Alternative 2S

Alternative 2S consists of a levee embankment that follows Alignment 2, which begins at station 853+50 of the existing dryland levee, continues eastward to Airport Way, and then jogs north-east to avoid impacts to the residences on Fig Avenue. The alignment then continues east until turning south-east and tying into high ground near the intersection of Fig Avenue and Union Road. This results an approximate total length of levee embankment of 12,100 feet.

To account for seepage mitigation, this alternative includes a 100-foot wide, five-foot-tall (at the landside toe) seepage berm. This seepage berm will run from the beginning of the new levee embankment (at station 853+50 of the existing dryland levee) to where the hydraulic loading of the levee is less than two feet, which was found to be at the intersection with Oleander Avenue, for a total berm length of approximately 9,200 feet.

Alternative 2S will also require raising existing roads which it crosses in order to bring them up to the top of levee elevation. Airport Way and Oleander Avenue will require raising as part of this alternative.

Modifications to existing irrigation supply infrastructure will also be required where crossings exist. Alternative 2S proposes to install positive closure structures and devices at each one of these crossings, of which one is expected for this alternative. Relocation of an existing drainage ditch will also be required east of Airport Way. This ditch will be relocated south of the new levee embankment, tying into the existing ditch at both the upstream and downstream ends.

A graphical depiction of this alternative is included as Figure 5 (attached).

Future Design Recommendations

It is recommended that once an alignment is selected a formal geotechnical evaluation be performed. This evaluation should take into consideration existing data plus new explorations, laboratory testing, and analysis. The analysis would need to evaluate site specific conditions for liquefaction, seepage (through seepage and underseepage), and slope stability. Additionally, a borrow study should evaluate potential levee embankment material sources. The explorations and analyses would need to follow ULDC guidelines with findings contained in a geotechnical design report.

LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided. The remainder of the limitations included in the referenced report also apply to this letter.

CLOSING

We appreciate the opportunity to continue to be of service on this project. If you have any questions or if we can be of further assistance, please contact our office.

Sincerely,

KLEINFELDER, INC.

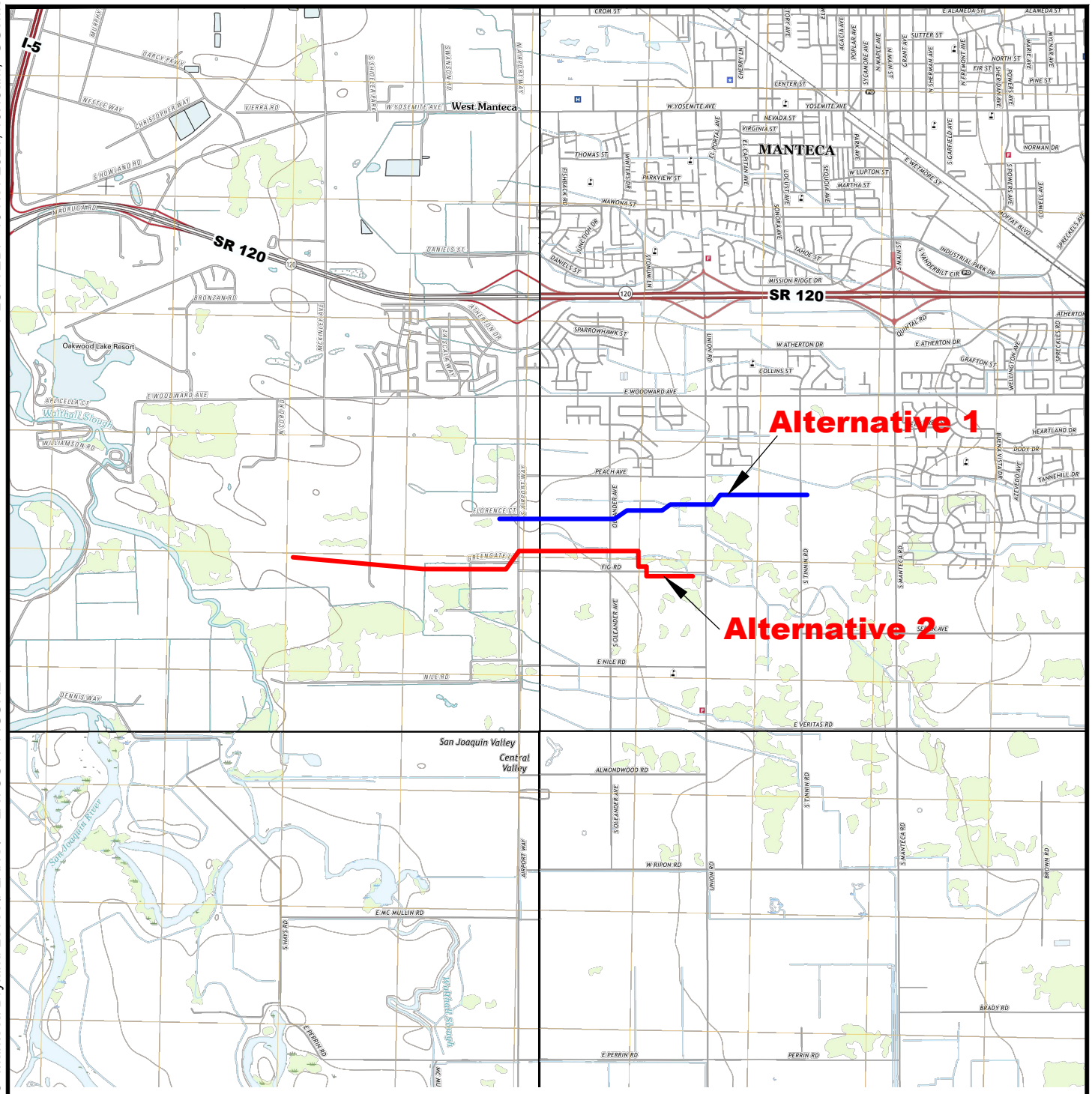
Steven Wiesner, PE, GE No. 3027
Principal Geotechnical Engineer

Timothy A. Williams, PE, GE
Sr. Principal Geotechnical Engineer

Attachments:
Figure 1 – Site Vicinity Map
Figure 2 – Alternative 1C Alignment and Typical Cross Sections
Figure 3 – Alternative 1S Alignment and Typical Cross Sections
Figure 4 – Alternative 2C Alignment and Typical Cross Sections
Figure 5 – Alternative 2S Alignment and Typical Cross Sections
Figure 6 – Previous Exploration Location Map
Figure 7 – Geologic Map
Figure 8a – Soil Survey Map
Figure 8b – Soil Survey Map Legend (1 of 2)
Figure 8c – Soil Survey Map Legend (2 of 2)

Appendix A – Previous Explorations and Laboratory Testing

FIGURES



NOTE: Colored alignments (2) are Potential Levee Alignments

0 4000 8000

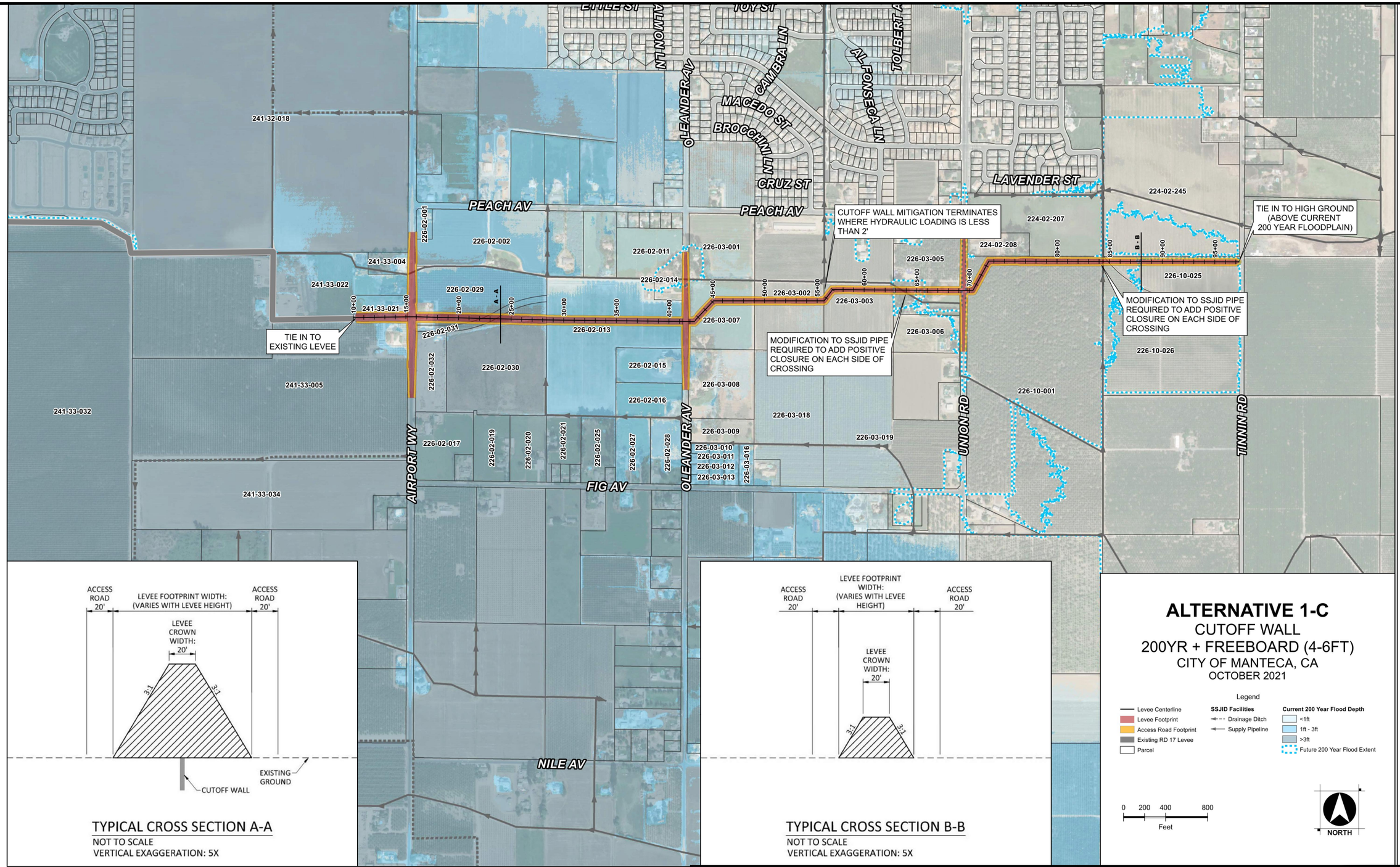
SCALE: 1" = 4000' SCALE IN FEET

PLOTTED: 16 Nov 2021, 10:43am, GGomez
CAD FILE: W:\2021\20212453- Manteca Dryland Levee\PLANS\ LAYOUT: FIGURE 1
ATTACHED IMAGES:
ATTACHED XREFS:
OFFICE_NAME

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20212453	
DRAWN: 10/27/2020	**SITE VICINITY MAP**
DRAWN BY: GG	
CHECKED BY: SR	Manteca Dry Land Levee Manteca, California
FILE NAME: STO20D050r.CAD	

FIGURE
1



TYPICAL CROSS SECTION A-A
NOT TO SCALE
VERTICAL EXAGGERATION: 5X

TYPICAL CROSS SECTION B-B
NOT TO SCALE
VERTICAL EXAGGERATION: 5X

ALTERNATIVE 1-C

CUTOFF WALL
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
OCTOBER 2021

Legend

- Levee Centerline
- Levee Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Parcel

SSJID Facilities
- Drainage Ditch
- Supply Pipeline

Current 200 Year Flood Depth
- <1ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

0 200 400 800
Feet

NORTH

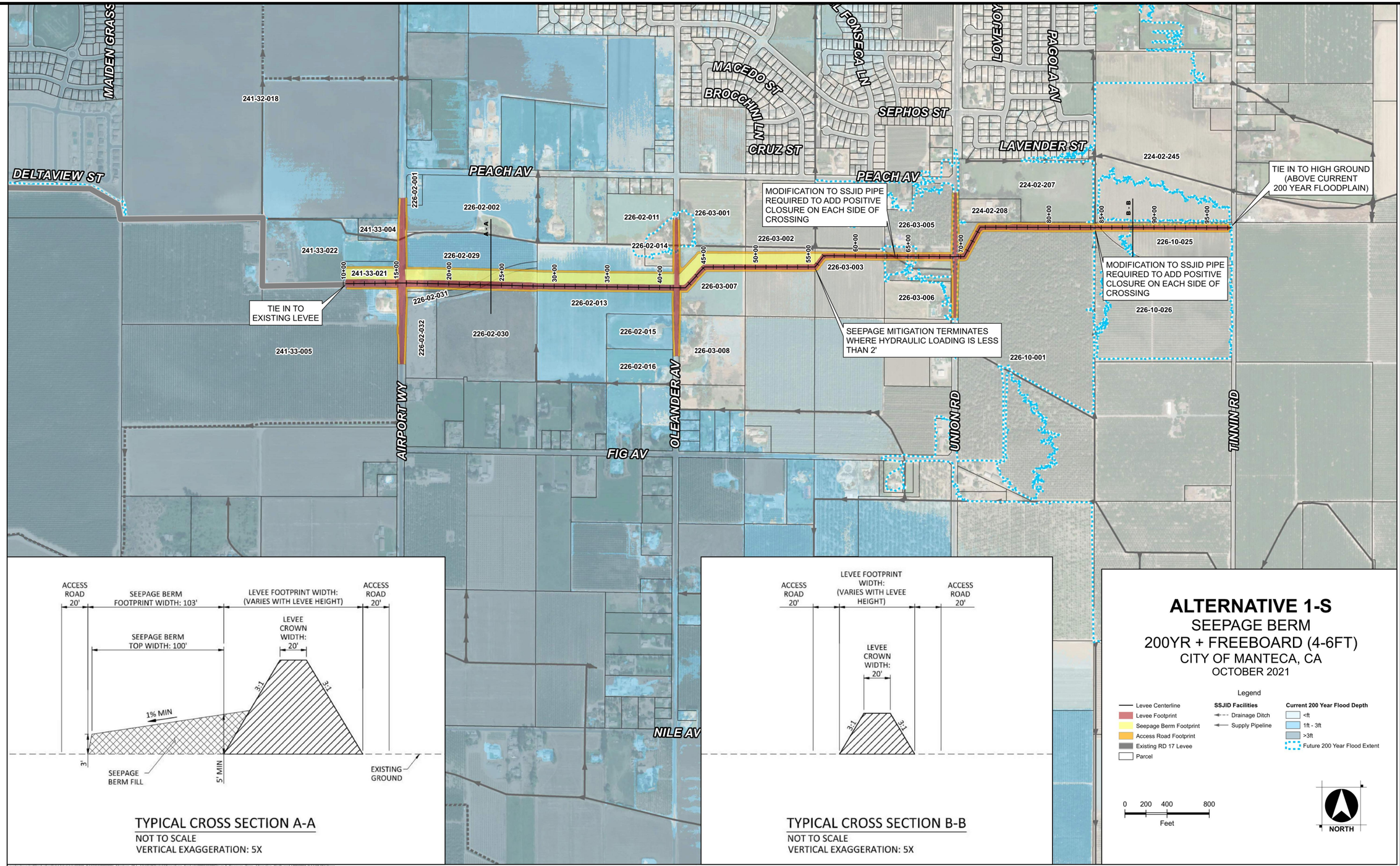
KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20212453	
DRAWN: 10/27/2020	
DRAWN BY: GG	
CHECKED BY: SR	
FILE NAME: STO20D050r.CAD	

ALIGNMENT ALTERNATIVE 1-C MAP

Manteca Dry Land Levee
Manteca, California

FIGURE
2



TYPICAL CROSS SECTION A-A
NOT TO SCALE
VERTICAL EXAGGERATION: 5X

TYPICAL CROSS SECTION B-B
NOT TO SCALE
VERTICAL EXAGGERATION: 5X

ALTERNATIVE 1-S

SEEPAGE BERM
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
OCTOBER 2021

Legend

- Levee Centerline
- Levee Footprint
- Seepage Berm Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Parcel

SSJID Facilities

- Drainage Ditch
- Supply Pipeline

Current 200 Year Flood Depth

- <ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

0 200 400 800
Feet

NORTH

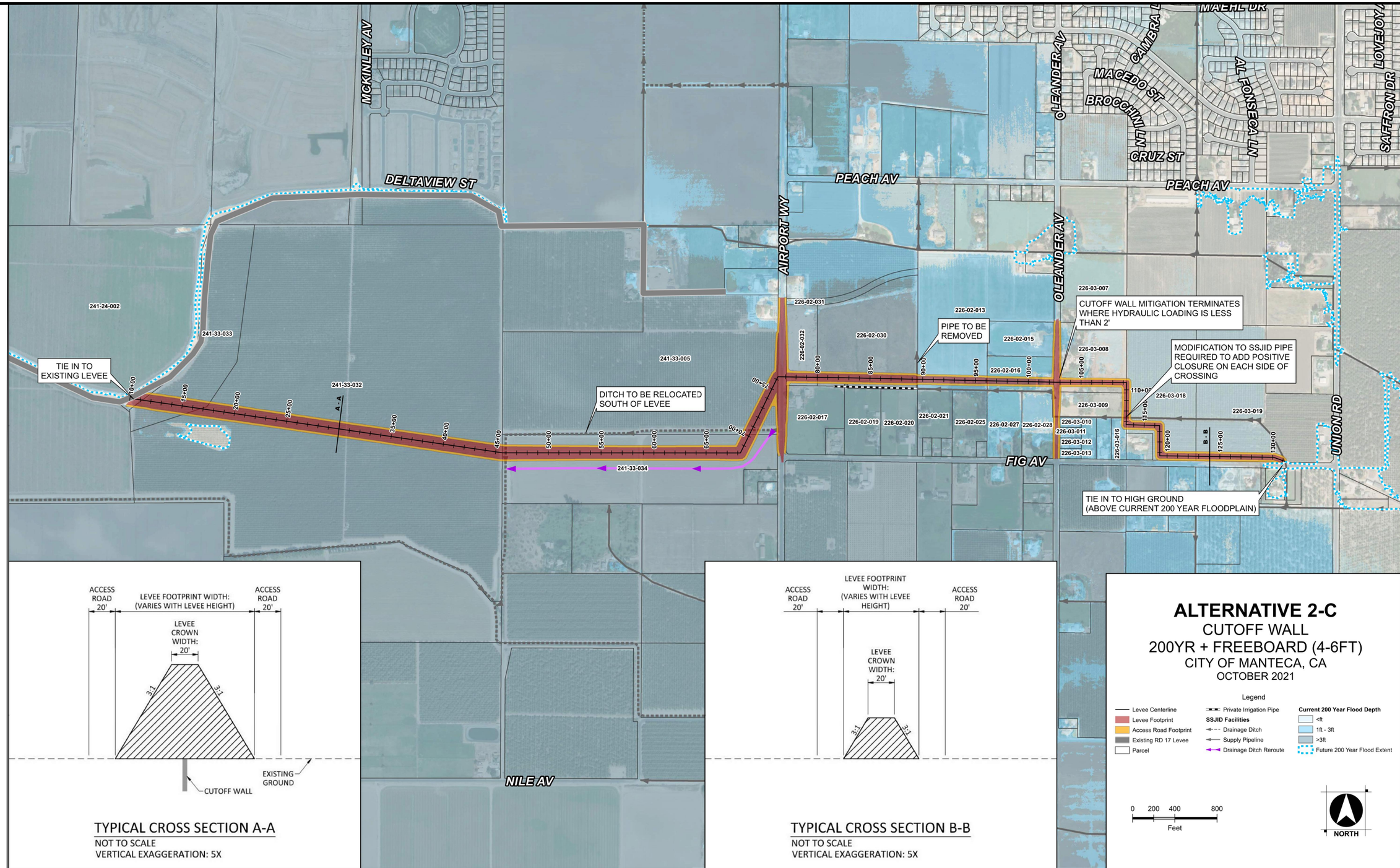
KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20212453	
DRAWN: 10/27/2020	
DRAWN BY: GG	
CHECKED BY: SR	
FILE NAME: STO20D050r.CAD	

ALIGNMENT ALTERNATIVE 1-S MAP

Manteca Dry Land Levee
Manteca, California

FIGURE
3



TYPICAL CROSS SECTION A-A
NOT TO SCALE
VERTICAL EXAGGERATION: 5X

TYPICAL CROSS SECTION B-B
NOT TO SCALE
VERTICAL EXAGGERATION: 5X

ALTERNATIVE 2-C

CUTOFF WALL
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
OCTOBER 2021

Legend

- Levee Centerline
- Levee Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Parcel
- Private Irrigation Pipe
- **SSJID Facilities**
- Drainage Ditch
- Supply Pipeline
- Drainage Ditch Reroute
- **Current 200 Year Flood Depth**
- <ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

0 200 400 800
Feet

NORTH

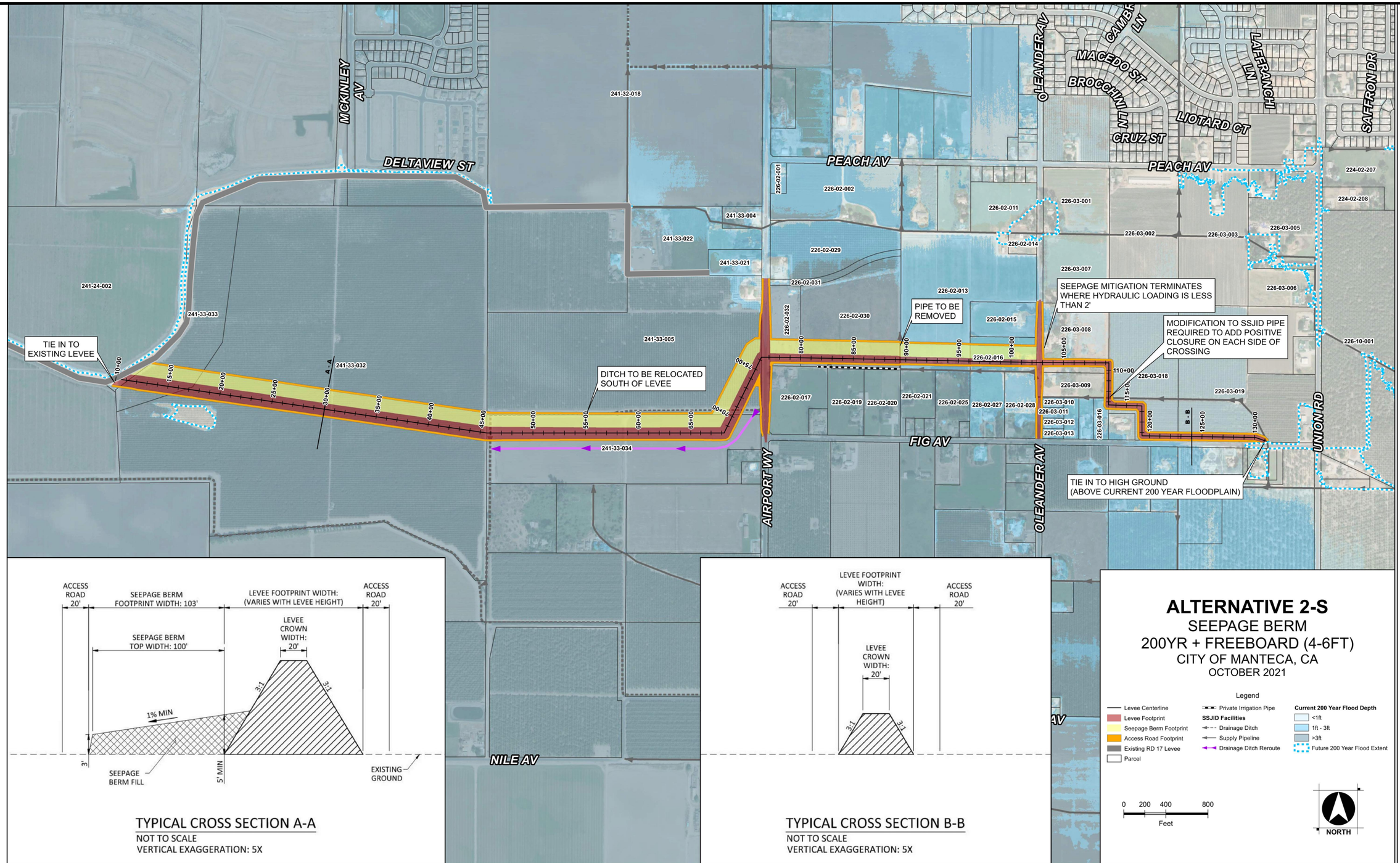
KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20212453	
DRAWN: 10/27/2020	
DRAWN BY: GG	
CHECKED BY: SR	
FILE NAME: STO20D050r.CAD	

ALIGNMENT ALTERNATIVE 2-C MAP

Manteca Dry Land Levee
Manteca, California

FIGURE
4



TYPICAL CROSS SECTION A-A

NOT TO SCALE
VERTICAL EXAGGERATION: 5X

TYPICAL CROSS SECTION B-B

NOT TO SCALE
VERTICAL EXAGGERATION: 5X

ALTERNATIVE 2-S

SEEPAGE BERM
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
OCTOBER 2021

Legend

- Levee Centerline
- Levee Footprint
- Seepage Berm Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Parcel
- Private Irrigation Pipe
- **SSJID Facilities**
- Drainage Ditch
- Supply Pipeline
- Drainage Ditch Reroute
- **Current 200 Year Flood Depth**
- <1ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

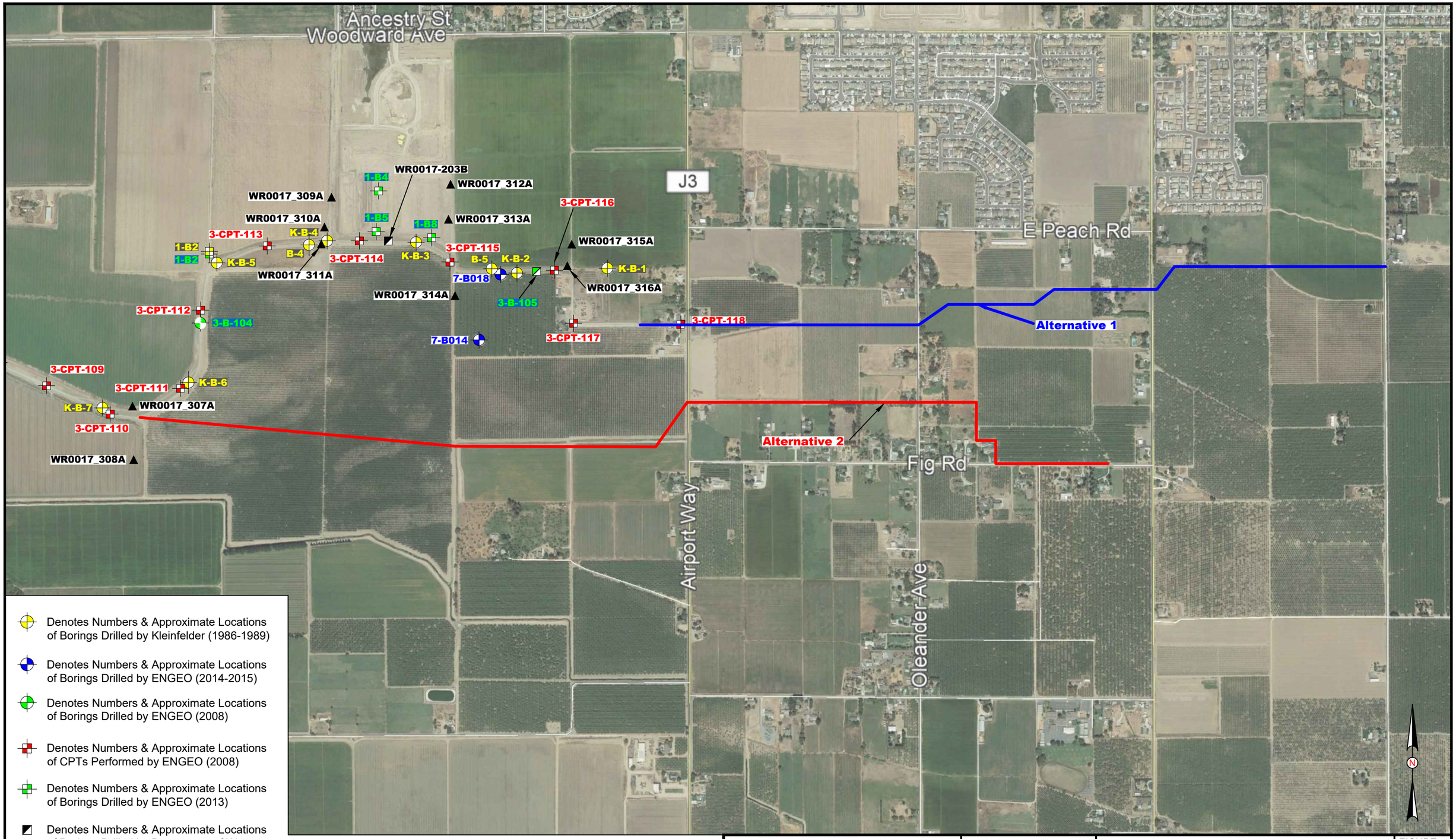
0 200 400 800
Feet

NORTH

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20212453	**ALIGNMENT ALTERNATIVE 2-S MAP**
DRAWN: 10/27/2020	
DRAWN BY: GG	
CHECKED BY: SR	
FILE NAME: STO20D050r.CAD	Manteca Dry Land Levee Manteca, California

FIGURE
5



Denotes Numbers & Approximate Locations of Borings Drilled by Kleinfelder (1986-1989)

Denotes Numbers & Approximate Locations of Borings Drilled by ENGEO (2014-2015)

Denotes Numbers & Approximate Locations of Borings Drilled by ENGEO (2008)

Denotes Numbers & Approximate Locations of CPTs Performed by ENGEO (2008)

Denotes Numbers & Approximate Locations of Borings Drilled by ENGEO (2013)

Denotes Numbers & Approximate Locations of Borings Drilled by Department of Water Resources (2012)

Denotes Numbers & Approximate Locations of Borings Drilled by Department of Water Resources (2014)

0 1000 2000

SCALE: 1" = 1000' SCALE IN FEET

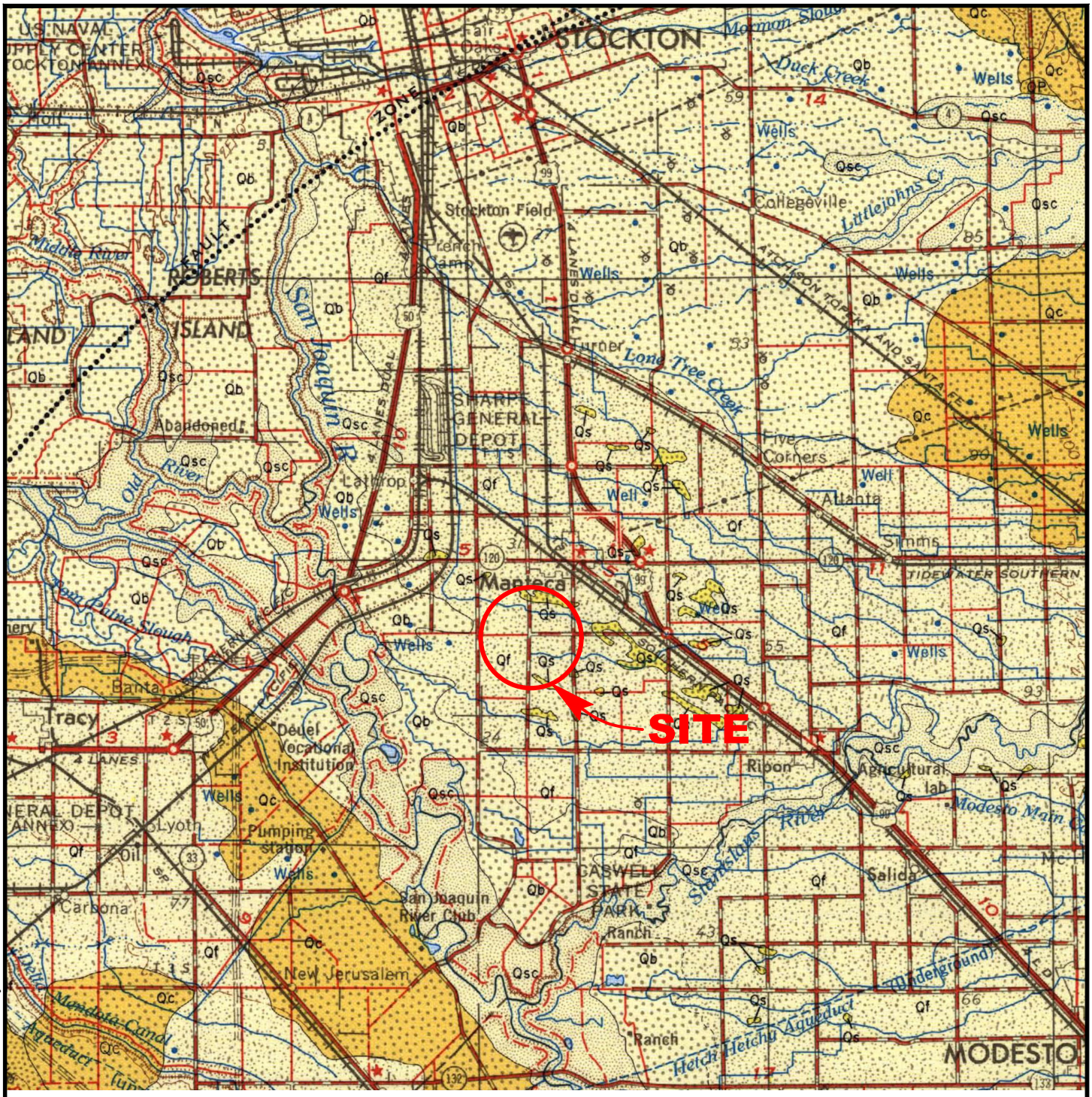
KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20212453
DRAWN: 10/27/2020
DRAWN BY: GG
CHECKED BY: SR
FILE NAME: STO20D050r.CAD

PREVIOUS EXPLORATION LOCATION MAP

Manteca Dry Land Levee
Manteca, California

FIGURE
6



Qsc Stream Channel Deposits

Qf Fan Deposits

Qb Basin Deposits

Qs Dune Sand

N

0 3

Statute Miles

REFERENCE:
Geologic Map of Callifornia, San Jose Sheet, Compolation by Thomas H. Rogers, 1966

PLOTTED: 16 Nov 2021, 10:46am, GGomez

CAD FILE: W:\20211\20212453- Manteca Dryland Levee\PLANS\ LAYOUT: FIGURE 7

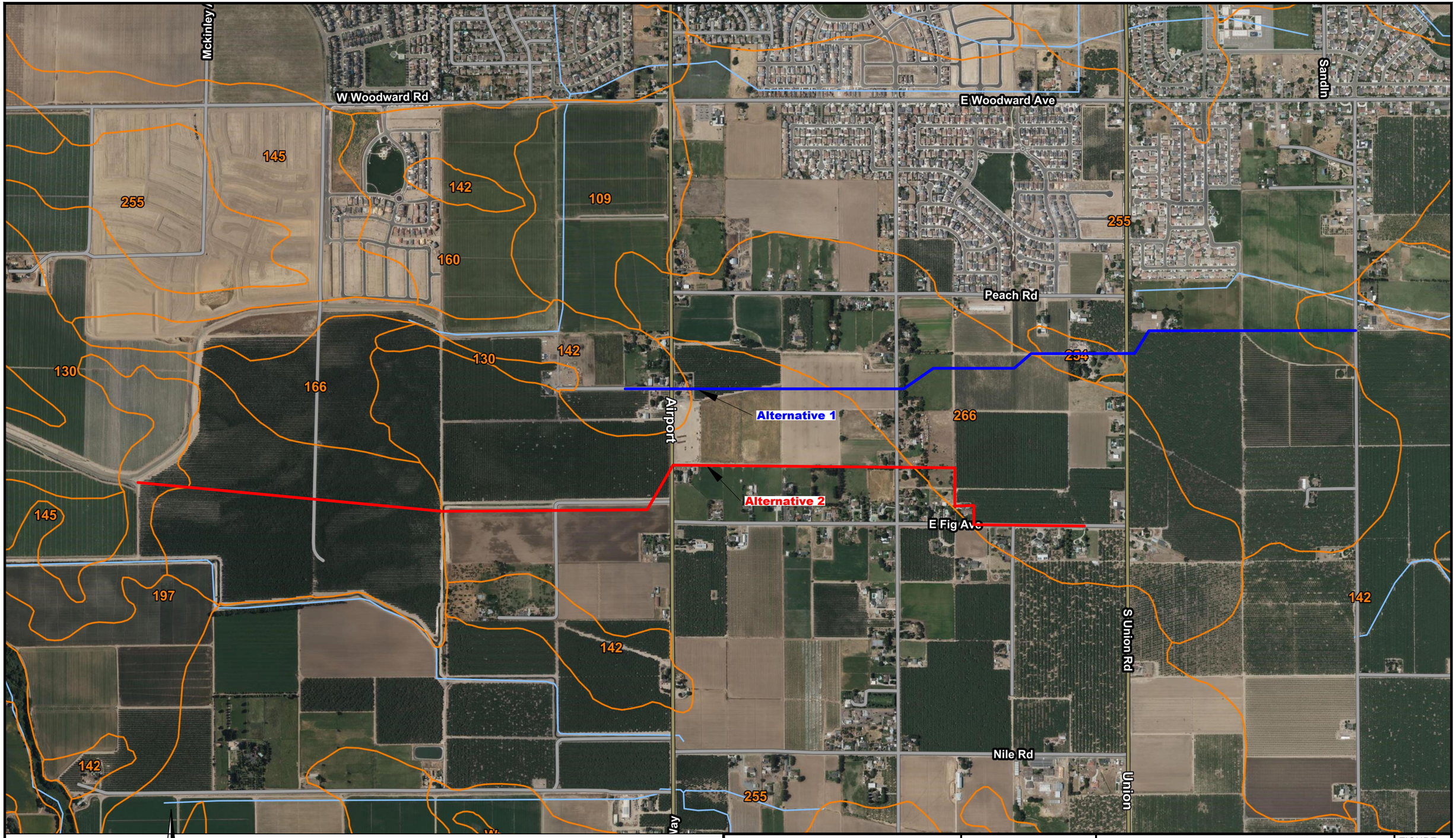
ATTACHED IMAGES:
ATTACHED XREFS:
OFFICE_NAME

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20212453	
DRAWN: 10/27/2020	**GEOLOGIC MAP**
DRAWN BY: GG	
CHECKED BY: SR	Manteca Dry Land Levee Manteca, California
FILE NAME: STO20D050r.CAD	

FIGURE

7



N

0 1000 2000

SCALE: 1" = 1000' SCALE IN FEET

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20212453	
DRAWN: 10/27/2020	
DRAWN BY: GG	
CHECKED BY: SR	
FILE NAME: STO20D050r.CAD	

SOIL SURVEY MAP

Manteca Dry Land Levee
Manteca, California

FIGURE
8a

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
108	Arents, saline-sodic, 0 to 2 percent slopes	395.5	3.2%
109	Bisgani loamy coarse sand, partially drained, 0 to 2 percent slopes	512.8	4.2%
130	Columbia fine sandy loam, drained, 0 to 2 percent slopes, MLRA 17	603.8	5.0%
131	Columbia fine sandy loam, partially drained, 0 to 2 percent slopes, occasionally flooded	156.9	1.3%
132	Columbia fine sandy loam, channeled, partially drained, 0 to 2 percent slopes, frequently flooded	64.3	0.5%
133	Columbia fine sandy loam, clayey substratum, partially drained, 0 to 2 percent slopes	64.1	0.5%
141	Delhi fine sand, 0 to 5 percent slopes	148.0	1.2%
142	Delhi loamy sand, 0 to 2 percent slopes, MLRA 17	1,249.3	10.2%
143	Delhi-Urban land complex, 0 to 2 percent slopes	366.4	3.0%
144	Dello sand, partially drained, 0 to 2 percent slopes, occasionally flooded	170.6	1.4%
145	Dello loamy sand, drained, 0 to 2 percent slopes	390.6	3.2%
148	Dello clay loam, drained, 0 to 2 percent slopes, overwashed	259.9	2.1%
152	Egbert mucky clay loam, partially drained, 0 to 2 percent slopes	23.8	0.2%
153	Egbert silty clay loam, partially drained, 0 to 2 percent slopes, MLRA 16	216.9	1.8%
159	Fluvaquents, 0 to 2 percent slopes, frequently flooded, MLRA 16	10.9	0.1%
160	Galt clay, 0 to 1 percent slopes, MLRA 17	87.9	0.7%
166	Grangeville fine sandy loam, partially drained, 0 to 2 percent slopes	252.6	2.1%

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20212453	
DRAWN: 10/27/2020	**SOIL SURVEY MAP LEGEND**
DRAWN BY: GG	
CHECKED BY: SR	Manteca Dry Land Levee Manteca, California
FILE NAME: STO20D050r.CAD	

FIGURE
8b

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
167	Grangeville clay loam, partially drained, 0 to 2 percent slopes	25.1	0.2%
169	Guard clay loam, drained, 0 to 2 percent slopes	189.6	1.6%
175	Honcut sandy loam, 0 to 2 percent slopes	183.4	1.5%
196	Manteca fine sandy loam, 0 to 2 percent slopes	354.0	2.9%
197	Merritt silty clay loam, partially drained, 0 to 2 percent slopes	1,296.8	10.6%
198	Merritt silty clay loam, partially drained, 0 to 2 percent slopes, occasionally flooded	40.2	0.3%
254	Timor loamy sand, 0 to 2 percent slopes	380.9	3.1%
255	Tinnin loamy coarse sand, 0 to 2 percent slopes	3,077.6	25.2%
265	Veritas sandy loam, partially drained, 0 to 2 percent slopes	10.7	0.1%
266	Veritas fine sandy loam, 0 to 2 percent slopes	1,161.5	9.5%
W	Water	501.4	4.1%
Totals for Area of Interest		**12,195.4**	**100.0%**

PLOTTED: 16 Nov 2021, 10:48am, GGomez
CAD FILE: W:\2021\20212453- Manteca Dryland Levee\PLANS\ LAYOUT: FIGURE 8c
ATTACHED IMAGES:
ATTACHED XREFS:
OFFICE_NAME

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20212453
DRAWN: 10/27/2020
DRAWN BY: GG
CHECKED BY: SR
FILE NAME: STO20D050r.CAD

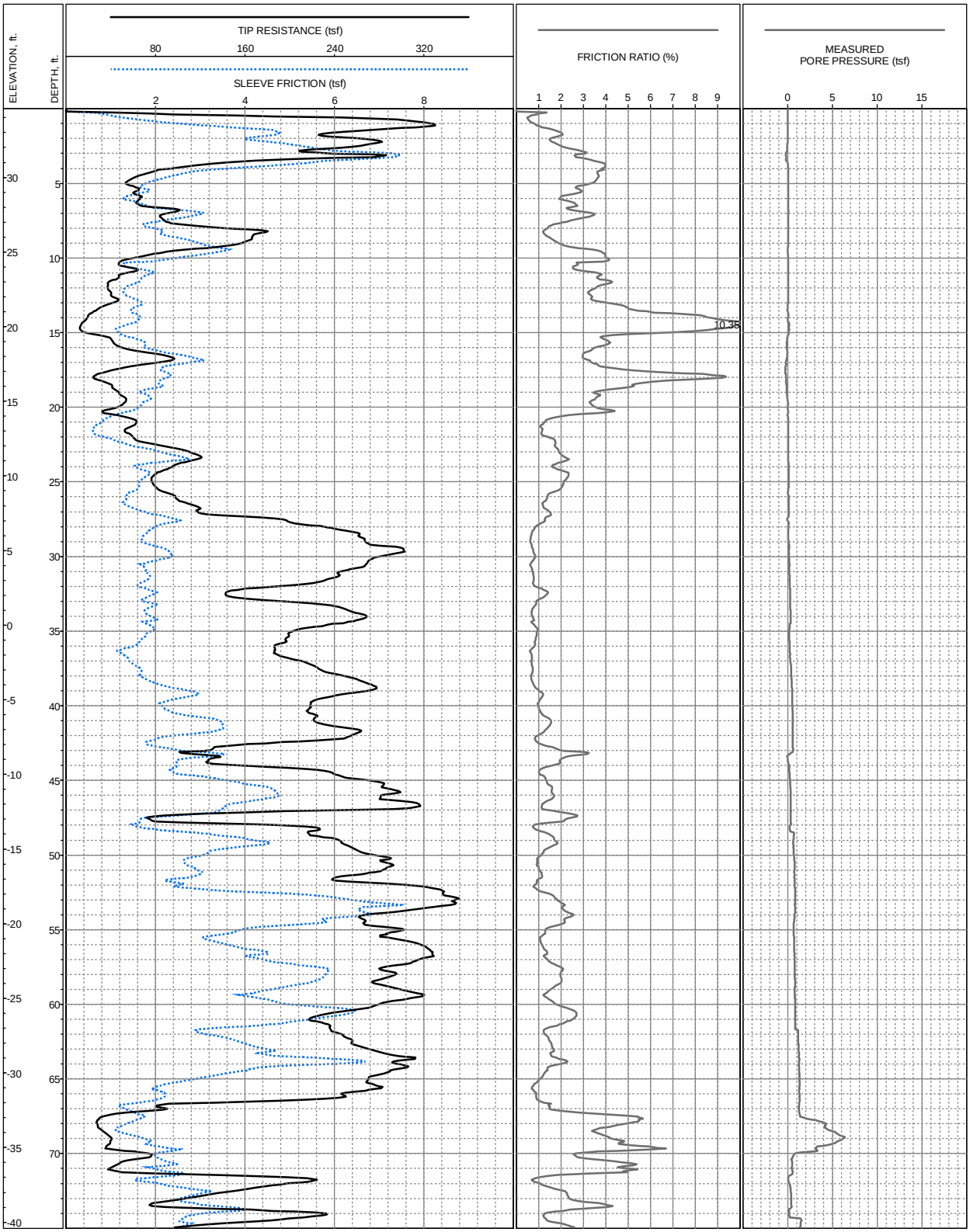
SOIL SURVEY MAP LEGEND

Manteca Dry Land Levee
Manteca, California

FIGURE
8c

APPENDIX A

CPT Locations
(Fugro 2007)



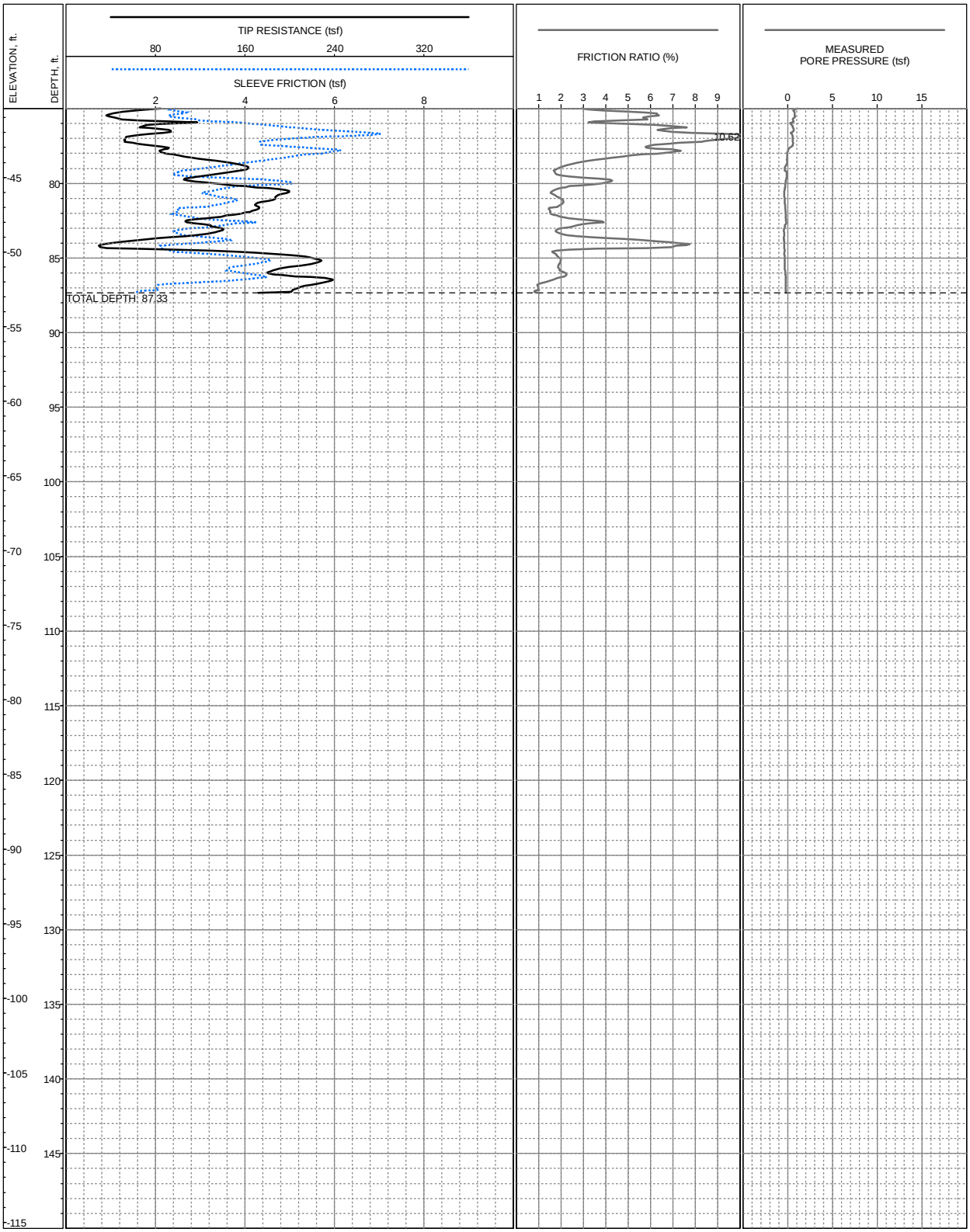
LOCATION: E6,333,717.67 N2,104,539.97 (CA SP ZnIII, ft.) Lat:37.77204 Long:-121.28867 (WGS 84)
SURFACE EL: 34.60ft (NAVD88)
COMPLETION DEPTH: 87.33ft
TEST DATE: 2/1/2007
STATIONING: 1854+83.96 Left 0.9 ft

CONE: F7.5CKEW1300
PERFORMED BY: Fugro Geosciences, Inc.
OPERATOR: R. Norris & R. Soto

LOG OF WR0017_105C

Reclamation District 17

San Joaquin County, California



LOCATION: E6,333,717.67 N2,104,539.97 (CA SP ZnIII, ft.) Lat:37.77204 Long:-121.28867 (WGS 84)
SURFACE EL: 34.60ft (NAVD88)
COMPLETION DEPTH: 87.33ft
TEST DATE: 2/1/2007
STATIONING: 1854+83.96 Left 0.9 ft

CONE: F7.5CKEW1300
PERFORMED BY: Fugro Geosciences, Inc.
OPERATOR: R. Norris & R. Soto

LOG OF WR0017_105C

Reclamation District 17

San Joaquin County, California

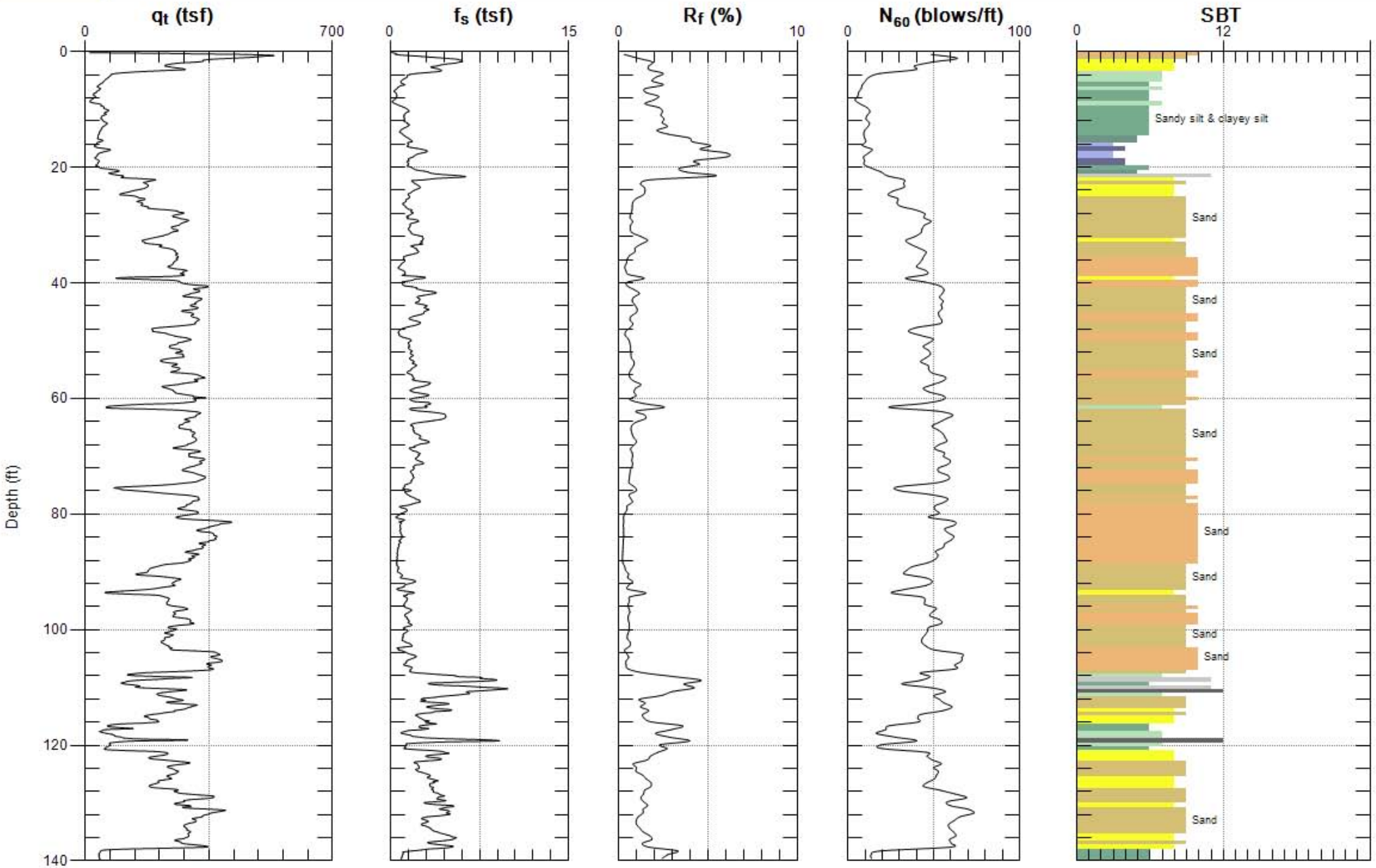
CPT Locations
(ENGEO 2008)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT106

Engineer: Z.CRAWFORD
Date: 7/14/2008 08:04



Max. Depth: 140.256 (ft)
Avg. Interval: 0.656 (ft)

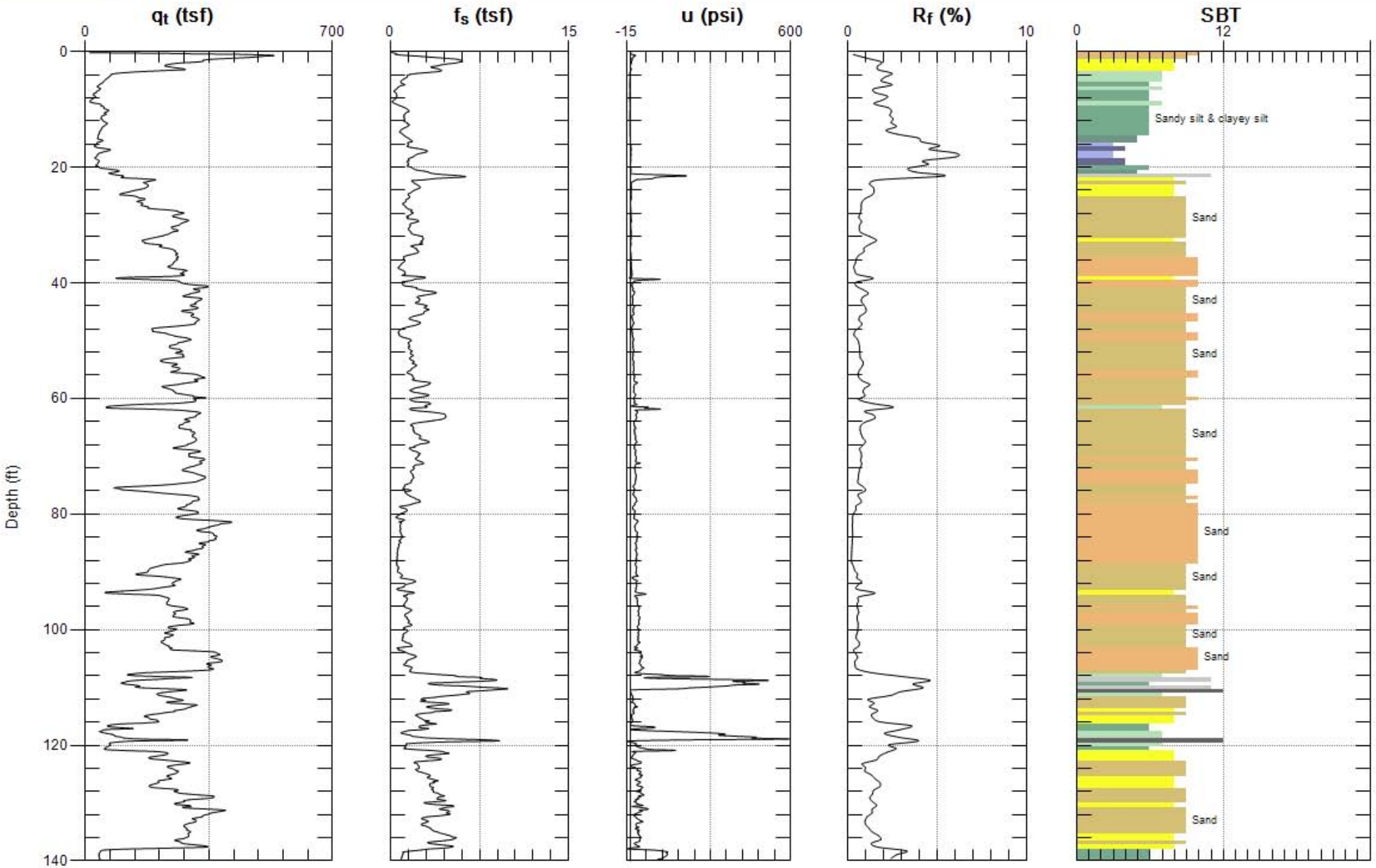
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA **Engineer: Z.CRAWFORD**

Sounding: 3-CPT106 **Date: 7/14/2008 08:04**



Max. Depth: 140.256 (ft)
Avg. Interval: 0.656 (ft)

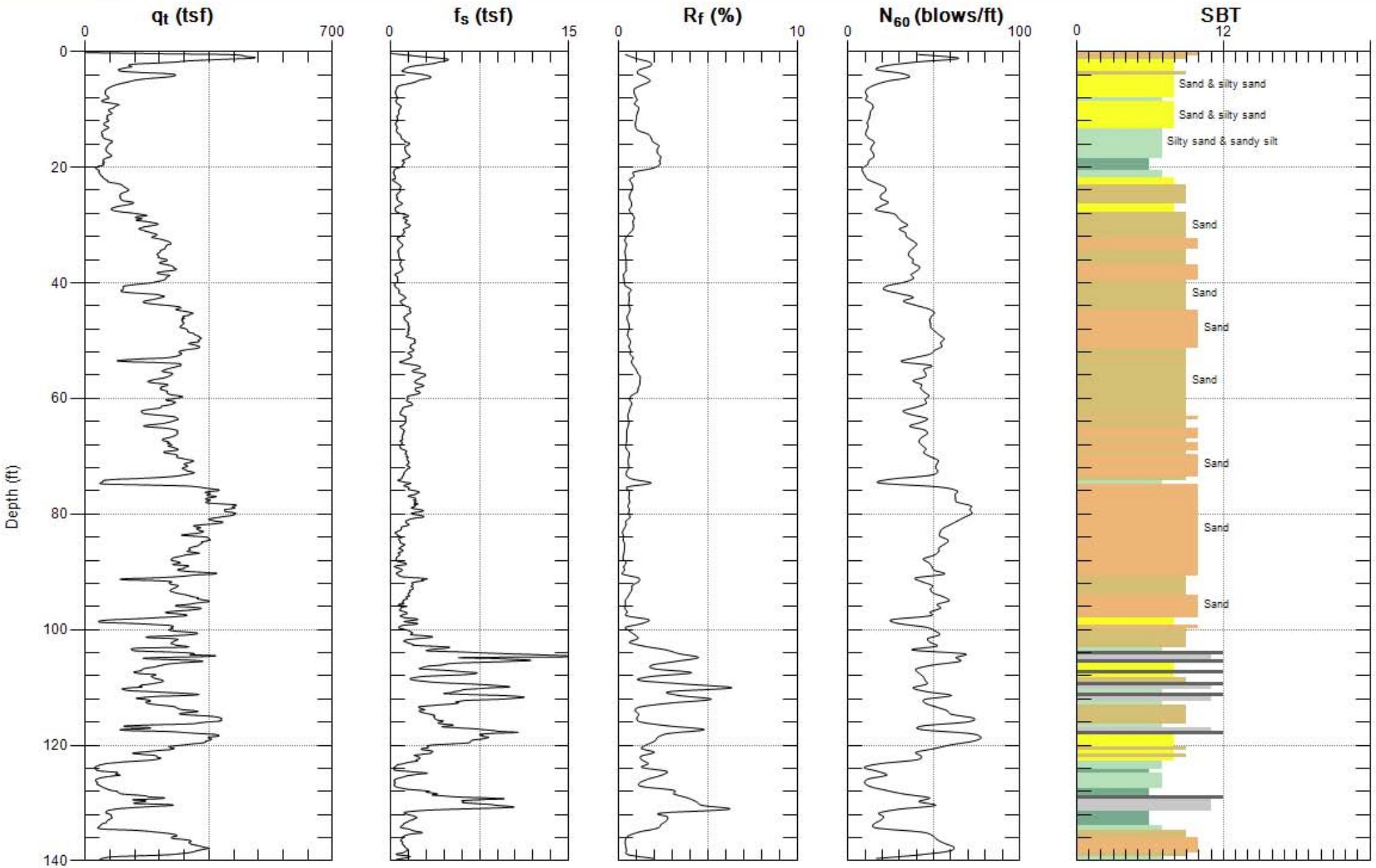
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT107

Engineer: Z.CRAWFORD
Date: 7/14/2008 10:19



Max. Depth: 140.092 (ft)
Avg. Interval: 0.656 (ft)

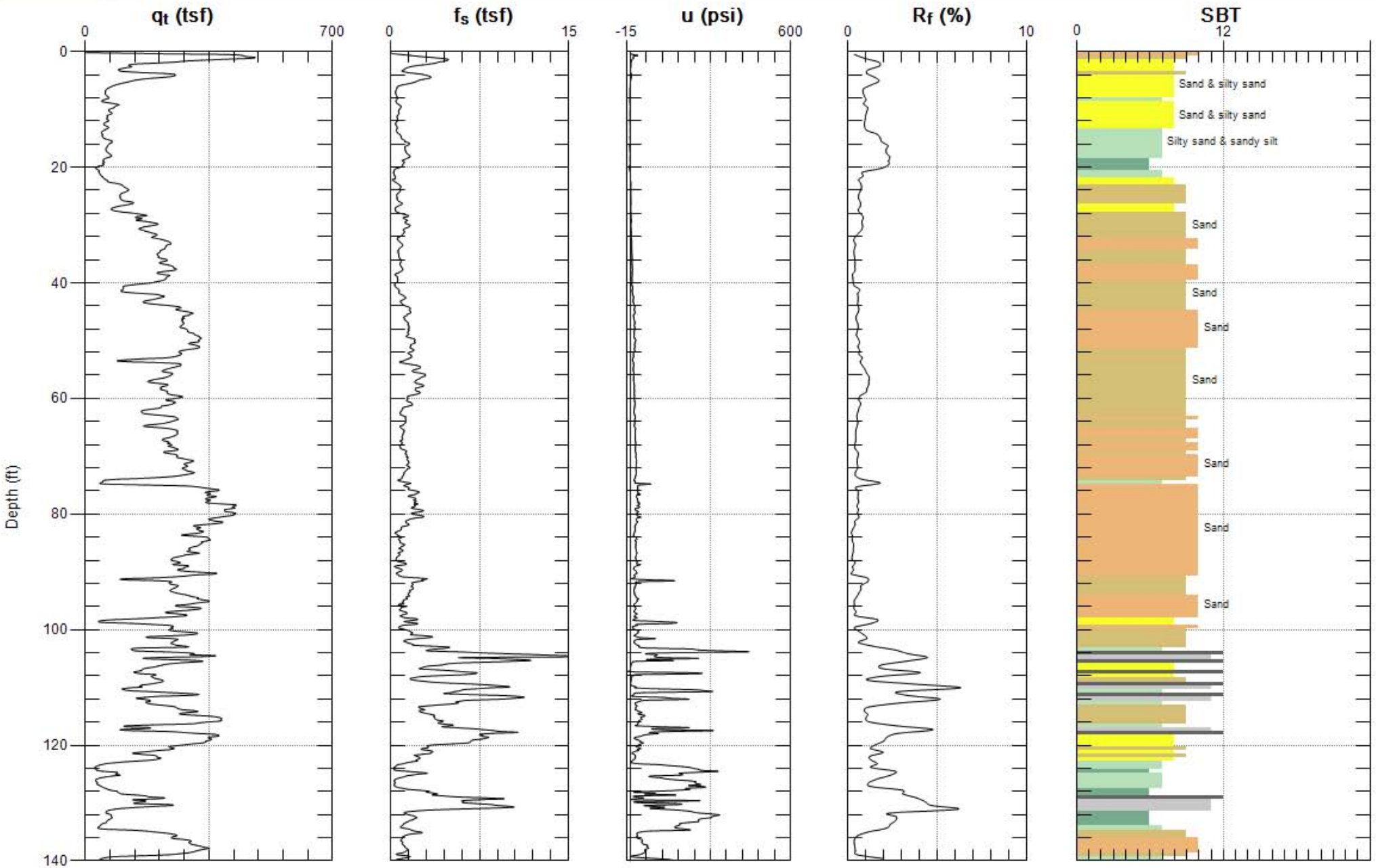
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA **Engineer: Z.CRAWFORD**

Sounding: 3-CPT107 **Date: 7/14/2008 10:19**



Max. Depth: 140.092 (ft)
Avg. Interval: 0.656 (ft)

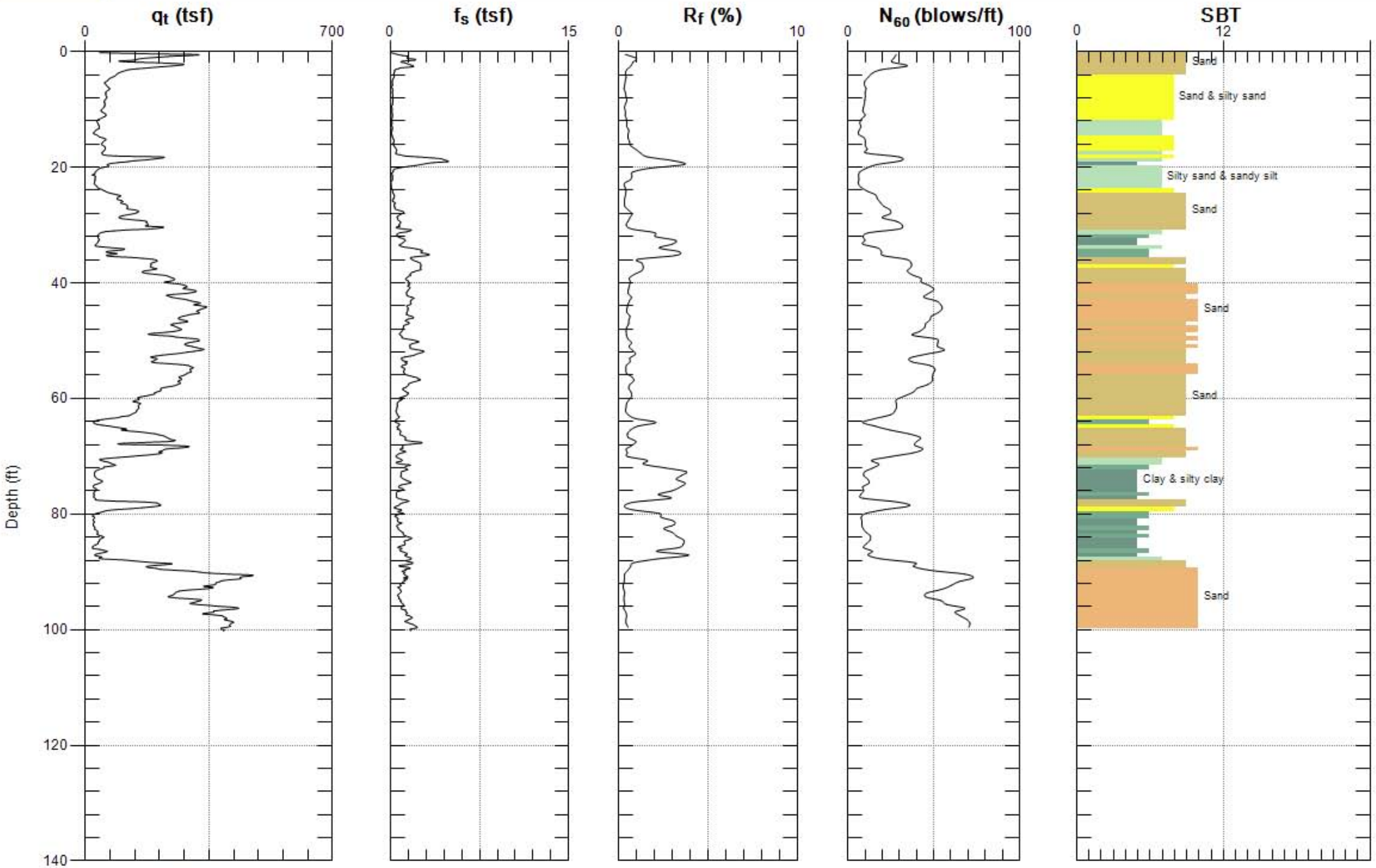
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT108

Engineer: Z.CRAWFORD
Date: 7/14/2008 01:14



Max. Depth: 100.230 (ft)
Avg. Interval: 0.656 (ft)

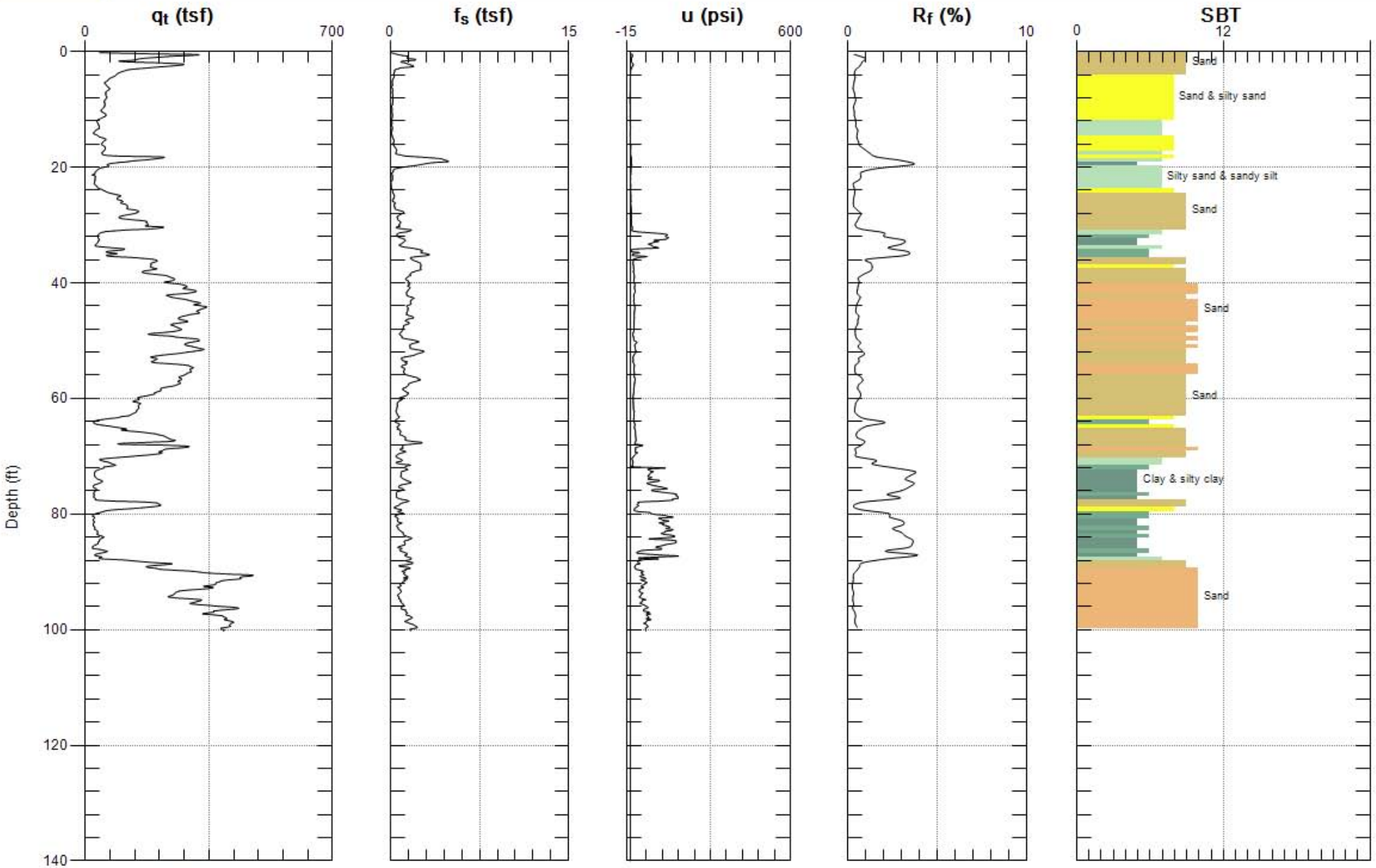
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA **Engineer: Z.CRAWFORD**

Sounding: 3-CPT108 **Date: 7/14/2008 01:14**



Max. Depth: 100.230 (ft)
Avg. Interval: 0.656 (ft)

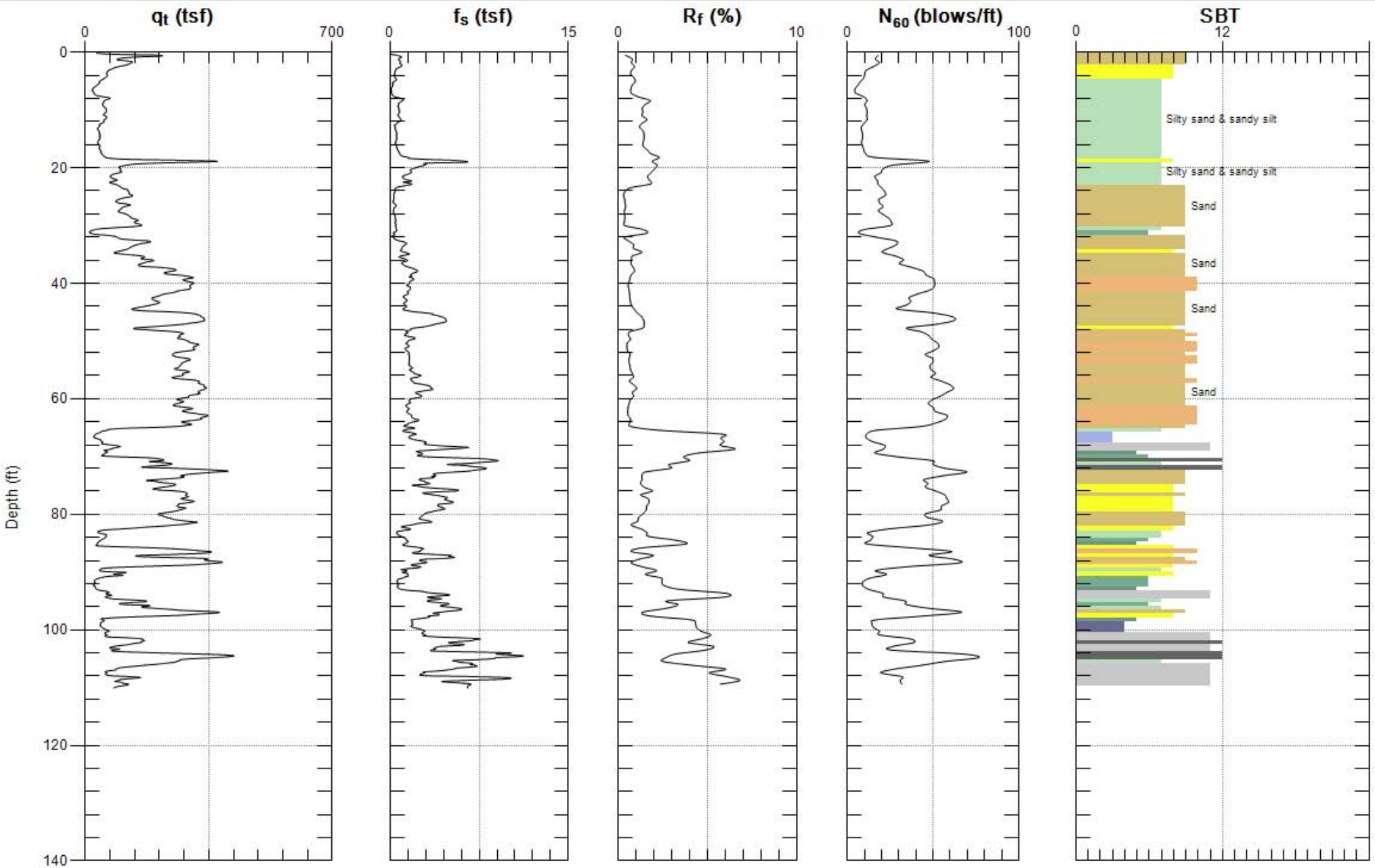
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT109

Engineer: Z.CRAWFORD
Date: 7/15/2008 07:17



Max. Depth: 110.072 (ft)
Avg. Interval: 0.656 (ft)

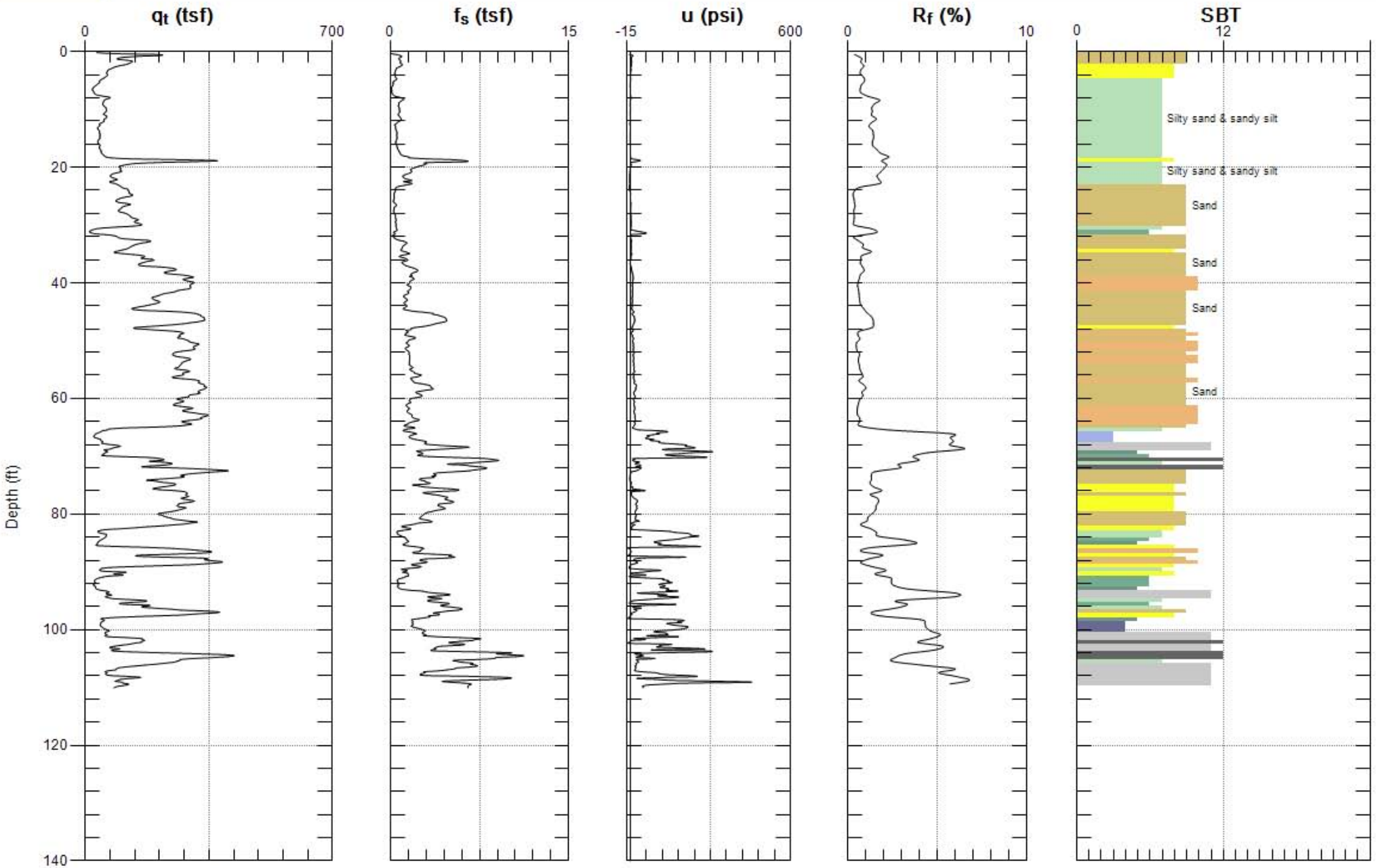
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT109

Engineer: Z.CRAWFORD
Date: 7/15/2008 07:17



Max. Depth: 110.072 (ft)
Avg. Interval: 0.656 (ft)

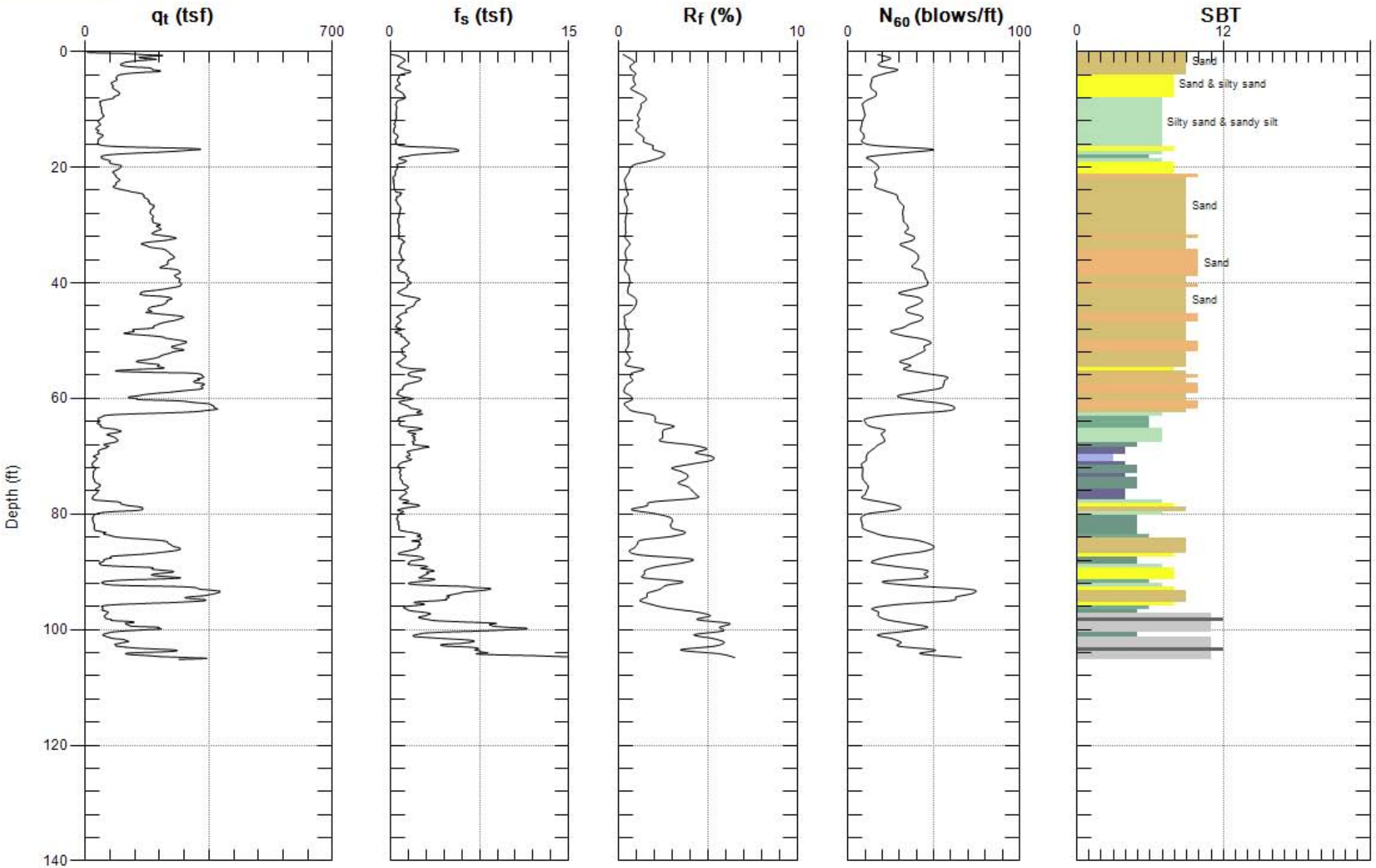
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT110

Engineer: Z.CRAWFORD
Date: 7/15/2008 08:54



Max. Depth: 105.151 (ft)
Avg. Interval: 0.656 (ft)

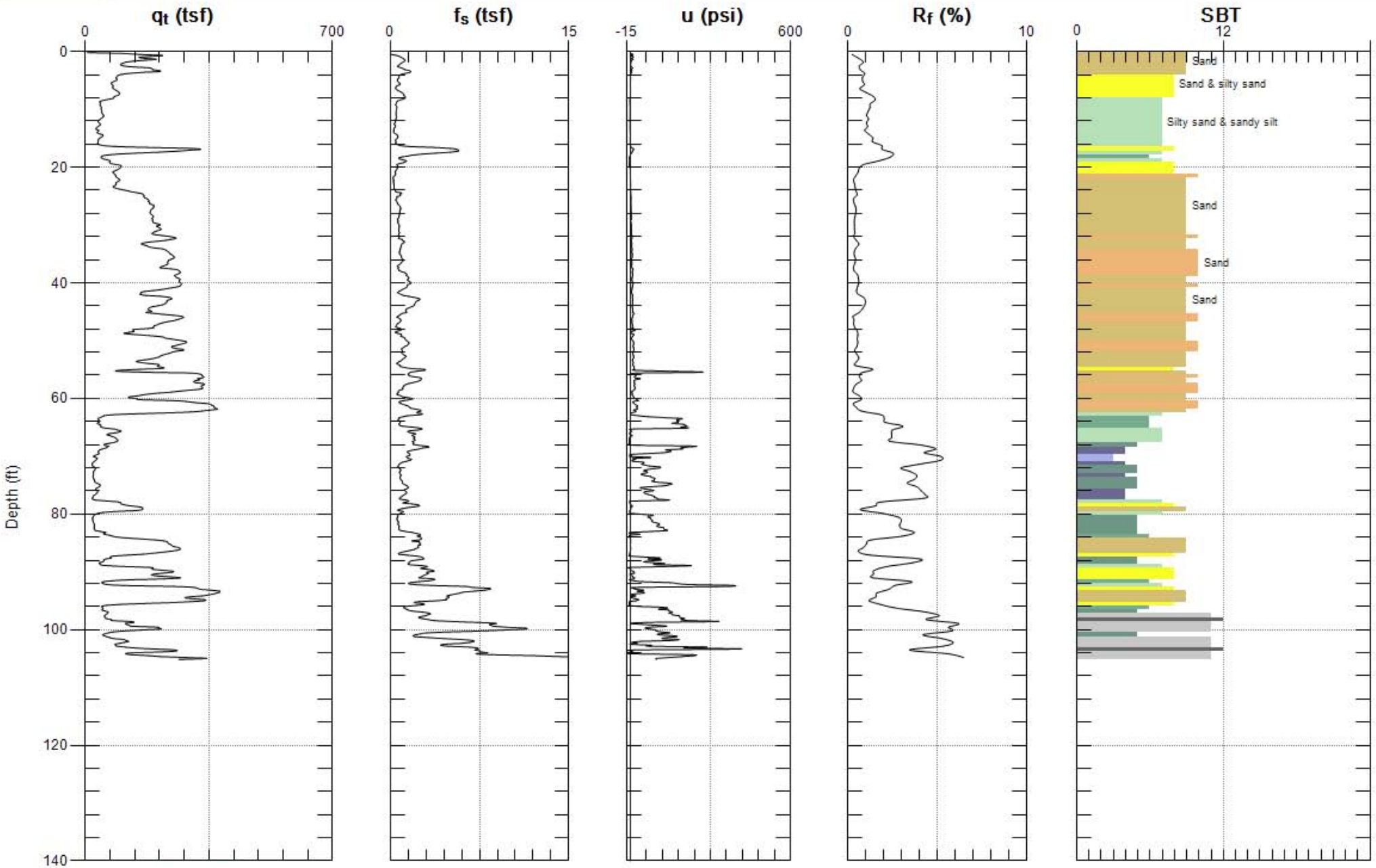
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT110

Engineer: Z.CRAWFORD
Date: 7/15/2008 08:54



Max. Depth: 105.151 (ft)
Avg. Interval: 0.656 (ft)

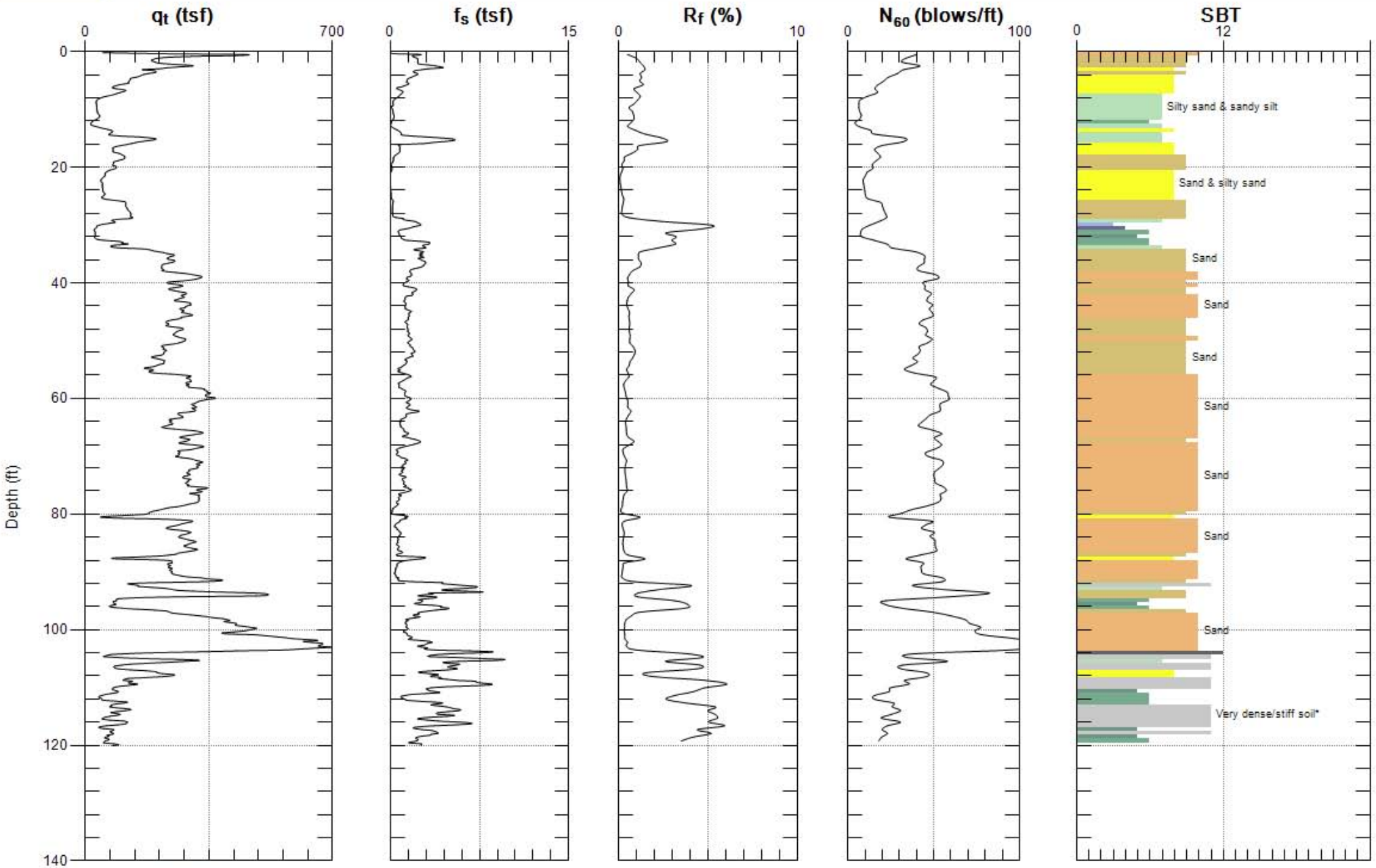
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT111

Engineer: Z.CRAWFORD
Date: 7/15/2008 11:24



Max. Depth: 120.079 (ft)
Avg. Interval: 0.656 (ft)

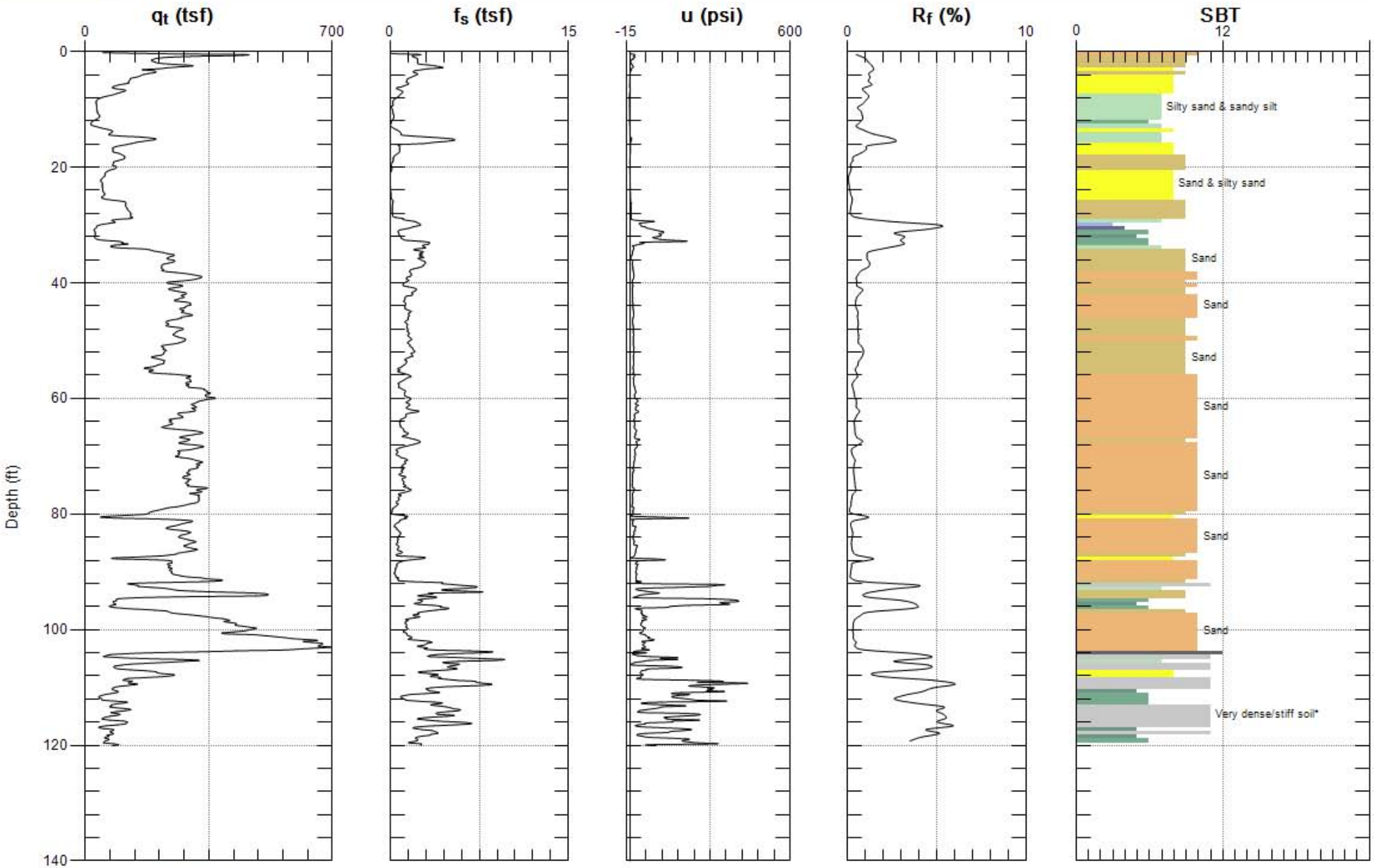
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA **Engineer: Z.CRAWFORD**

Sounding: 3-CPT111 **Date: 7/15/2008 11:24**



Max. Depth: 120.079 (ft)
Avg. Interval: 0.656 (ft)

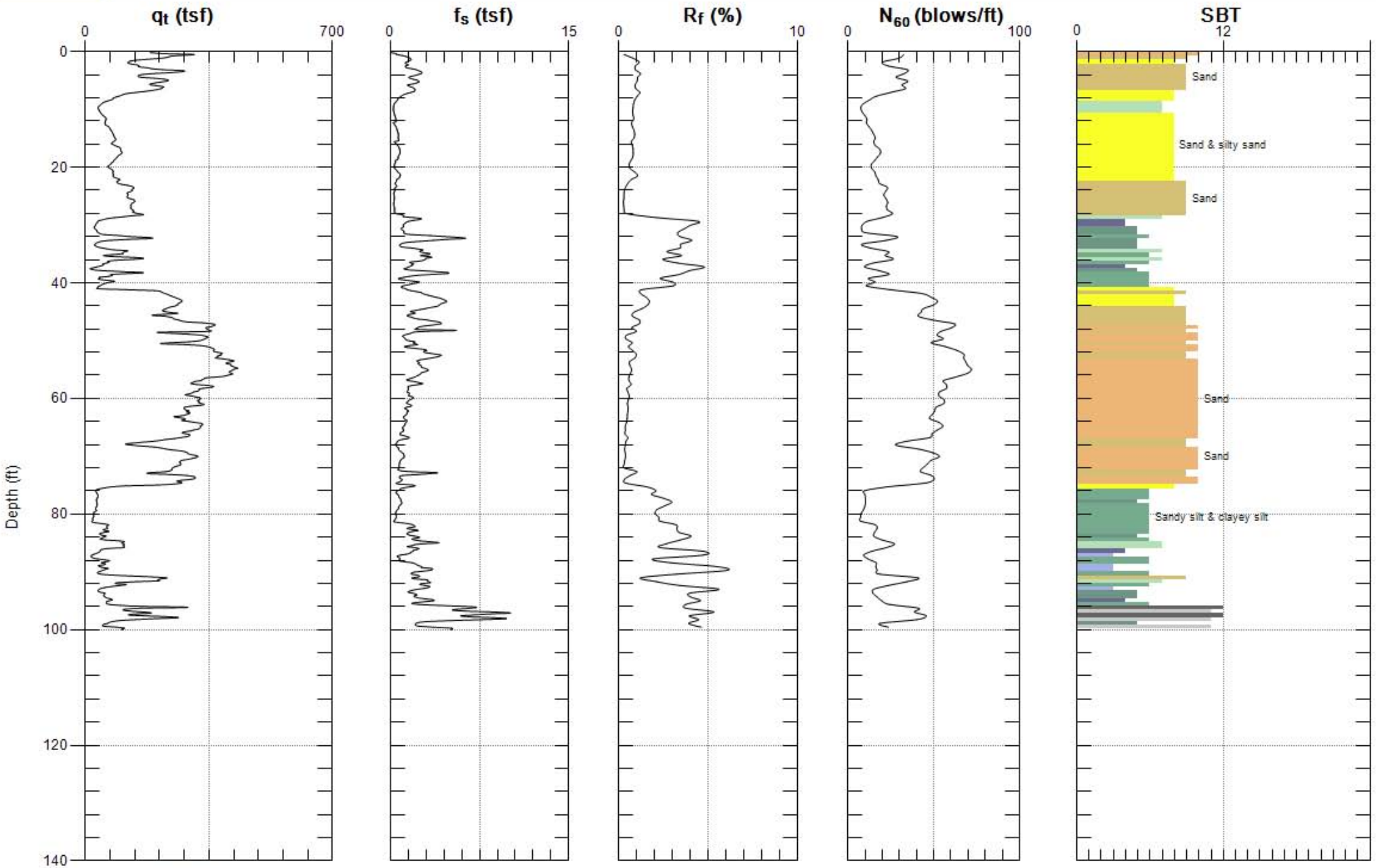
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT112

Engineer: Z.CRAWFORD
Date: 7/15/2008 01:29



Max. Depth: 100.066 (ft)
Avg. Interval: 0.656 (ft)

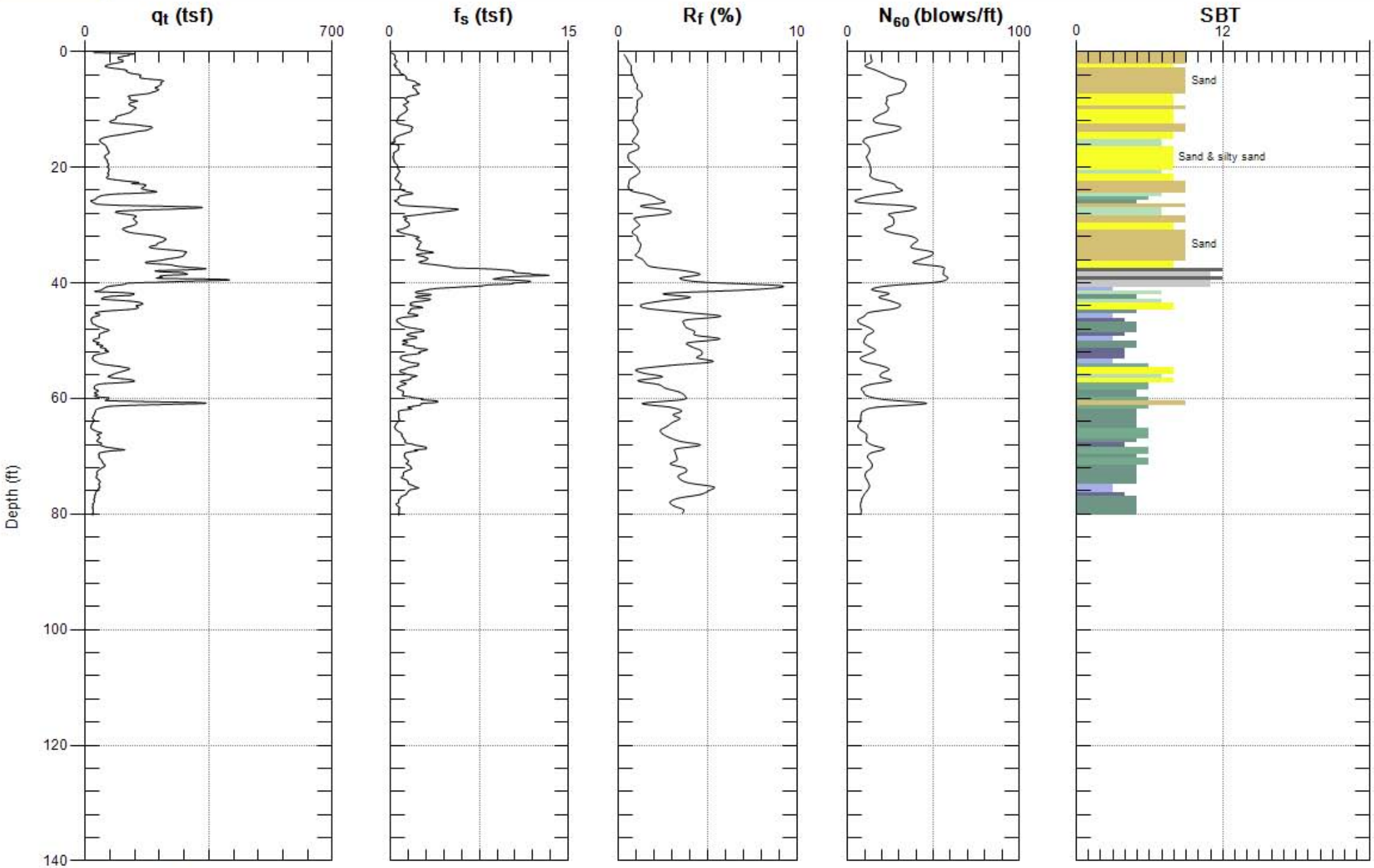
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT115

Engineer: Z.CRAWFORD
Date: 7/16/2008 11:52



Max. Depth: 80.217 (ft)
Avg. Interval: 0.656 (ft)

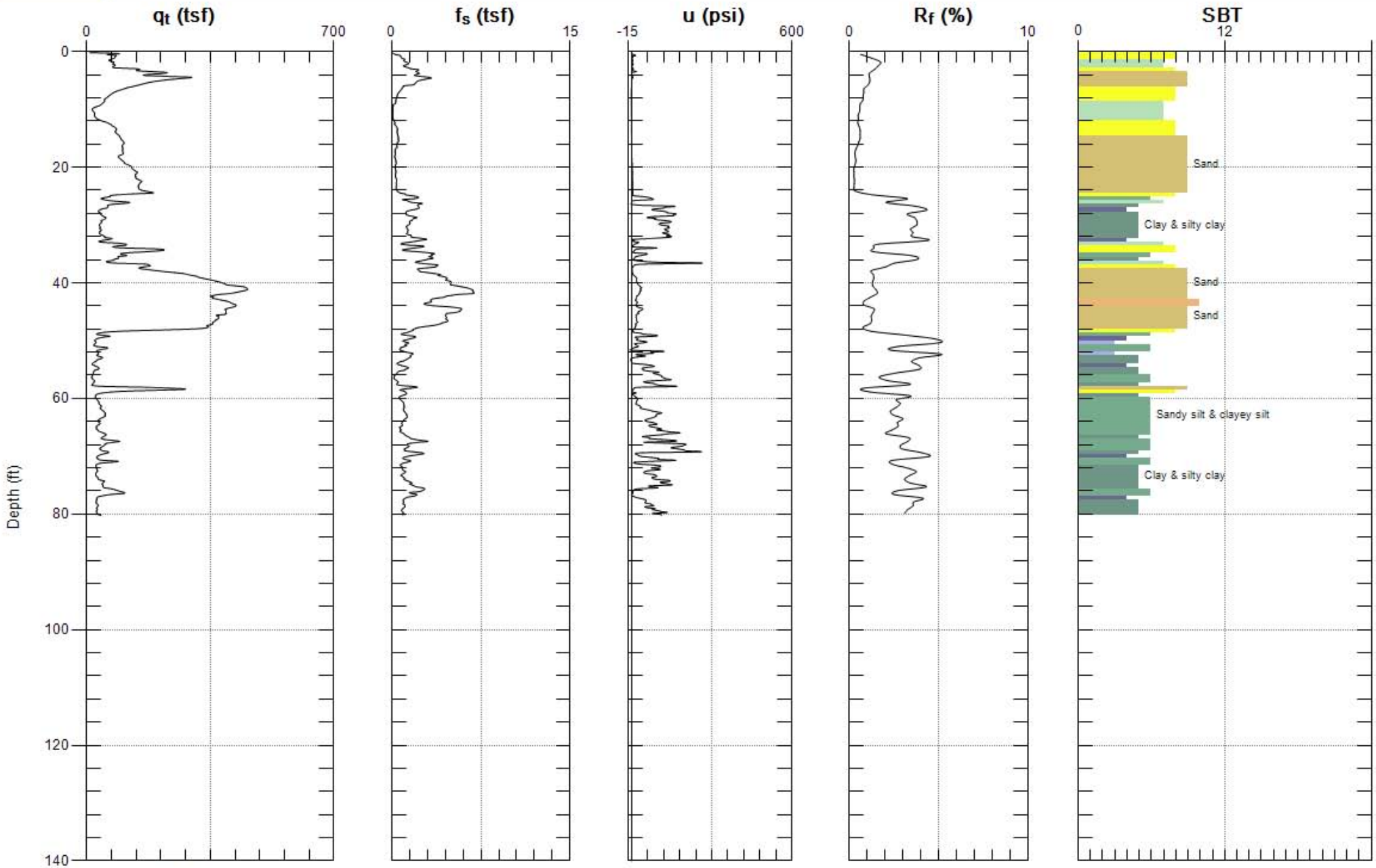
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA **Engineer: Z.CRAWFORD**

Sounding: 3-CPT114 **Date: 7/16/2008 10:02**



Max. Depth: 80.217 (ft)
Avg. Interval: 0.656 (ft)

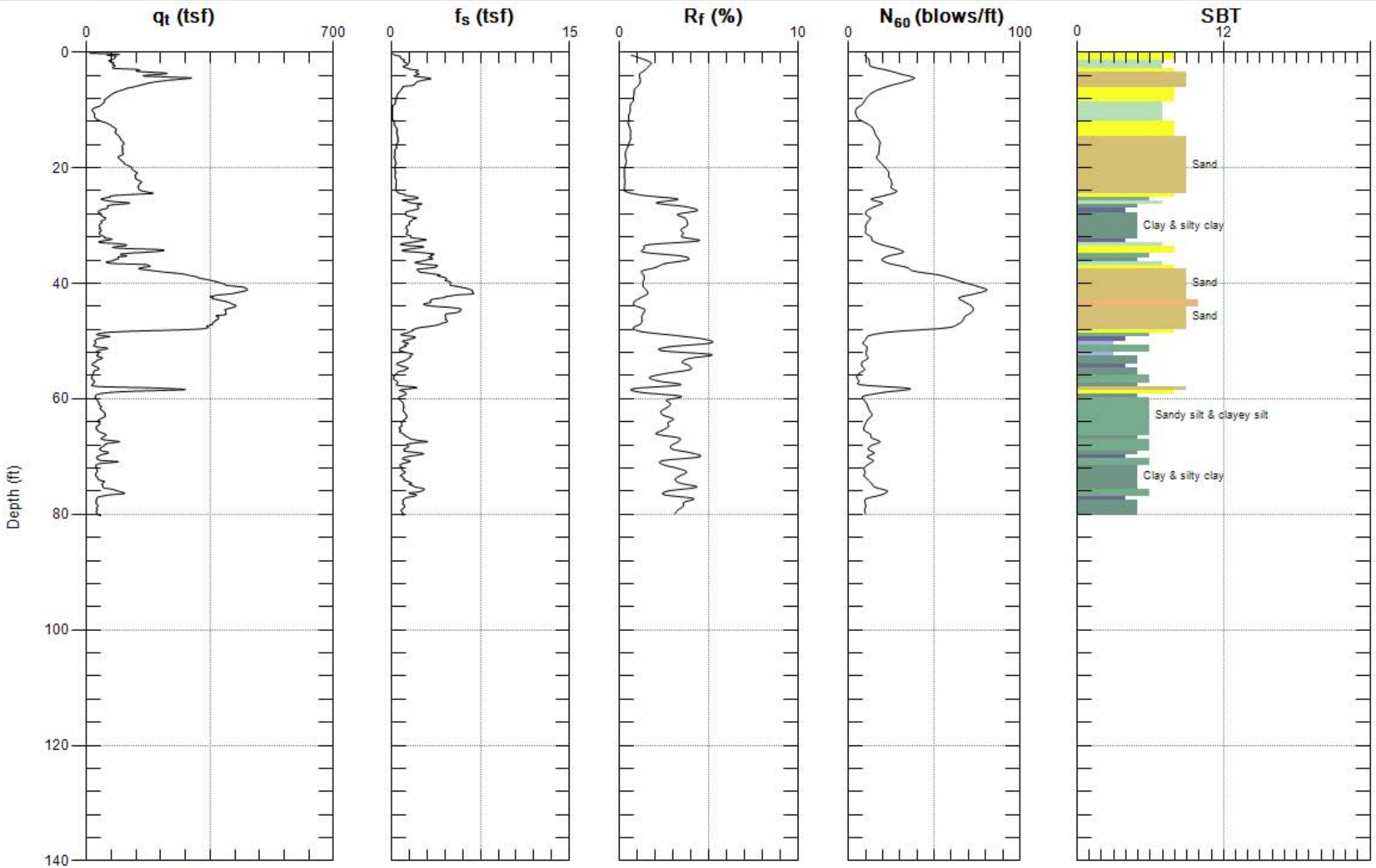
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT114

Engineer: Z.CRAWFORD
Date: 7/16/2008 10:02



Max. Depth: 80.217 (ft)
Avg. Interval: 0.656 (ft)

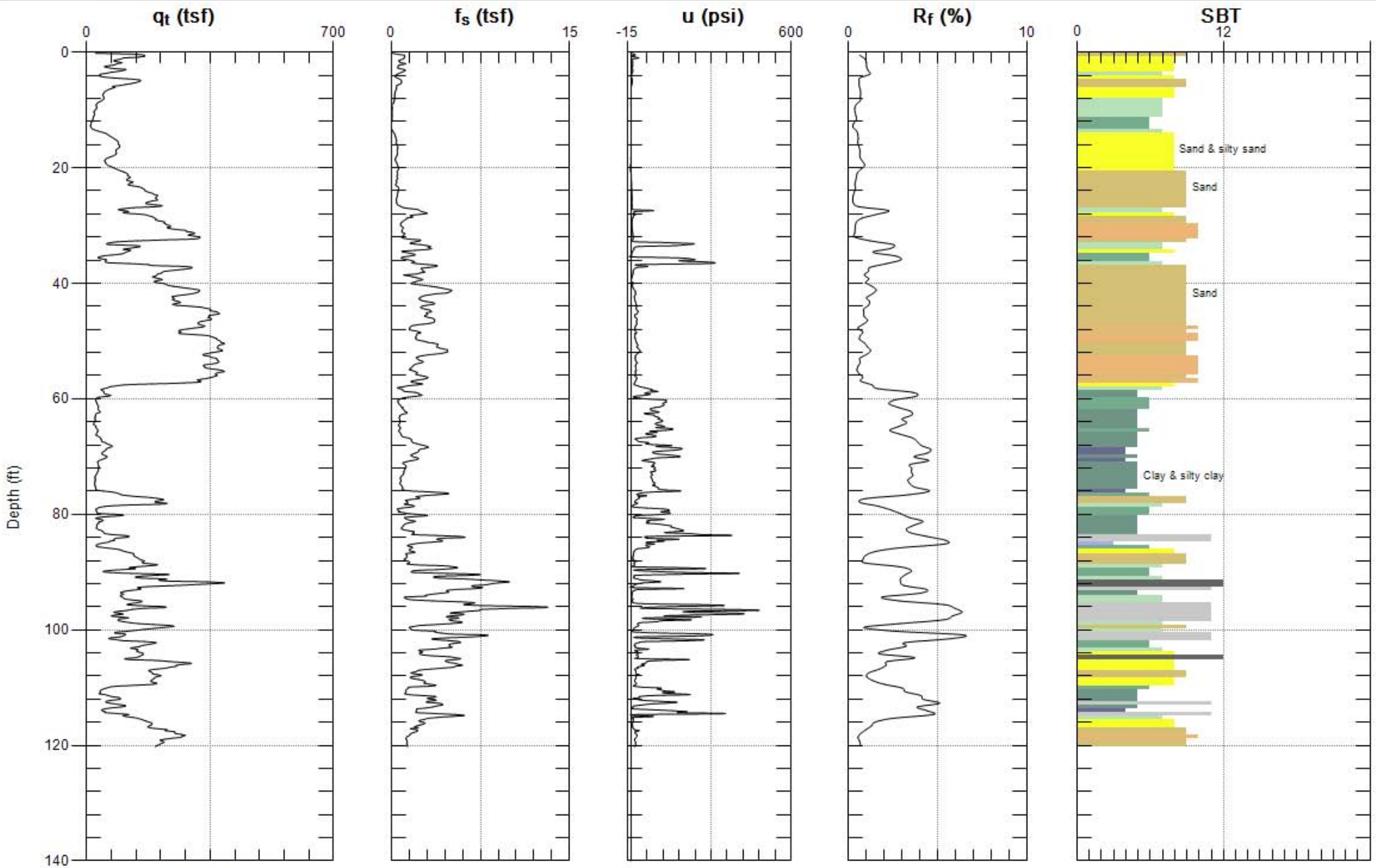
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT113

Engineer: Z.CRAWFORD
Date: 7/16/2008 07:19



Max. Depth: 120.243 (ft)
Avg. Interval: 0.656 (ft)

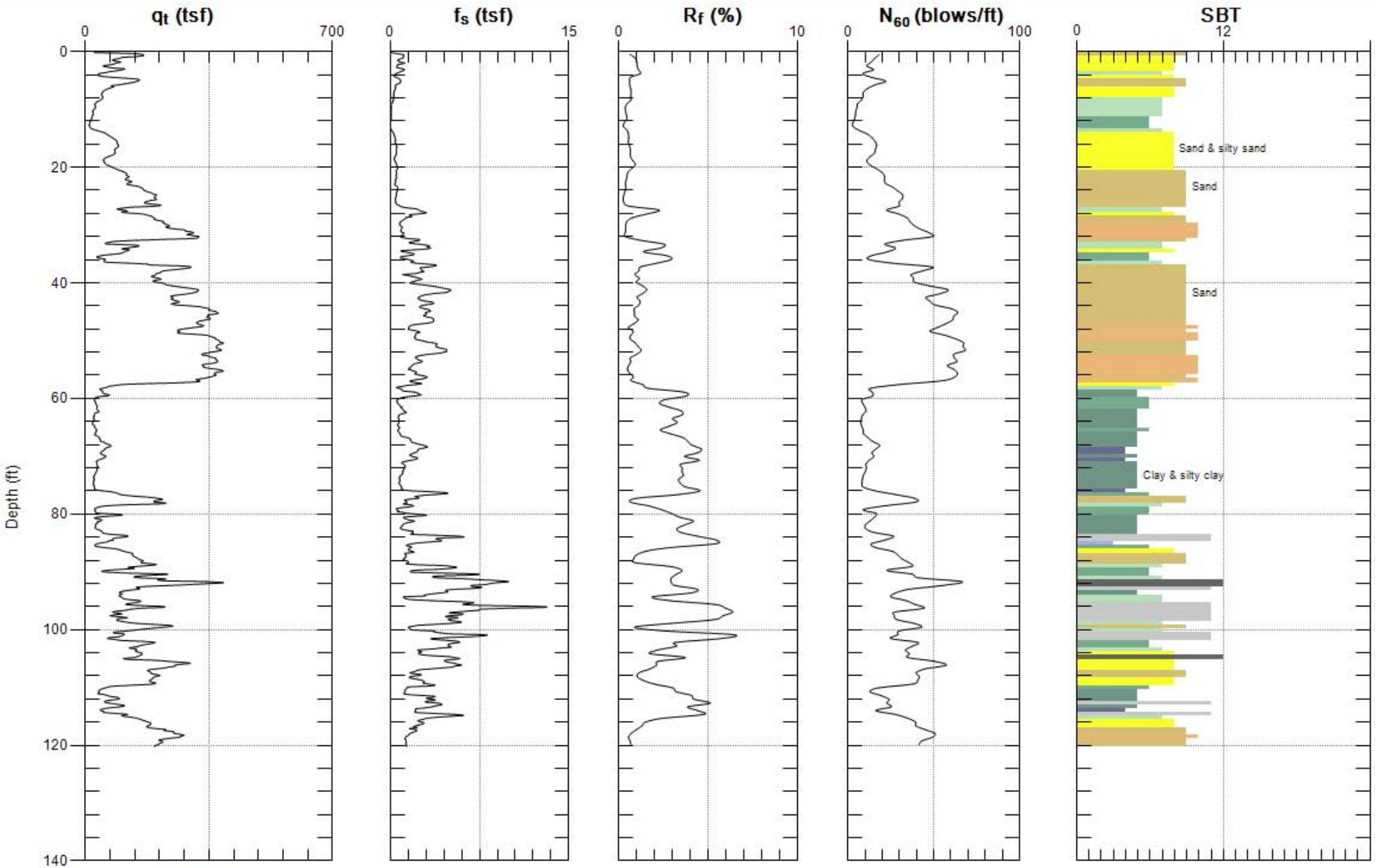
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT113

Engineer: Z.CRAWFORD
Date: 7/16/2008 07:19



Max. Depth: 120.243 (ft)
Avg. Interval: 0.656 (ft)

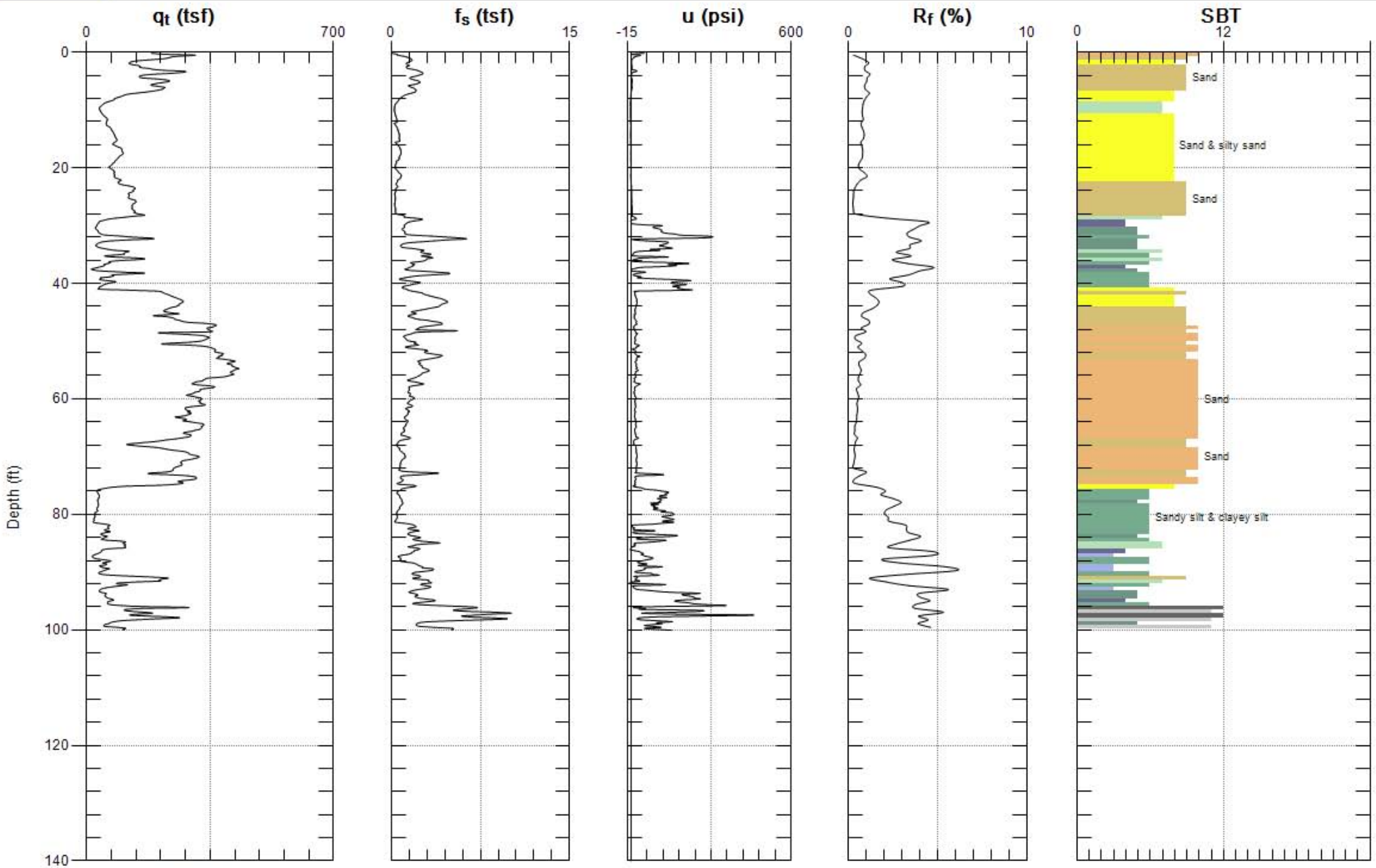
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA **Engineer: Z.CRAWFORD**

Sounding: 3-CPT112 **Date: 7/15/2008 01:29**



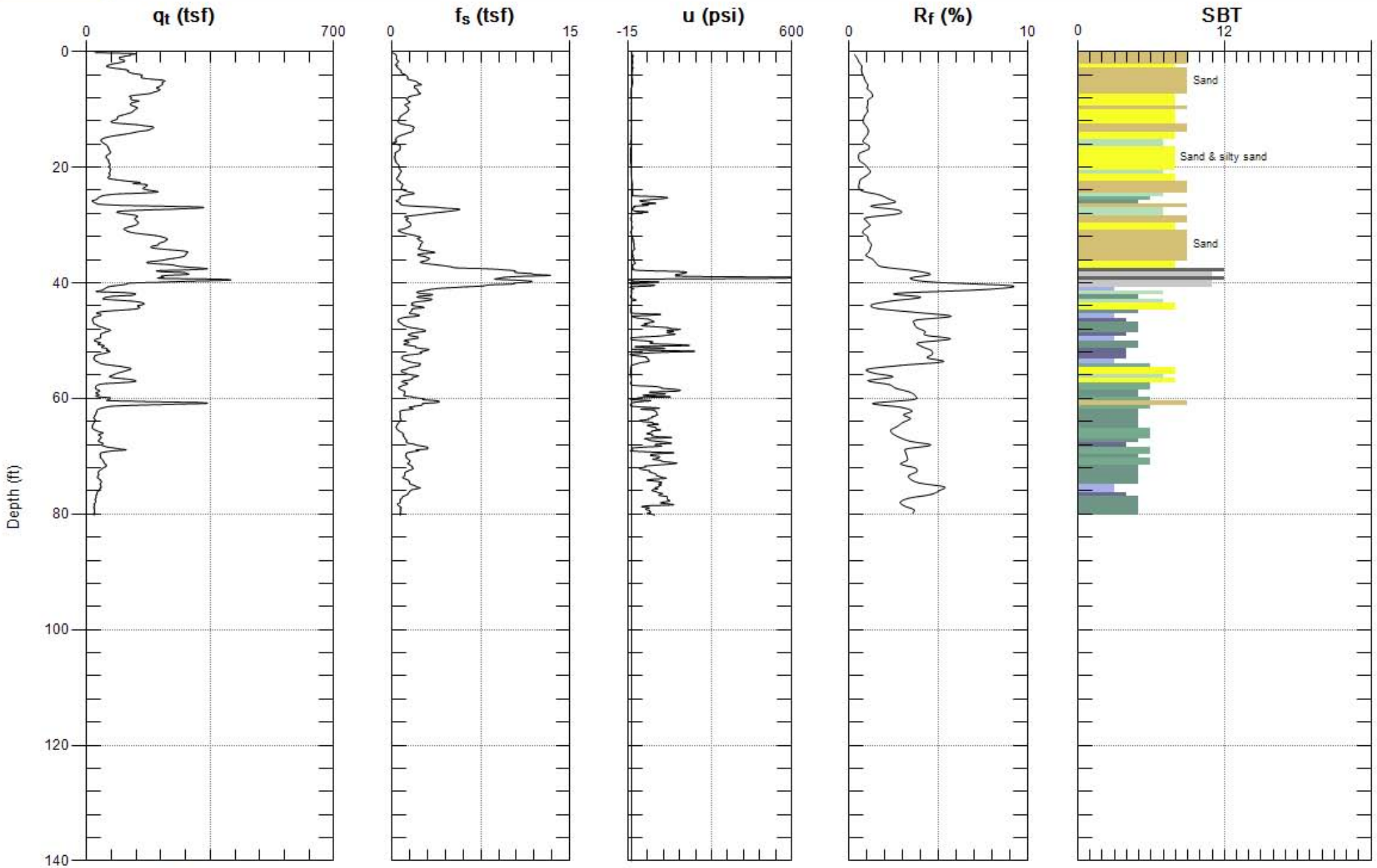
Max. Depth: 100.066 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Engineer: Z.CRAWFORD
Sounding: 3-CPT115
Date: 7/16/2008 11:52



Max. Depth: 80.217 (ft)
Avg. Interval: 0.656 (ft)

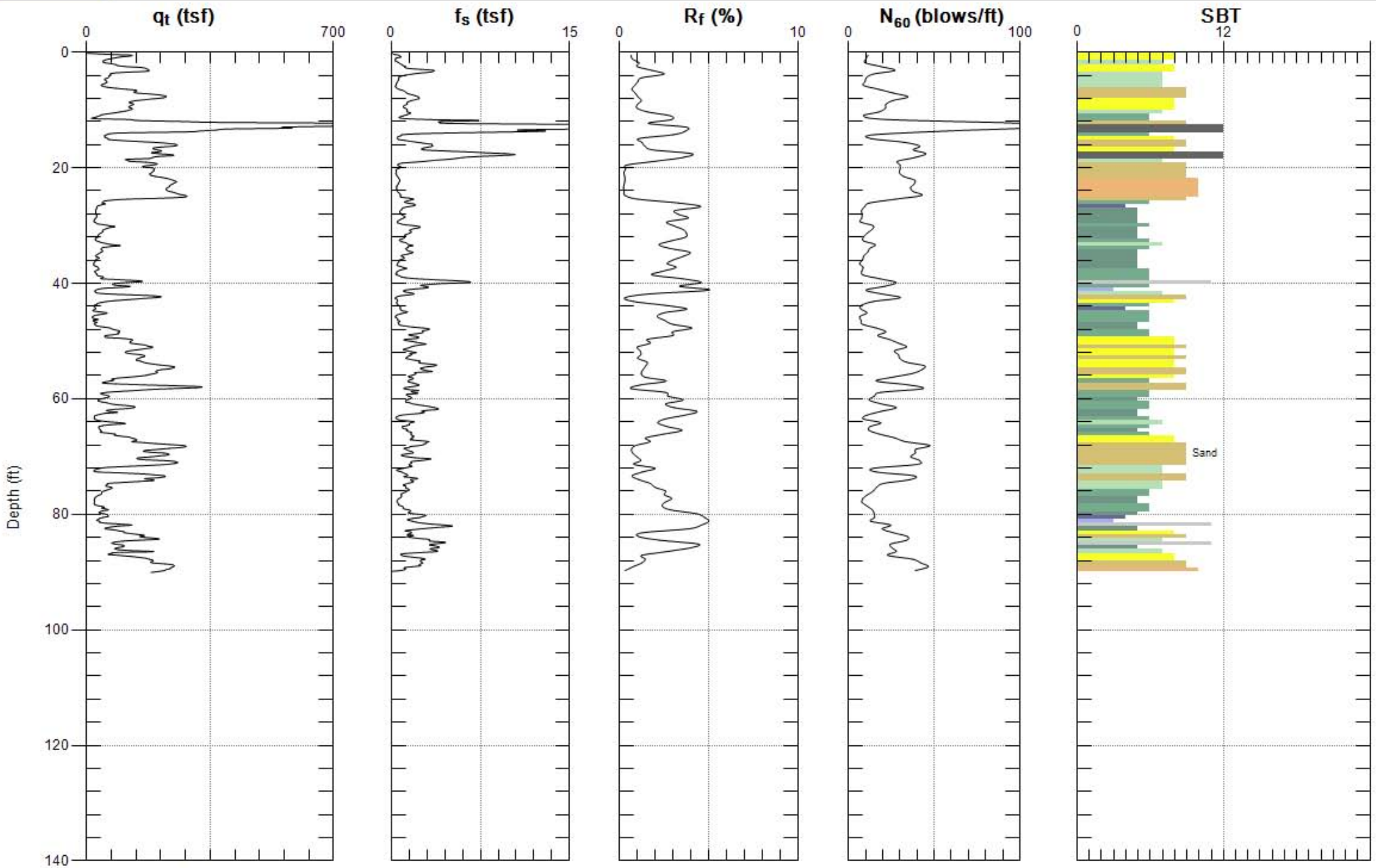
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT116

Engineer: Z.CRAWFORD
Date: 7/17/2008 10:49



Max. Depth: 90.059 (ft)
Avg. Interval: 0.656 (ft)

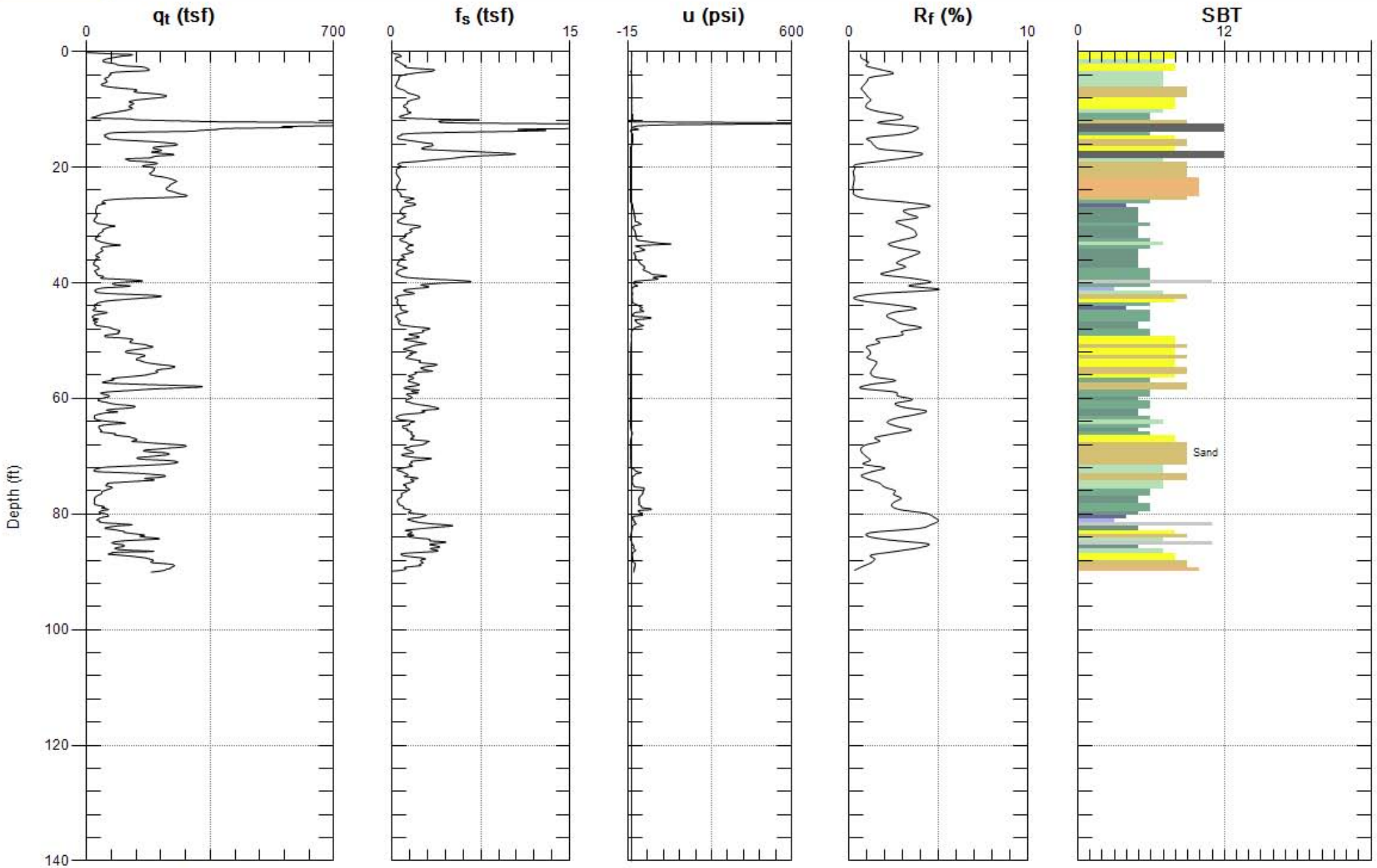
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT116

Engineer: Z.CRAWFORD
Date: 7/17/2008 10:49



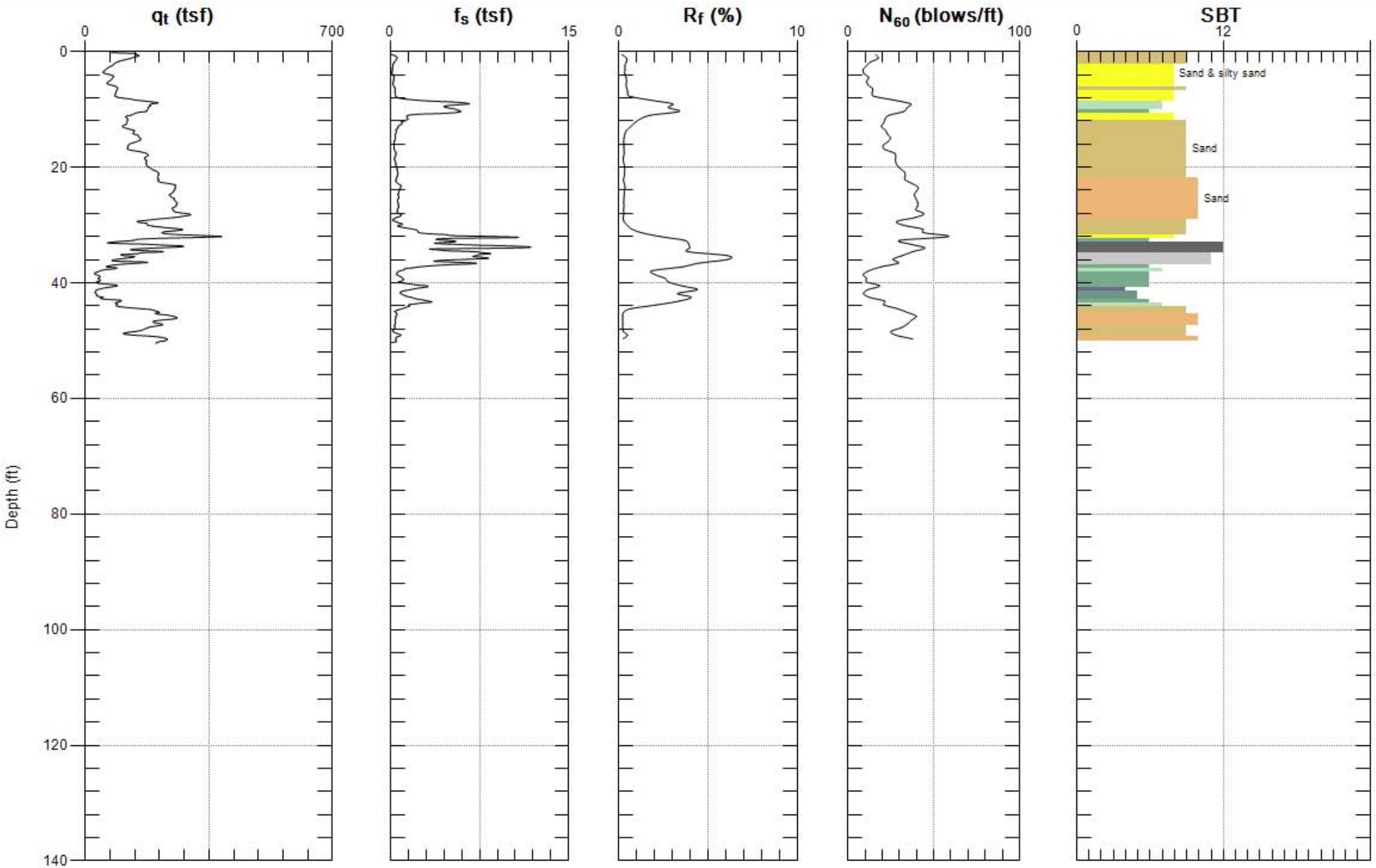
Max. Depth: 90.059 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Engineer: Z.CRAWFORD
Sounding: 3-CPT117
Date: 7/17/2008 09:41



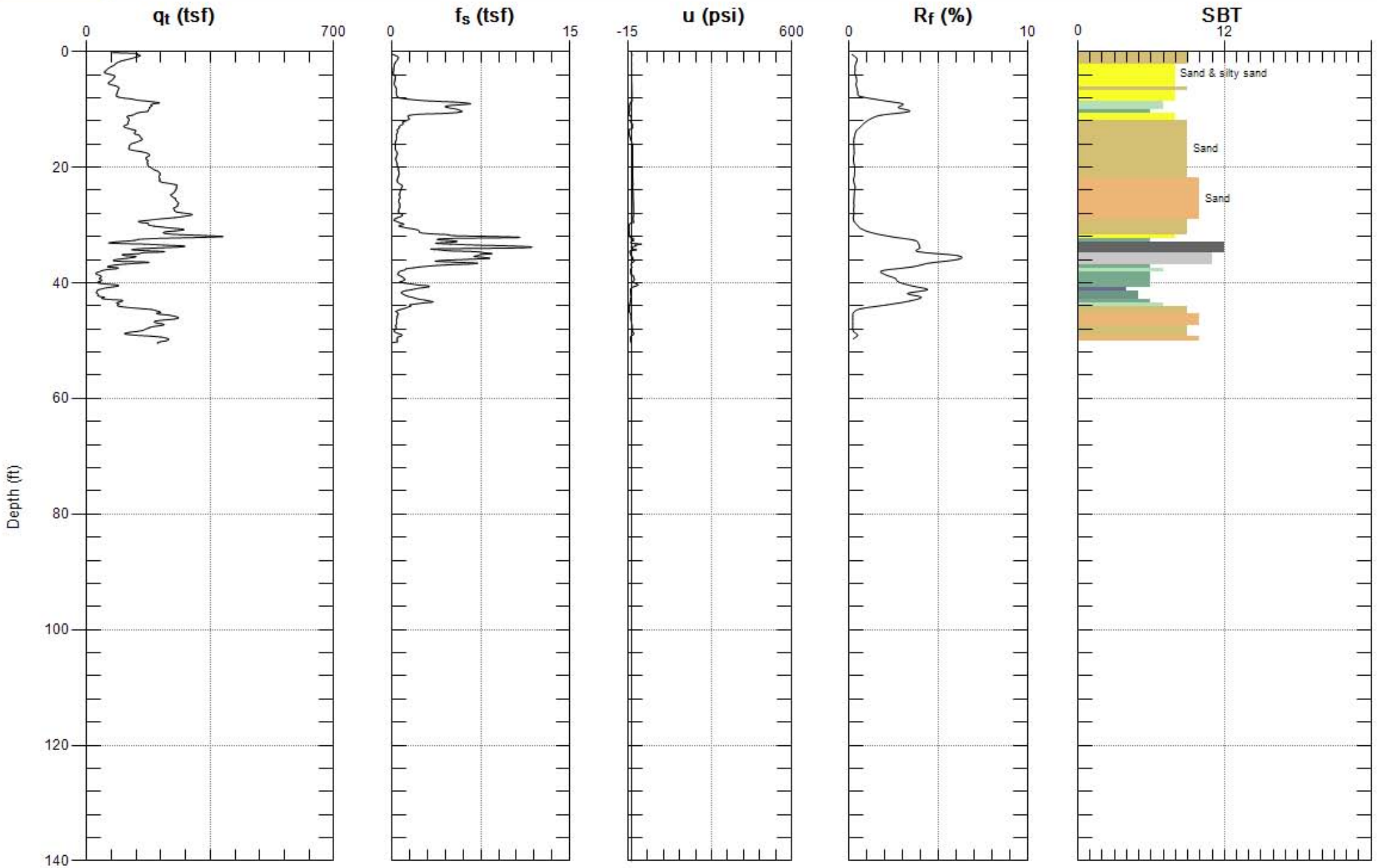
Max. Depth: 50.525 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Engineer: Z.CRAWFORD
Sounding: 3-CPT117
Date: 7/17/2008 09:41



Max. Depth: 50.525 (ft)
Avg. Interval: 0.656 (ft)

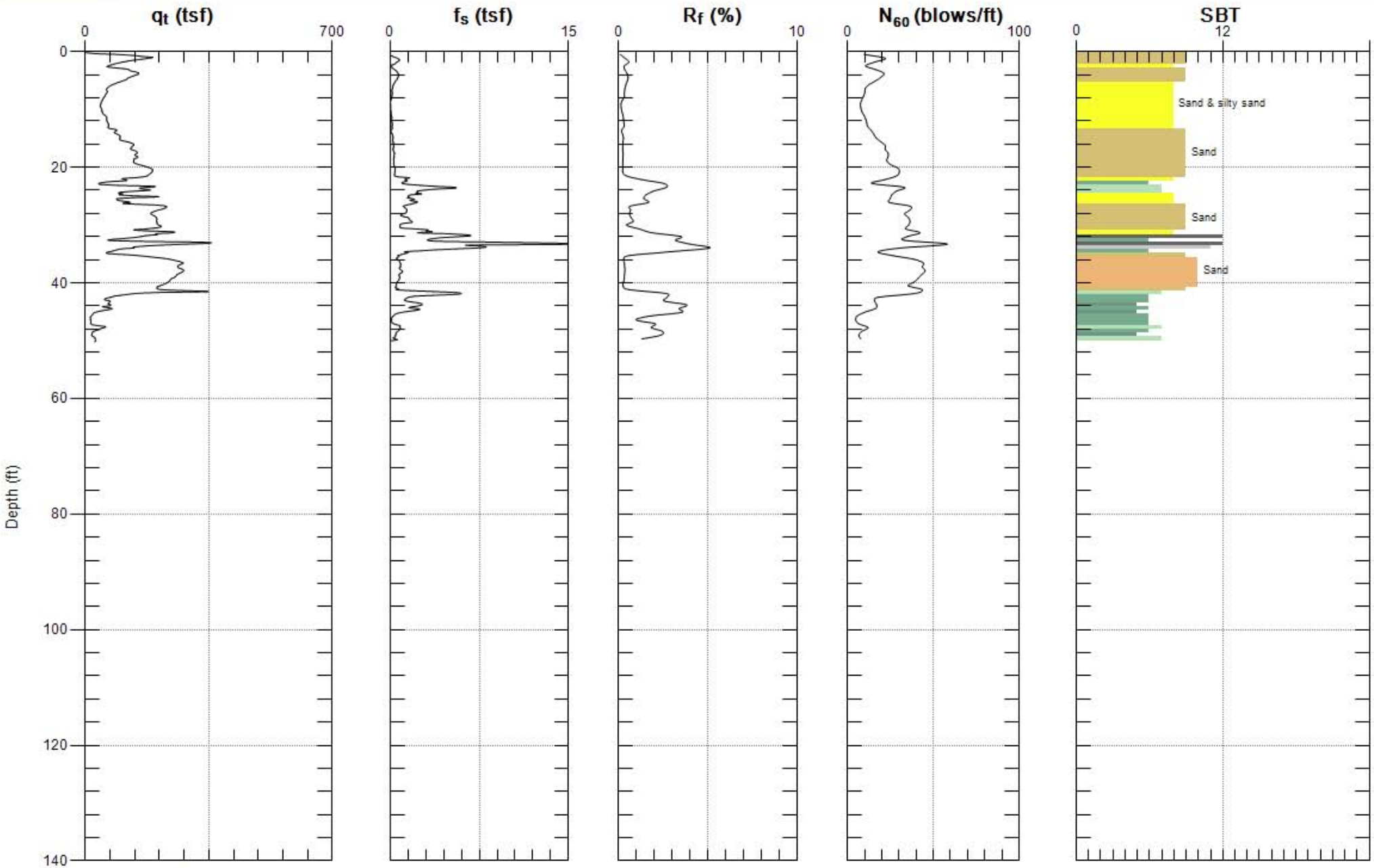
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Sounding: 3-CPT118a

Engineer: Z.CRAWFORD
Date: 7/17/2008 08:08



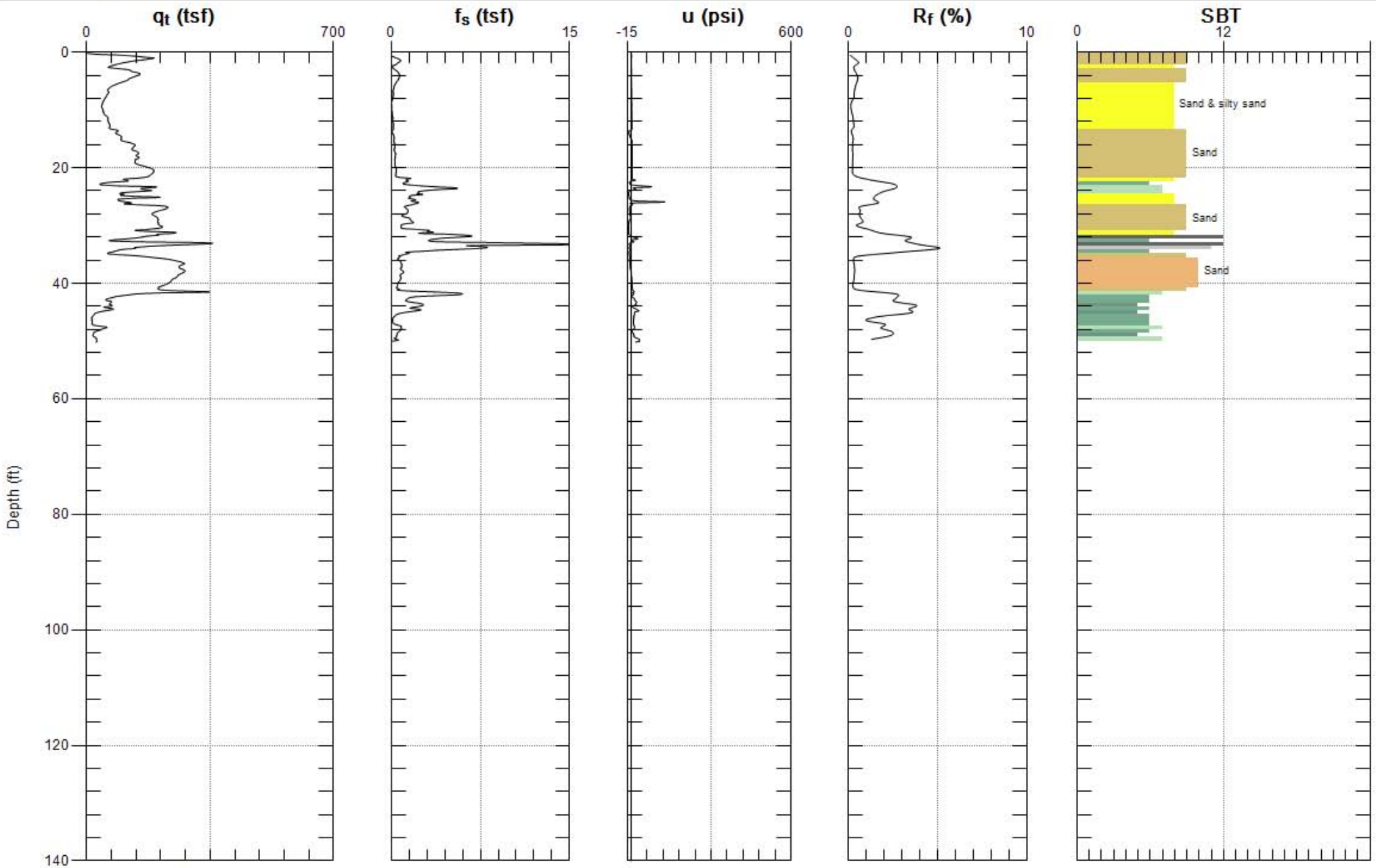
Max. Depth: 50.197 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG

ENGEO

Site: TRAILS OF MANTECA
Engineer: Z.CRAWFORD
Sounding: 3-CPT118a
Date: 7/17/2008 08:08



Max. Depth: 50.197 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Boring Logs
(ENGEO 2014-2015)

KEY TO BORING LOGS

MAJOR TYPES			DESCRIPTION
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #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 or gravel-sand mixtures GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES	GM - Silty gravels, gravel-sand and silt mixtures GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW - Well graded sands, or gravelly sand mixtures SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES	SM - Silty sand, sand-silt mixtures SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS		ML - Inorganic silt with low to medium plasticity CL - Inorganic clay with low to medium plasticity OL - Low plasticity organic silts and clays
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 %		MH - Inorganic silt with high plasticity CH - Inorganic clay with high plasticity OH - Highly plastic organic silts and clays
	HIGHLY ORGANIC SOILS		PT - Peat and other highly organic soils

GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE				CLEAR SQUARE SIEVE OPENINGS				
200	40	10	4	3/4 "	3"	12"		
SILTS AND CLAYS	SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE			

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT (S.P.T.)
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	STRENGTH*	BLOWS/FOOT (S.P.T.)
VERY SOFT	0-1/4	0-2
SOFT	1/4-1/2	2-4
MEDIUM STIFF	1/2-1	4-8
STIFF	1-2	8-15
VERY STIFF	2-4	15-30
HARD	OVER 4	OVER 30

MOISTURE CONDITION

DRY	Absence of moisture, dusty, dry to touch
MOIST	Damp but no visible water
WET	Visible freewater
SATURATED	Below the water table

SAMPLER SYMBOLS

- Modified California (3" O.D.) sampler
- California (2.5" O.D.) sampler
- S.P.T. - Split spoon sampler
- Shelby Tube
- Continuous Core
- Bag Samples
- Grab Samples
- NR No Recovery

MINOR CONSTITUENT QUANTITIES (BY WEIGHT)

TRACE	Particles are present, but estimated to the less than 5%
SOME	5 to 15%
WITH	15 to 30%
.....Y	30 to 50%

LINE TYPES

- ———— Solid - Layer Break
- – – – – – Dashed - Gradational or approximate layer break

GROUND-WATER SYMBOLS

- ▽ Groundwater level during drilling
- ▼ Stabilized groundwater level

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer

LOG OF BORING 7-B014

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 10/10/2014
HOLE DEPTH: Approx. 66½ ft.
HOLE DIAMETER: 4.8 in.
SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: Z. Crawford / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			AGGREGATE BASE (AB), approximately 6" at surface										
			CLAYEY SAND (SC), dark brown, dense, moist, fine-grained sand, 20-30% fines			60					8.8	127.9	
	1		SILT WITH SAND (ML), olive gray, very stiff, moist, 15-20% fine-grained sand			20							
5			SILTY SAND (SM), light grayish brown, loose to medium dense, fine-grained sand			22	NP	NP	NP	39	13.2	109.5	>4.5*
	2					12							
10	3		SANDY SILT (ML), olive gray, stiff to very stiff, moist, 30-40% fine-grained sand (Torvane=0.3 tsf at 10 feet)			14	NP	NP	NP		11.7	113	1.75* 3.0*
						4				67			
15	4												
	5					20	NP	NP	NP		14.7	112.9	3.75* 3.5*
						12							
20	6		SILT (ML), brownish gray, hard, moist, fine-grained sand, 5-10% fines			26	NP	NP	NP		15	110.9	>4.5* 4.5*
	7		SILTY SAND (SM), grayish brown, medium dense, moist to wet, fine- to medium-grained sand, 15-20% fines			12							
25			SILTY SAND (SM), olive brown, medium dense, wet, fine-grained sand										

LOG - GEOTECHNICAL W/METERS 5747005000 - RD17 ULDC.GPJ ENGEO INC.GDT 10/23/15

LOG OF BORING 7-B014

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 10/10/2014
HOLE DEPTH: Approx. 66½ ft.
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SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: Z. Crawford / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
	8		SILTY SAND (SM), olive brown, medium dense, wet, fine-grained sand			17				35			
			POORLY GRADED SAND (SP), brownish gray, dense, wet, fine- to medium-grained sand										
30	9		(med. dense)			26				0	19.7		
	10												
35	11		(dense)			32				1	20		
	12												
40			(grayish brown, dense)			37				0			
	13												
45	14		(dense)			48				1	22.1		
	15												
50													

LOG OF BORING 7-B014

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 10/10/2014
HOLE DEPTH: Approx. 66½ ft.
HOLE DIAMETER: 4.8 in.
SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: Z. Crawford / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			(dense)			31				3	25.5		
			(thin 2-3" sandy silt layer)										
	16												
55			(gray, very dense, fine to coarse-grained sand)			46				0	21.8		
	17												
	18												
60			(fine to medium-grained sand)			48				2	19.3		
	19												
65			SANDY SILT (ML), dark bluish gray, stiff, wet, fine-grained sand			15	NP	NP	NP	57	28.5		
	20		Bottom of boring at 66 1/2 feet. Groundwater not encountered due to drilling method.										

LOG OF BORING 7-B018

ENGEO INCORPORATED

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 1/5/2015
HOLE DEPTH: Approx. 66½ ft.
HOLE DIAMETER: 4.8 in.
SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: C. Crawford / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			SILTY SAND (SM), dark brown, loose, moist, fine- to coarse-grained sand, 25-35% fines [FILL]			18							
5	1		(medium dense)			58				32			
	2					24							
10	3		(loose) (very dark brown)			19 14				40	9.7	115.4	
	4		POORLY GRADED SAND WITH SILT (SP-SM), olive brown, loose, moist, medium- to coarse-grained sand [FILL]										
15	5		SILTY SAND (SM), olive brown, dense, moist, fine- to medium-grained sand			17				19			
			SANDY SILT (ML), gray, hard, wet, fine- to medium-grained sand, non plastic			32	NP	NP	NP	67			
20	6		POORLY GRADED SAND (SP), light brown, medium dense, wet, medium- to coarse-grained sand			39							
	7					17				4	23.3		
25													

LOG - GEOTECHNICAL W/METERS 5747005000 - RD17 ULDC.GPJ ENGEO INC.GDT 10/23/15

LOG OF BORING 7-B018

ENGEO INCORPORATED

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 1/5/2015
HOLE DEPTH: Approx. 66½ ft.
HOLE DIAMETER: 4.8 in.
SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: C. Crawford / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			FAT CLAY (CH), olive brown, very stiff, wet, fine- to medium-grained sand				57	23	34	99			3.0*
30	9					53	40	25	15	95			3.25*
			CLAYEY SAND (SC), olive brown, dense, wet, fine- to coarse-grained sand										
35	10		SILTY SAND (SM), light brown, loose, wet, fine- to medium-grained sand			22				28	23.8	96.5	
40	12		(brown, dense, fine- to coarse-grained sand, cemented)			66				33	28.7		
	13		SANDY LEAN CLAY (CL), olive brown, stiff to very stiff, wet, fine- to coarse-grained sand										
45	14					24	44	18	26	56			1.5*
			POORLY GRADED SAND (SP), reddish brown, dense, wet, medium- to coarse-grained sand										
50	15												

LOG - GEOTECHNICAL W/METERS 5747005000 - RD17 ULDC.GPJ ENGEO INC.GDT 10/23/15

LOG OF BORING 7-B018

ENGEO INCORPORATED

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 1/5/2015
HOLE DEPTH: Approx. 66½ ft.
HOLE DIAMETER: 4.8 in.
SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: C. Crawford / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			POORLY GRADED SAND (SP), reddish brown, dense, wet, medium- to coarse-grained sand			37				5			
	16												
55			(grayish brown)			46							
	17												
	18												
60			LEAN CLAY WITH SAND (CL), light olive brown, stiff, wet, fine-grained sand			20	44	20	24	77			
	19												
65			FAT CLAY (CH), light olive brown, stiff, wet, some fine-grained sand			20	75	29	46	92			
	20		Bottom of boring at 66 1/2 feet. Groundwater not encountered due to drilling method.										

LOG OF BORING 7-B020

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 1/9/2015
HOLE DEPTH: Approx. 116½ ft.
HOLE DIAMETER: 4.8 in.
SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: J. Botelho / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			AGGREGATE BASE (AB) approximately 4" thick										
			SANDY LEAN CLAY (CL), brown, stiff, fine-grained sand			20							
	1												
5			(reddish brown oxidation staining)			5	25	16	9	64			
	2												
			SANDY SILT (ML), brown, medium stiff										
10	3					7	NP	NP	NP	52			
	4												
15			Olive brown, stiff to very stiff, sandy (at bottom of sample, zones of clayey material, fine-grained sand) (Torvane=0.5 tsf at 15 feet)			12	NP	NP	NP	58	15.9	108.4	3.25*
	5					15							
			(contains carbonates and organics)			16					28	88.1	3.0*
						10							
20	6		(some reddish brown oxidation staining)			20					33.1	86.6	
						11							
	7		SILTY SAND (SM), yellowish brown, medium dense, fine-grained sand, some reddish brown oxidation staining										
						19				17	17.4		
25			(grayish brown, medium dense, fine- to medium-grained sand, some reddish brown oxidation staining)										

LOG - GEOTECHNICAL W/METERS 5747005000 - RD17 ULDC.GPJ ENGEO INC.GDT 10/23/15

LOG OF BORING 7-B020

ENGEO INCORPORATED

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 1/9/2015
HOLE DEPTH: Approx. 116½ ft.
HOLE DIAMETER: 4.8 in.
SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: J. Botelho / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			SILTY SAND (SM), yellowish brown, medium dense, fine-grained sand, some reddish brown oxidation staining			24							
	8		POORLY GRADED SAND (SP), gray, medium dense, fine- to medium-grained sand										
	9												
30						49				2	17.7		
			(dense)			34							
	10												
35			(yellowish brown, medium- to coarse-grained sand)			44							
	11					35							
	12												
40			(gray mottled with yellowish brown, very dense, some clay inclusions)			63				4	15.9		
	13					60							
45			(thin layer of fine-grained sand)			55/6"							
	14					36							
	15												
50													

LOG OF BORING 7-B020

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 1/9/2015
HOLE DEPTH: Approx. 116½ ft.
HOLE DIAMETER: 4.8 in.
SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: J. Botelho / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			POORLY GRADED SAND (SP), gray mottled with yellowish brown, very dense			82				2	21.9		
	16					58							
55	17												
	18												
60						57							
	19												
65	20												
	21												
70			SANDY SILT (ML), dark bluish gray, stiff, fine-grained sand			12	NP	NP	NP	54	35.2		
	22												
75													

LOG - GEOTECHNICAL W/METERS 5747005000 - RD17 ULDC.GPJ ENGEO INC.GDT 10/23/15

LOG OF BORING 7-B020

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 1/9/2015
HOLE DEPTH: Approx. 116½ ft.
HOLE DIAMETER: 4.8 in.
SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: J. Botelho / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
	23		POORLY GRADED SAND WITH SILT (SP-SM), dark gray, very dense			57				8	26		
	24												
80													
	25												
85	26		(gray, fine- to medium-grained sand)			57				6			
	27												
90													
	28												
95	29		(fine-grained sand)			50				9			
	30												
100													

LOG - GEOTECHNICAL W/METERS 5747005000 - RD17 ULDC.GPJ ENGEO INC.GDT 10/23/15

LOG OF BORING 7-B020

ENGEO INCORPORATED

Geotechnical Exploration
RD-17 Levee Evaluation
San Joaquin County, California
5747.005.000

DATE DRILLED: 1/9/2015
HOLE DEPTH: Approx. 116½ ft.
HOLE DIAMETER: 4.8 in.
SURF ELEV (NAVD 88): 34 ft.

LOGGED / REVIEWED BY: J. Botelho / MMG
DRILLING CONTRACTOR: So Cal Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: Automatic Trip Hammer

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
	31		POORLY GRADED SAND WITH SILT (SP-SM), dark gray, very dense										
105	32												
			SANDY SILT (ML), dark bluish gray, very stiff, non plastic plasticity, fine-grained sand			33	NP	NP	NP	65			
	33												
110													
	34												
			LEAN CLAY WITH SAND (CL), dark bluish gray, very stiff, fine-grained sand										
115	35					35	30	20	10	71			
			Bottom of boring at 116.5 feet. Groundwater not encountered due to drilling method.										

LOG - GEOTECHNICAL W/METERS 5747005000 - RD17 ULDC.GPJ ENGEO INC.GDT 10/23/15

Boring Logs
(Kleinfelder 1986-1989)

Depth In Feet	Dry Density lb/ft³	Moisture Content %	Blow/ Ft.	Sample No.	USCS	DESCRIPTION
0					SM	Brown Silty Fine Sand with Gravel on Surface
3					SM	Grades with Clay Balls
6	81	35	14		ML	Brown Very Fine Very Sandy Silt, Stiff
9	93	26	11		ML	Brown Grey Slightly Clayey Silt, Dense
12						
15			10		ML	Light Brown Grey Very Sandy Silt, Stiff
18					ML	Dark Brown Slightly Clayey Silt ▽ Groundwater Encountered
21			11		CL	Blue Grey Very Fine Sandy Very Silty Clay, Stiff
24			8			
27						
30			43		ML	Light Blue Grey Very Fine Sandy Silt Medium Stiff
33						
36			22		CL	Tan Brown Silty Clay, Hard
39			12		SP CL	Light Grey Very to Fine Sand, Dense Grades Silty, Stiff
42						TEST BORING TERMINATED AT 41-1/2' DEPTH. NOTES: 1. Boring Drilled on 8-12-86. 2. Groundwater Encountered at 24'. 3. No Caving Noted.

J.H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS • MATERIALS TESTING

PROJECT NO. S-2598-2

LOG OF BORING NO. B-84 B-1

PLATE IV

Depth In Feet	Dry Density lb/ft³	Moisture Content %	Blow/ Ft.	Sample No.	USCS	DESCRIPTION
0			40		SM	BROWN SILTY FINE SAND
10			11			
			6		SM	GREY VERY SILTY SAND GROUNDWATER ENCOUNTERED
20			29		SP	BROWN CLEAN MEDIUM SAND
	97	26			SP	BROWN/RED BROWN SLIGHTLY SILTY FINE MEDIUM SAND
30						TEST BORING TERMINATED AT 31½' DEPTH. NOTES: 1. Test Boring Drilled on 12-15-89. 2. Groundwater Encountered at 16½'. 3. Caved to 17½'.

KLEINFELDER

PROJECT NO. 20-2598-02

LOG OF BORING NO. B-2

PLATE

Depth In Feet	Dry Density lb/ft³	Moisture Content %	Blow/ Ft.	Sample No.	USCS	DESCRIPTION
0			10		SM	BROWN SILTY FINE SAND
10	99	4	10		SM	LIGHT BROWN SLIGHTLY SILTY FINE SAND
			13		SP	LIGHT BROWN CLEAN MEDIUM SAND
						GROUNDWATER ENCOUNTERED
20	104	20	21		SP	BROWN/RED BROWN CLEAN MEDIUM SAND
				*		
30				*		

TEST BORING TERMINATED AT 31½' DEPTH.

NOTES:

1. Test Boring Drilled on 12-15-89.
2. Groundwater Encountered at 18'.
3. Caved to 18'.

KLEINFELDER

LOG OF BORING NO. B-3

PLATE

PROJECT NO. 20-2598-02

Depth In Feet	Dry Density lb/ft³	Moisture Content %	Blow/ Ft.	Sample No.	B-4 USCS	DESCRIPTION
0						Gravel
					SM	Light Brown Silty Very Fine-to-Fine Sand
3					SM	Grades with Clay Balls
			8			
6					SP	Brown Fine Sand (Loose)
9						
	104	20	16			
12					ML SM	Brown Very Fine Slightly Sandy Clayey Silt with Sand Lenses (Medium Dense)
15	88	24	12		ML	Brown Grey Very Fine Sandy Silt (Stiff)
18						
						▽ Groundwater Encountered
21			5		SM SP	Blue-Grey Slightly Silty Very Fine Sand (Loose)
24					SM SP	Grades Medium Dense
			14			
27					SP	Grades to Clean Very Fine-to-Fine Sand
30			23		ML	Tan-Green Very Fine Very Sandy Silt (Hard)
33					ML	Tan-Brown Very Clayey Silt (Very Stiff)
			21			
36						
39					SP	Tan-Brown Fine-to-Medium Sand
			21			
					ML	Tan Very Fine Very Sandy Silt
42						BORING TERMINATED AT 41-1/2-FOOT DEPTH

NOTES:
1. Boring Drilled on 8-13-86.
2. Groundwater Encountered at 20'.
3. Caving of Clean Sand Below Groundwater.

J.H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS • MATERIALS TESTING

LOG OF BORING NO. B-66
B-4

PLATE VII

PROJECT NO. S-2598-2

Depth In Feet	Dry Density lb/ft³	Moisture Content %	Blow/ Ft.	Sample No.	USCS	DESCRIPTION
0			21		SM SP	LIGHT BROWN SLIGHTLY SILTY FINE SAND
					SP	GRADES SLIGHTLY CLEANER
10			11			
	96	7	16			
						GROUNDWATER ENCOUNTERED
					SP	BROWN/RED BROWN CLEAN MEDIUM SAND
20	95	24	19			
					SP	PACKED GREY CLEAN MEDIUM TO COARSE SAND
			35			
30					ML	SILT IN END OF TUBE

TEST BORING TERMINATED AT 31½' DEPTH.

NOTES:

1. Test Boring Drilled on 12-15-89.
2. Groundwater Encountered at 17½'.
3. Caved to 17'.

KLEINFELDER

LOG OF BORING NO. B-5

PLATE

PROJECT NO. 20-2598-02

Depth In Feet	Dry Density lb/ft³	Moisture Content %	Blow/ Ft.	Sample No.	USCS	DESCRIPTION
0			10		SM	DARK BROWN VERY SILTY VERY FINE SAND
10			8		SM	BROWN SILTY VERY FINE SAND
	86	19	22			
20			13		SP	LIGHT BROWN MEDIUM SAND
						GROUNDWATER ENCOUNTERED
			25		SP	GREY CLEAN MEDIUM SAND
30	92	30	23		ML	BROWN VERY FINE SANDY SILT

TEST BORING TERMINATED AT 31½' DEPTH.

NOTES:

1. Test Boring Drilled on 12-15-89.
2. Groundwater Encountered at 24'.
3. No Caving Noted.

KLEINFELDER

LOG OF BORING NO. B-6

PLATE

PROJECT NO. 20-2598-02

Depth In Feet	Dry Density lb/ft³	Moisture Content %	Blow/ Ft.	Sample No.	B-7 USCS	DESCRIPTION
0					SM	Brown Silty Fine Sand with Gravel
					SM	Brown Slightly Silty Very Fine-to-Fine Sand
3					SP	
					SP	Grades Clean
6					ML	Brown Very Fine Slightly Sandy Silt
					ML CL	Grades with Clay
9	95	23	12		ML	Grades Less Clay
12					ML	Grades No Clay (Stiff)
15	96	16	11		ML	Brown Very Fine Very Sandy Silt (Stiff)
18					SM	Brown Very Silty Very Fine Sand
21					SM/SP	Groundwater Encountered Brown Slightly Silty Very Fine-to-Fine Sand (Medium Dense)
					SP	Clean Very Fine-to-Fine Sand
24			14		SP	Blue-Grey Very Fine-to-Fine Sand (Medium Dense)
27						
30			30		ML	Blue-Grey Very Fine Very Sandy Silt (Medium Stiff/Hard)
33					SP	Blue-Grey Very Fine-to-Medium Sand (Medium Dense)
36			16			
39			35		SP	Grades Light Tan-Brown
42						BORING TERMINATED AT 41-1/2-FOOT DEPTH

NOTES:
1. Boring Drilled on 8-14-86.
2. Groundwater Encountered at 21'.
3. Caving of Clean Sand Below Groundwater.

J.H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS • MATERIALS TESTING

PROJECT NO. S-2598-2

LOG OF BORING NO. B-42 B-7

PLATE X

Depth In Feet	Dry Density lb/ft³	Moisture Content %	Blow/ Ft.	Sample No.	USCS	DESCRIPTION
0			5		SM	BROWN SILTY FINE SAND
10			8		SM	BROWN SILTY FINE SAND
			6			
20	101	22	56		ML	BROWN VERY FINE SANDY SILT
			14		SP	GREY BROWN SLIGHTLY SILTY FINE TO MEDIUM SAND
30			10			

GROUNDWATER ENCOUNTERED

TEST BORING TERMINATED AT 30' DEPTH.

NOTES:

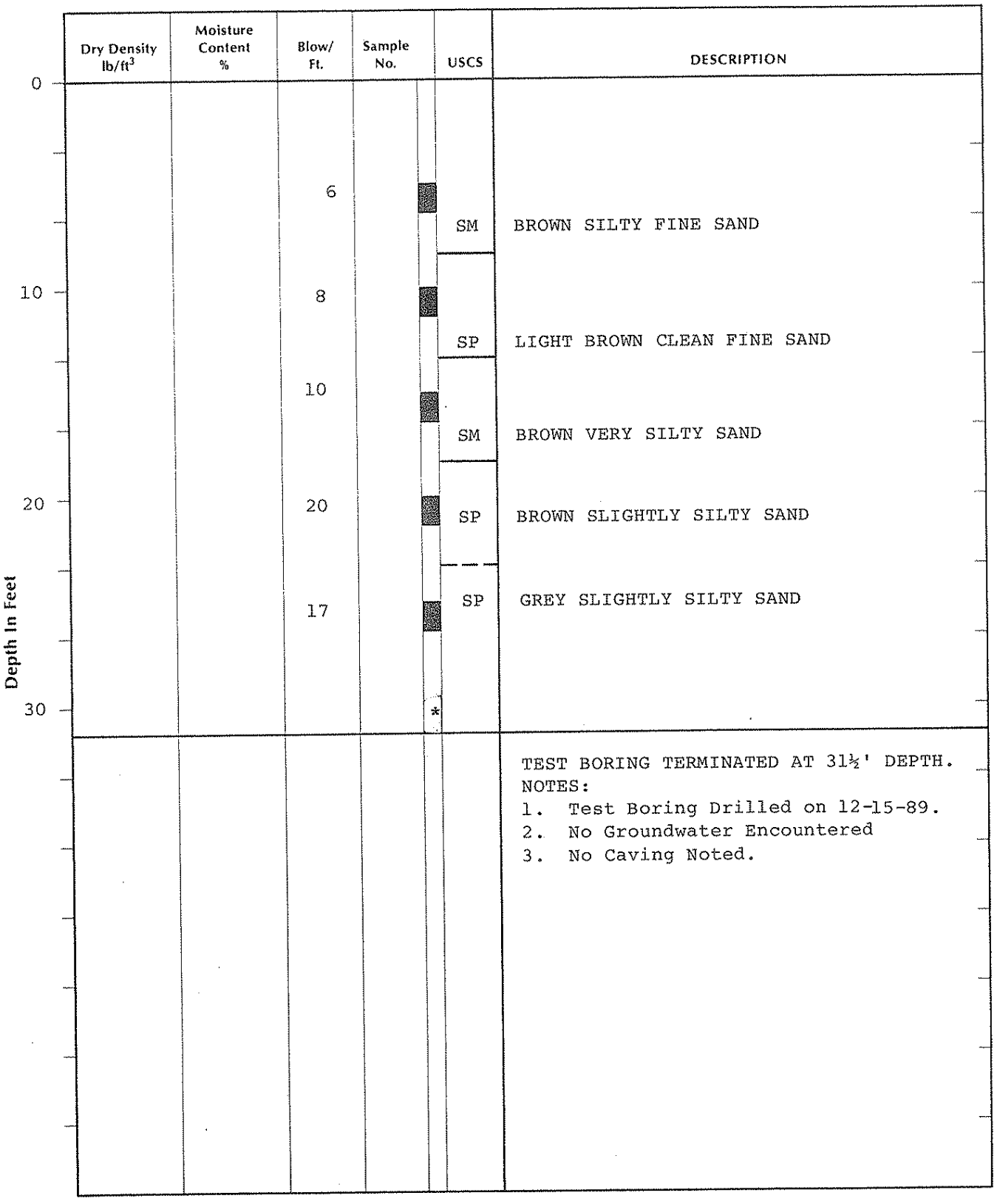
1. Test Boring Drilled on 12-15-89.
2. Groundwater Encountered at 27'.
3. Caved below 30'.

KLEINFELDER

LOG OF BORING NO. B-8

PLATE

PROJECT NO. 20-2598-02

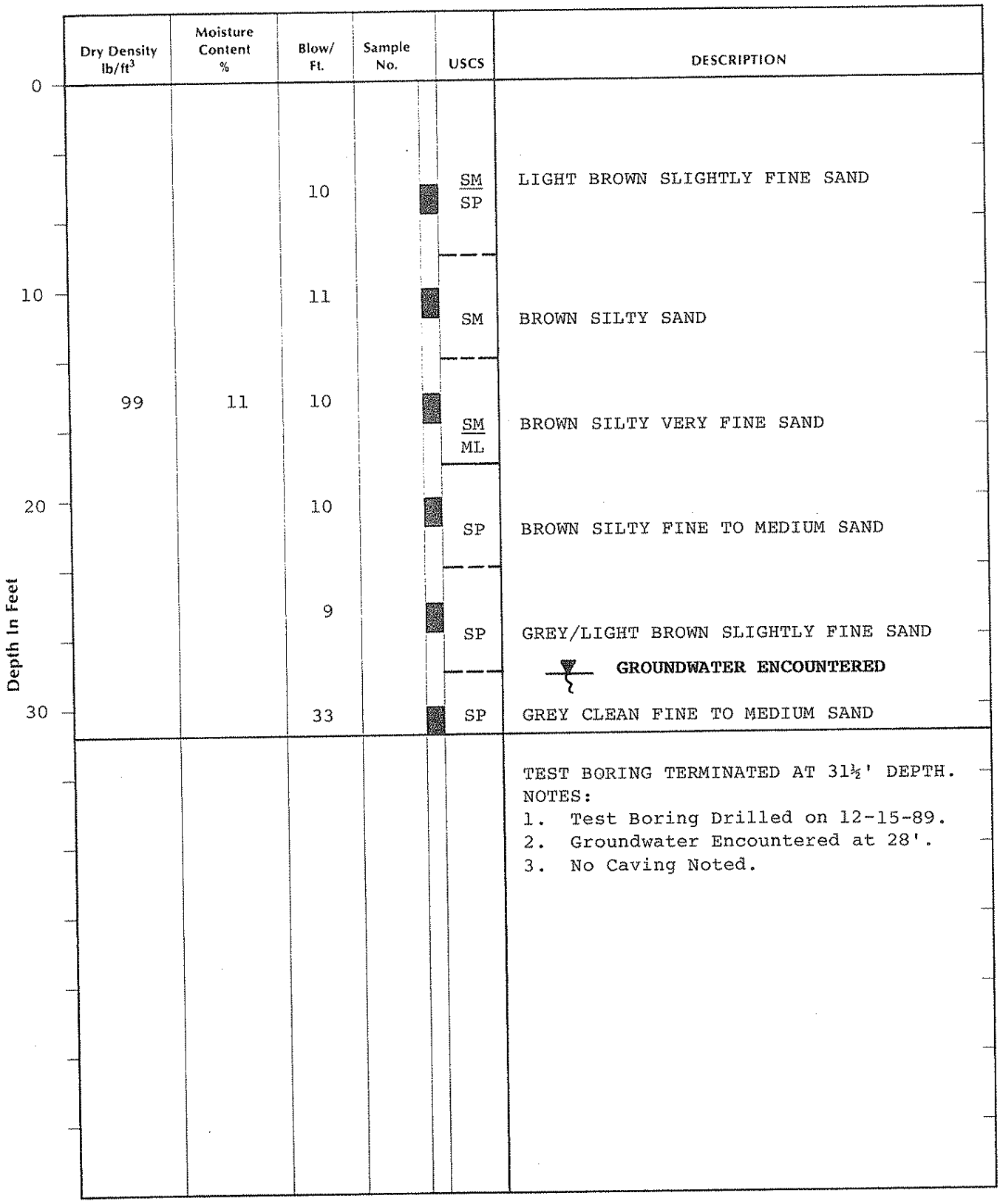


KLEINFELDER

LOG OF BORING NO. B-9

PLATE

PROJECT NO. 20-2598-02



KLEINFELDER

LOG OF BORING NO. B-10

PLATE

PROJECT NO. 20-2598-02

Depth In Feet	Dry Density lb/ft³	Moisture Content %	Blow/ Ft.	Sample No.	B-11 USCS	DESCRIPTION
0					ML	Gravelly Fine Sandy Clayey Silt
					ML	Grades No Gravel
3					ML	Brown Slightly Clayey Very Fine Sandy Silt
			6		ML	Grades No Clay (Medium Stiff)
6						
9	109	18	14		CL	Dark Brown Very Fine Sandy Clay (Stiff)
12					ML	Brown Very Fine Sandy Clayey Silt
15			17		ML	Grades Less Clay (Stiff-to-Very Stiff)
18						
21	102	24	26		CL	Brown Silty Clay (Very Stiff)
24						▽ Groundwater Encountered
	99	27	8		CL	Grades Light Brown (Medium Stiff-to-Stiff)
27						
30			16		ML	Blue-Grey Sandy Very Clayey Silt (Soft)
					CL	Blue Very Fine Sandy Silty Clay (Very Stiff)
33					SP	Blue-Grey Very Fine-to-Fine Sand
			35			
36					ML	Blue-Grey Very Fine Very Sandy Silt
39					SP	Blue-Grey Fine-to-Medium Sand
			23			
42						BORING TERMINATED AT 41-1/2-FOOT DEPTH

NOTES:
1. Boring Drilled on 8-19-86.
2. Groundwater Encountered at 25'.
3. Caving of Clean Sand Below Groundwater.

J.H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS • MATERIALS TESTING

LOG OF BORING NO. B-100 thru B-11

PLATE XIV

PROJECT NO. S-2598-2

JHK & A FORM R-22

Depth In Feet	Dry Density lb/ft³	Moisture Content %	Blow/ Ft.	Sample No.	USCS	DESCRIPTION
0			5		ML SM	LIGHT BROWN VERY FINE SANDY SILT
10	94	9	9		ML SM	BROWN VERY FINE SANDY SILT
			17			
20			14		SM	GREY/BROWN VERY SILTY VERY FINE SAND
	90	10	25		SP	BROWN CLEAN MEDIUM SAND
30			28		SP	LIGHT BROWN CLEAN MEDIUM SAND
						TEST BORING TERMINATED AT 31½' DEPTH. NOTES: 1. Test Boring Drilled on 12-15-89. 2. No Groundwater Encountered. 3. No Caving Noted.

KLEINFELDER

LOG OF BORING NO. B-12

PLATE

PROJECT NO. 20-2598-02

Boring Logs
(ENGEO 2008)

KEY TO BORING LOGS

MAJOR TYPES			DESCRIPTION
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #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 or gravel-sand mixtures GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES	GM - Silty gravels, gravel-sand and silt mixtures GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW - Well graded sands, or gravelly sand mixtures SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES	SM - Silty sand, sand-silt mixtures SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS		ML - Inorganic silt with low to medium plasticity CL - Inorganic clay with low to medium plasticity OL - Low plasticity organic silts and clays
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 %		MH - Inorganic silt with high plasticity CH - Inorganic clay with high plasticity OH - Highly plastic organic silts and clays
	HIGHLY ORGANIC SOILS		PT - Peat and other highly organic soils

GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE				CLEAR SQUARE SIEVE OPENINGS				
200	40	10	4	3/4 "	3"	12"		
SILTS AND CLAYS	SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE			

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT (S.P.T.)
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	STRENGTH*	BLOWS/FOOT (S.P.T.)
VERY SOFT	0-1/4	0-2
SOFT	1/4-1/2	2-4
MEDIUM STIFF	1/2-1	4-8
STIFF	1-2	8-15
VERY STIFF	2-4	15-30
HARD	OVER 4	OVER 30

MOISTURE CONDITION

DRY	Absence of moisture, dusty, dry to touch
MOIST	Damp but no visible water
WET	Visible freewater
SATURATED	Below the water table

SAMPLER SYMBOLS

- Modified California (3" O.D.) sampler
- California (2.5" O.D.) sampler
- S.P.T. - Split spoon sampler
- Shelby Tube
- Continuous Core
- Bag Samples
- Grab Samples
- NR No Recovery

MINOR CONSTITUENT QUANTITIES (BY WEIGHT)

TRACE	Particles are present, but estimated to the less than 5%
SOME	5 to 15%
WITH	15 to 30%
.....Y	30 to 50%

LINE TYPES

- ———— Solid - Layer Break
- – – – – – Dashed - Gradational or approximate layer break

GROUND-WATER SYMBOLS

- ▽ Groundwater level during drilling
- ▼ Stabilized groundwater level

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer

LOG OF BORING 3-B103

ENGEO — Expect Excellence

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/23/2008
HOLE DEPTH: Approx. 139½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: M. Swanson / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			SANDY SILT (ML), pale olive, loose, moist, fine- to medium-grained sand, some clay, (FILL)										
5	1		Pocket Torvane = 0.25 tsf			12							2.5*
	2					7				59	9.6		
10	3		Grades medium dense.			15							
	4		Pocket Torvane = 0.45 tsf										3.5*
15	5		CLAYEY SILT (ML), dark brown, very stiff, moist, some fine-grained sand, (NATIVE MATERIAL)			18					19.1	102.6	3.0*
20	6					21	35	25	10	93	27.4	87.9	> 4.5*
	7												
25	8		SAND (SP), light brown, medium dense, saturated, fine-grained sand, trace silt, and clay		▽	23							
			SAND (SP), gray, dense, saturated, fine- to coarse-grained sand, trace silt, and clay										
30	9					36				6	17.8		

LOG - GEOTECHNICAL 8188001000_BORE LOGS_MUDROT.GPJ ENGEO INC.GDT 9/8/08

LOG OF BORING 3-B103

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/23/2008
HOLE DEPTH: Approx. 139½ ft.
HOLE DIAMETER: 4.0 in.
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DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
35	10					35							
	11										25.1		
40	12					37							
	13					43							
45	14												
	15					37					18		
50	16												
55	17												
	18		Grades very dense.			51							
60													

LOG OF BORING 3-B103

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/23/2008
HOLE DEPTH: Approx. 139½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: M. Swanson / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
65	19												
	20												
	21					64				6	20.1		
70	22												
75	23												
	24					50							
80	25												
85	26												
	27		Grades dense.			48					24.2		
90													

LOG OF BORING 3-B103

Expect Excellence

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/23/2008
HOLE DEPTH: Approx. 139½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: M. Swanson / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
95	29												
	30		Grades very dense.			49							
100	31												
105	32												
	33		SILT (ML), dark gray, hard, saturated, some fine-grained sand, some clay Pocket Torvane = 1.0 tsf			50					24.3	91.4	> 4.5*
110	34												
115	35												
	36					65					18.7	111.6	
120			CLAYEY SAND (SC), dark gray, very dense, saturated, fine-grained sand, with silt										

LOG - GEOTECHNICAL 8188001000_BORE LOGS_MUDROT.GPJ ENGEO INC.GDT 9/8/08

ENGEO
Expect Excellence

LOG OF BORING 3-B103

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/23/2008
HOLE DEPTH: Approx. 139½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: M. Swanson / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
	37		SAND (SP), gray, very dense, saturated, fine- to medium-grained sand, trace silt, trace clay										
125	38												
	39					74							
130	40												
	41												
135			SILTY CLAY (CL), pale olive, hard, saturated, trace fine-grained sand										
	42		Pocket Torvane = 1.25 tsf			55					28.2	94.9	3.75*
			Bottom of boring at approximately 139 1/2 feet. Groundwater encountered durig drilling at approximately 25 feet.										

LOG - GEOTECHNICAL 8188001000_BORE LOGS_MUDROT.GPJ ENGEO INC.GDT 9/8/08

ENGEO
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LOG OF BORING 3-B104

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/24/2008
HOLE DEPTH: Approx. 121½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: Z. Crawford / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			SAND (SP), dark brown, medium dense, moist, fine-grained sand, some silt, trace clay, (FILL)			24							
5	1												
	2		SAND (SP), very dark brown, loose, moist, fine-grained sand, some silt, trace clay			7							
10	3												
	4		SAND (SP), dark brown, loose, moist, fine-grained sand, some silt, trace clay			7 11					8.3		
15	5												
	6		SAND (SP), light brown, medium dense, moist to saturated, medium- to coarse-grained sand, trace silt Saturated.		▽	15							
20	7					13				2			
25	8												
	9		SILT (ML), olive gray, very stiff to hard, saturated, some clay, trace fine-grained sand, mottled with reddish brown iron oxide. (NATIVE MATERIAL)			42	28	26	2	98	28.8	49.6	> 4.5*
30													

LOG - GEOTECHNICAL 8188001000_BORE LOGS_MUDROT.GPJ ENGEO INC.GDT 9/8/08

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LOG OF BORING 3-B104

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/24/2008
HOLE DEPTH: Approx. 121½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: Z. Crawford / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			Pocket Torvane = 0.75 tsf			15							
	10												
35			SILTY SAND (SM), olive brown, dense, saturated, fine- to medium-grained sand, trace clay			40				41	25.6		
	11												
	12												
40			SAND (SP), grayish brown, dense, saturated, fine-grained sand, trace silt			36				6	21.7		
	13												
			Grades gray.										
45						35							
	14												
			Grades to trace coarse-grained sand.										
50	15		Thin lense of fine-grained sand.			40							
	16												
55													
	17		Grades to fine- to coarse-grained sand.										
	18		Grades to less (trace) fine-grained sand.										
60													

LOG OF BORING 3-B104

Expect Excellence

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/24/2008
HOLE DEPTH: Approx. 121½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: Z. Crawford / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
	19					49				5	17.9		
65	20												
	21												
70						43							
	22												
75	23		Grades to olive gray, very dense.										
	24												
80						65							
	25												
85	26												
	27												
90													

LOG - GEOTECHNICAL 8188001000_BORE LOGS_MUDROT.GPJ ENGEO INC.GDT 9/8/08

ENGEO
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LOG OF BORING 3-B104

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/24/2008
HOLE DEPTH: Approx. 121½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: Z. Crawford / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
	28		SILTY CLAY (CL), olive gray, hard, saturated, trace fine-grained sand			58							
			SANDY SILT (ML), olive gray, hard, saturated, fine-grained sand, trace clay										
95	29		SILTY CLAY (CL), olive gray, hard, saturated, trace fine-grained sand Pocket Torvane = 2.13 tsf			50/6"							> 4.5*
			SAND (SP), grayish brown, dense to very dense, saturated, fine- to coarse-grained sand, trace silt, trace clay										
	30												
100	31												
			SILTY CLAY (CL), olive gray, hard, saturated, trace fine-grained sand Pocket Torvane = 1.0 tsf			50/5"							3.0*
105	32		SAND (SM), olive, very dense, saturated, fine-grained sand, with silt, trace clay										
	33												
110			Grades to some clay.										
	34		Mottled with carbonate.			80/11"				33			
115	35												
	36		SILTY CLAY (CL), grayish olive, hard, saturated, some fine-grained sand, mottled with iron oxide										
120													

LOG OF BORING 3-B104

Expect Excellence

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/24/2008
HOLE DEPTH: Approx. 121½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: Z. Crawford / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
	37		Bottom of boring at approximately 121 1/2 feet. Groundwater encountered durig drilling at approximately 21 feet.			43							3.5*

LOG OF BORING 3-B105

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/25/2008
HOLE DEPTH: Approx. 89½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: M. Swanson / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			SILTY SAND (SM), very dark brown, medium dense, moist, fine-grained sand, trace clay, (FILL)			12							
5	1												
						22	16	18	NP	28	7.9		
10	3		SILTY CLAY (CL), pale olive brown, hard, moist, trace fine-grained sand, (NATIVE MATERIAL)			50/6"	33	32	1		32.5	67.9	3.5*
			CLAYEY SILT (ML), brown, hard, moist, trace fine-grained sand Pocket Torvane = 0.5 tsf			50/3"							
	4		SAND (SM), brown, medium dense, moist, fine-grained sand, some silt										
15					▽								
	5		SANDY ELASTIC SILT (SM), brown, medium dense, saturated, fine-grained sand, some silt			22					26.6	91.4	
20	6		SAND (SP), brown, dense, saturated, fine- to coarse-grained sand, some subangular fine gravel, trace silt			42							
	7					56				6	15.1		
25	8		SILT (ML), brown, hard, saturated, with clay, some fine-grained sand										
	9		Pocket Torvane = 1.25 tsf			51	25	22	3	88	24	93.2	> 4.5*
30													

LOG - GEOTECHNICAL 8188001000_BORE LOGS_MUDROT.GPJ ENGEO INC.GDT 9/8/08

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LOG OF BORING 3-B105

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/25/2008
HOLE DEPTH: Approx. 89½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 32 ft.

LOGGED / REVIEWED BY: M. Swanson / JJT
DRILLING CONTRACTOR: V&W Drilling
DRILLING METHOD: Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
35	10		Pocket Torvane = 0.95 tsf			39							
	11												
40	12		Grades olive brown, some fine-grained-sand.			84							
	13												
45	14		Pocket Torvane = 1.03 tsf			29 21							3.0*
50	15		SAND (SM), dark brown, medium dense, saturated, fine-grained sand, with silt, trace clay			24				24	29.6		
55	16												
	17												
60	18		SILT (ML), dark brown, hard, saturated, with clay, some fine-grained sand Pocket Torvane = 0.8 tsf			43				93	31.7	83.2	4.5*

LOG - GEOTECHNICAL 8188001000_BORE LOGS_MUDROT.GPJ ENGEO INC.GDT 9/8/08

LOG OF BORING 3-B105

Expect Excellence

Geotechnical Exploration
The Trails of Manteca
Manteca, CA
8188.001.000

DATE DRILLED: 7/25/2008
HOLE DEPTH: Approx. 89½ ft.
HOLE DIAMETER: 4.0 in.
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LOGGED / REVIEWED BY: M. Swanson / JJT
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Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
65	19												
	20												
			SAND (SM), dark gray, dense, saturated, fine- to medium-grained sand, some silt, trace clay										
	21					24				15	33.6		
70													
	22												
75													
	23												
	24		SILTY CLAY (CL), brown, hard, saturated, with fine-grained sand Pocket Torvane = 0.5 tsf			85					19.1	112	> 4.5*
80			12 inch sand lense at 81 feet.										
	25												
85													
	26		SAND (SP), grayish brown, very dense, saturated, fine- to coarse-grained sand, trace silt, trace clay										
	27					75/11"					20.5		
			Bottom of boring at approximately 89 1/2 feet. Groundwater encountered durig drilling at approximately 15 1/2 feet.										

LOG - GEOTECHNICAL 8188001000_BORE LOGS_MUDROT.GPJ ENGEO INC.GDT 9/8/08

Boring Logs
(ENGEO 2013)

KEY TO BORING LOGS

MAJOR TYPES			DESCRIPTION
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #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 or gravel-sand mixtures GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES	GM - Silty gravels, gravel-sand and silt mixtures GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW - Well graded sands, or gravelly sand mixtures SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES	SM - Silty sand, sand-silt mixtures SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS		ML - Inorganic silt with low to medium plasticity CL - Inorganic clay with low to medium plasticity OL - Low plasticity organic silts and clays
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 %		MH - Inorganic silt with high plasticity CH - Inorganic clay with high plasticity OH - Highly plastic organic silts and clays
	HIGHLY ORGANIC SOILS		PT - Peat and other highly organic soils

GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE				CLEAR SQUARE SIEVE OPENINGS				
200	40	10	4	3/4 "	3"	12"		
SILTS AND CLAYS	SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE			

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT (S.P.T.)
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	STRENGTH*	BLOWS/FOOT (S.P.T.)
VERY SOFT	0-1/4	0-2
SOFT	1/4-1/2	2-4
MEDIUM STIFF	1/2-1	4-8
STIFF	1-2	8-15
VERY STIFF	2-4	15-30
HARD	OVER 4	OVER 30

MOISTURE CONDITION

DRY	Absence of moisture, dusty, dry to touch
MOIST	Damp but no visible water
WET	Visible freewater
SATURATED	Below the water table

SAMPLER SYMBOLS

- Modified California (3" O.D.) sampler
- California (2.5" O.D.) sampler
- S.P.T. - Split spoon sampler
- Shelby Tube
- Continuous Core
- Bag Samples
- Grab Samples
- NR No Recovery

MINOR CONSTITUENT QUANTITIES (BY WEIGHT)

TRACE	Particles are present, but estimated to the less than 5%
SOME	5 to 15%
WITH	15 to 30%
.....Y	30 to 50%

LINE TYPES

- ———— Solid - Layer Break
- – – – – – Dashed - Gradational or approximate layer break

GROUND-WATER SYMBOLS

- ▽ Groundwater level during drilling
- ▼ Stabilized groundwater level

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer

LOG OF BORING 1-B2

ENGEO INCORPORATED

Geotechnical Exploration
Terra Ranch
Manteca, California
10218.000.000

DATE DRILLED: 4/25/2013
HOLE DEPTH: Approx. 16½ ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (MSL): Approx. 18 ft.

LOGGED / REVIEWED BY: C. Crawford / ZC
DRILLING CONTRACTOR: West Coast Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
			SILTY SAND (SM), dark brown, medium dense, moist, fine- to coarse-grained sand, 30-40% fines			16				19					
	1					27									
5			(20-25% fines)			18									
	2														
			SANDY SILT (ML), grayish brown, very stiff, wet, fine-grained sand												
10	3					30	NP	NP	NP	63					
			LEAN CLAY (CL), light brown, stiff, wet												
	4														
15			SILTY SAND (SM), grayish brown, very dense, wet, fine- to medium-grained sand, 15-20% fines			53									
	5		POORLY GRADED SAND WITH SILT (SP-SM), light brown, very dense, wet, fine- to medium-grained sand												
			Bottom of Boring at approximately 16.5 feet below ground surface Groundwater tagged at 6 feet below ground surface after drilling												

LOG OF BORING 1-B4

ENGEO INCORPORATED

Geotechnical Exploration
Terra Ranch
Manteca, California
10218.000.000

DATE DRILLED: 4/25/2013
HOLE DEPTH: Approx. 21½ ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (MSL): Approx. 18 ft.

LOGGED / REVIEWED BY: C. Crawford / ZC
DRILLING CONTRACTOR: West Coast Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
			SILTY SAND (SM), dark brown, medium dense, moist, fine- to medium-grained sand, 20-30% fines			20									
	1					13									
5			CLAYEY SAND (SC), dark brown, loose, moist, fine- to medium-grained sand, 30-40% fines			18				23					
	2														
10	3		SILTY CLAY (CL-ML), grayish brown, very stiff, wet, fine-grained sand, 85-95% fines			22	26	21	5						
			LEAN CLAY (CL), light grayish brown, very stiff, wet, fine-grained sand, 85-95% fines												
	4														
15						66									
	5														
			POORLY GRADED SAND WITH SILT (SP-SM), light brown, medium dense, wet, fine- to medium-grained sand, 10-15% fines												
20	6					20									
			SILT (ML), light grayish brown, stiff, wet, fine-grained sand, 75-85% fines												
			Bottom of Boring at approximately 21.5 feet below ground surface Groundwater tagged at approximately 6 feet below ground surface after drilling												

LOG OF BORING 1-B5

ENGEO INCORPORATED

Geotechnical Exploration
Terra Ranch
Manteca, California
10218.000.000

DATE DRILLED: 5/2/2013
HOLE DEPTH: Approx. 26½ ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (MSL): Approx. 18 ft.

LOGGED / REVIEWED BY: C. Crawford / ZC
DRILLING CONTRACTOR: West Coast Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
			POORLY GRADED SAND (SP), reddish brown, medium dense, moist, fine- to medium-grained sand			17				3					
	1					17					3.6				
5			SILTY SAND (SM), reddish brown, medium dense, moist, fine- to medium-grained sand, 10-20% fines, pockets of rust			13					23.2				
	2														
			POORLY GRADED SAND WITH SILT (SP-SM), reddish brown, medium dense, wet, fine- to medium-grained sand, 5-10% fines												
10	3					26					22.1				
	4														
15			(grayish brown)			23				8	24				
	5														
	6														
20						32					25.9				
			SILTY SAND (SM), gray, medium dense, wet, fine-grained sand, 35-45% fines												
25	7														
	8					21									
			Bottom of Boring at approximately 26.5 feet below ground surface Groundwater tagged at approximately 5 feet below ground surface after drilling												

LOG OF BORING 1-B8

ENGEO INCORPORATED

Geotechnical Exploration
Terra Ranch
Manteca, California
10218.000.000

DATE DRILLED: 5/2/2013
HOLE DEPTH: Approx. 21½ ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (MSL): Approx. 18 ft.

LOGGED / REVIEWED BY: C. Crawford / ZC
DRILLING CONTRACTOR: West Coast Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
			SILTY SAND (SM), dark brown, loose to medium dense, moist, fine- to medium-grained sand			23				13					
	1					7									
5			POORLY GRADED SAND WITH SILT (SP-SM), dark brown, loose, moist, fine- to medium-grained sand			8				7					
	2														
10	3		POORLY GRADED SAND (SP), light gray, medium dense, wet, fine- to medium-grained sand			13				1					
	4														
15			(fine- to course-grained sand)			27									
	5														
			SILTY SAND (SM), gray, dense, wet, fine- to medium-grained sand, 10-20% fines												
20	6					36									
			Bottom of Boring at approximately 21.5 feet below ground surface Groundwater tagged at approximately 5 feet below ground surface after drilling												

LOG - SHEAR AND UNCONF STRENGTH 10218.000.000 BORINGS.GPJ ENGEO INC.GDT 5/22/13

Boring Logs

(Department of Water Resources 2012)

DATE STARTED	DATE COMPLETED	GROUND ELEVATION	ELEVATION DATUM	TOTAL DEPTH OF BORING
2/21/12	2/21/12	34.52 ft	NAVD 88	51.0 ft

DRILLING CONTRACTOR	DRILLER'S NAME	HELPER'S NAME	TOTAL DEPTH OF FILL
Gregg Drilling & Testing, Inc.	Eric Santellan	Rick Ryan	12.5 ft

DRILLING METHOD	DRILL RIG MAKE AND MODEL	CONSULTANT COMPANY
HSA/Rotary Wash	MARL M10	Kleinfelder

DRILL BIT SIZE AND TYPE (HOLE DIAMETER)	DRILLING ROD TYPE AND DIAMETER	FIELD LOGGER
8" HSA, 3-7/8" Drag Bit	NWJ 2-5/8"	Hamid Parsa

	CASING TYPE, DIAMETER, INSTALLATION DEPTH	FIELD LOG REVIEWER
[X] VERTICAL [ ] INCLINED	HSA, 8", 20 ft.	J. Wetenkamp

SAMPLER TYPE(S)	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP	HAMMER EFFICIENCY
StdCal(2.5"), SPT (1.375"), DM (2.5"), OST (3")	MARL Auto Hammer 140lb./30-inch drop	74.3%

BOREHOLE BACKFILL OR COMPLETION	GROUNDWATER READING: DURING DRILLING	AFTER DRILLING (DATE-TIME)
Grout	Not Measured Due to 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		4 inches of Aggregate Base.	NSD											
	1		CLAYEY SAND (SC); medium dense; dark brown (7.5YR 3/3); moist; 65% fine to coarse, subrounded sand; 30% fines; 5% fine, subrounded gravel; [Levee Fill].		S01A	44	3 5 5	12							S01A_001_003S
	2														
	3			NSD			[10]								
	4				S02B		14 12								S02B_004_005C
30			SILTY SAND (SM); yellowish brown (10YR 5/6); moist; 82% fine to medium sand; 18% fines; [Levee Fill]. Below 4.5 feet, brown (10YR 4/3).		S02A		12			11			18	UW PA	S02A_005_005C
	5			NSD			[24]								
	6														S03A_006_009T Osterberg pushed with 250 psi
	7				S03A	80									
	8														
	9			NSD											
25	10														S04A_010_012T D&M pushed with 75 psi
	11		Below 10.5 feet, yellowish brown (10YR 5/6).		S04A	83				5				UW	
FILL	12			NSD											
	13		Poorly Graded SAND with Silt (SP-SM); medium dense; light olive brown (2.5Y 5/3); moist; 94% fine to medium sand; 6% fines.		S05A	44	4 8 8	20					6	PA	S05A_012_014S
20	14			NSD			[16]								
	15		Poorly Graded SAND (SP); brownish yellow (10YR 6/8); moist; 98% fine to medium sand; 2% fines.												
	16				S06A	60				6			2	UW PA PE	S06A_015_018T Osterberg pushed with 500 psi K = 1.2E-03 cm/sec
	17														
	18			NSD											
	19														
15	20		At 19.25 feet, lens of SILT SAND (SM). Below 19.5 feet, mottled rust.		S07C S07B	100	6			21			2	UW	S07C_019_020C

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Borehole Location: Levee Crown **County:** San Joaquin
Coordinates: Northing: 2,103,421.59 **Easting:** 6,340,865.99
Latitude: 37.76913 **Longitude:** -121.26391
Levee Station or Milepost: 1949+96 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: Ground Survey **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
WR0017_203B
Sheet 1 of 3

Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

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
	20				S07A	100	12 14								S07B_020_020C S07A_020_021C
	21			NSD			[26]								
	22		Below 21.5 feet, wet.		S08A	44									S08A_021_023T D&M pushed with 600 psi
	23			NSD											
	24														S09A_024_027T Osterberg pushed with 600 psi
10	25				S09A	60									
	26														
	27		Poorly Graded SAND with Silt (SP-SM); gray (2.5Y 5/1); moist; 95% fine to medium sand; 5% fines.	NSD											
	28				S10B	67	17 25			22			5	UW PA PE UW	S10B_028_029C K = 4.4E-04 cm/sec
	29				S10A		27			21					S10A_029_030C
5	30		SILTY SAND (SM); gray (2.5Y 5/1); wet; 85% fine to medium sand; 15% fines.	NSD			[52]								
	31		SANDY LEAN CLAY (CL); hard; yellowish brown (10YR 5/6); moist; 61% high dry strength, no dilatancy, medium toughness fines; 39% fine sand.		S11A	83			>4.5P	25	37	18	61	UW	S11A_030_032T D&M pushed with 300 psi
	32			NSD											
	33				S12B	56	7 14	48							S12B_033_034S
	34		SILTY SAND (SM); dense; yellowish brown (10YR 5/6); moist; 65% fine to medium sand; 35% fines.		S12A		25								S12A_034_035S
0	35			NSD			[39]								
	36														S13A_035_038T Osterberg pushed with 600 psi
	37				S13A	0									
	38														
	39			NSD											
-5	40				S14B	89	27 41								S14B_040_041C
	41		Below 40.5 feet, 84% sand; 16% fines.		S14A		46			21			16	UW PA	S14A_041_041C
	42			NSD			[87]								
	43		Poorly Graded SAND (SP); light gray (5Y 7/1); moist; 96% fine to medium, subangular sand; 4% fines.		S15C S15B S15A	89	26 43 45			18			4	UW	S15C_042_043C S15B_043_043C S15A_043_044C
	44			NSD			[88]								
-10	45				S16A	56	21	67							S16A_044_046S

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Borehole Location: Levee Crown **County:** San Joaquin
Coordinates: **Northing:** 2,103,421.59 **Easting:** 6,340,865.99
Latitude: 37.76913 **Longitude:** -121.26391
Levee Station or Milepost: 1949+96 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: Ground Survey **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
WR0017_203B
Sheet 2 of 3

Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

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		Poorly Graded SAND with Silt (SP-SM); very dense; light gray (5Y 7/1); wet; 90% fine to medium sand; 10% fines.		S16A	56	25 29	67							
	46			NSD			[54]								
	47						18								
	48				S17B S17A	89	25 44			23			10	UW	S17B_047_048C S17A_048_049C
	49			NSD			[69]								
-15	50		At 50.0 feet, 2.5 inch lens of SANDY LEAN CLAY (CL).		S18A	94									S18A_049_051T D&M pushed with 600 psi
	51														
	52		Total Depth Drilled 51 Feet. Boring backfilled with neat cement grout: 4 (94 lb.) bags of Portland Cement 35 gallons of water												
	53														
	54														
-20	55														
	56														
	57														
	58														
	59														
-25	60														
	61														
	62														
	63														
	64														
-30	65														
	66														
	67														
	68														
	69														
-35	70														

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DEPARTMENT OF WATER RESOURCES · STATE OF CALIFORNIA ·

Borehole Location: Levee Crown **County:** San Joaquin
Coordinates: Northing: 2,103,421.59 **Easting:** 6,340,865.99
Latitude: 37.76913 **Longitude:** -121.26391
Levee Station or Milepost: 1949+96 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: Ground Survey **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
WR0017_203B
Sheet 3 of 3

Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

Boring Logs

(Department of Water Resources 2014)

DATE STARTED	DATE COMPLETED	GROUND ELEVATION	ELEVATION DATUM	TOTAL DEPTH OF BORING
2/11/14	2/11/14	19.9 ft	NAVD 88	14.0 ft

DRILLING CONTRACTOR	DRILLER'S NAME	HELPER'S NAME	TOTAL DEPTH OF FILL
Gregg Drilling & Testing, Inc.	Jeremy Neff	Rick Ryan	0 ft

DRILLING METHOD	DRILL RIG MAKE AND MODEL	CONSULTANT COMPANY
HSA	MARL RHINO M5	Kleinfelder

DRILL BIT SIZE AND TYPE (HOLE DIAMETER)	DRILLING ROD TYPE AND DIAMETER	FIELD LOGGER
6" HSA		G. Lenehan

	CASING TYPE, DIAMETER, INSTALLATION DEPTH	FIELD LOG REVIEWER
[X] VERTICAL [ ] INCLINED		H. Parsa

SAMPLER TYPE(S)	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP	HAMMER EFFICIENCY
SPT (1.375" I.D.)	Auto Drop Hammer, DH 10, 140lb./30-inch drop	89%

BOREHOLE BACKFILL OR COMPLETION	GROUNDWATER READING: DURING DRILLING	AFTER DRILLING (DATE-TIME)
Neat Cement Grout	8.5 feet	

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		SILTY SAND (SM); dark brown (10YR 3/3); moist; 70% fine sand; 30% no plasticity fines.												
	1			NSD											
	2														
	3		Below 2.5 feet, loose; 62% fine to medium sand; 38% fines.	X	S01A	100	2 2 3 [5]	7					38	PA	S01A_002_004S
	4			NSD											
15	5			X	S02A	89	6 4 4 [8]	12							S02A_005_007S
	6														
	7			NSD											
	8		SANDY SILT (ML); loose; greenish black (5G 2.5/1); moist; 58% low plasticity, no dry strength, rapid dilatancy, low toughness fines; 42% fine to medium sand; trace organics.	X	S03A S03B	94	2 4 4 [8]	12					58	HD PA	S03B_007_008S S03A_008_009S
	9		Poorly Graded SAND with Silt (SP-SM); loose; greenish black (10Y 2.5/1); wet; 90% fine sand; 10% fines.	NSD											
10	10														
	11			X	S04A	72	2 3 5 [8]	12							S04A_010_012S
	12			NSD											
	13		Below 12.5 feet, medium dense; dark greenish gray (10Y 4/1).	X	S05A	100	5 7 7 [14]	21							S05A_012_014S
	14														
5	15		Total Depth Drilled 14.0 Feet Boring backfilled with neat cement grout: 3 (94 lb.) bags of Portland Cement 15 gallons of water												
	16														
	17														
	18														
	19														
0	20														

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Borehole Location: Waterside Toe **County:** San Joaquin
Coordinates: **Northing:** 2,102,117.04 **Easting:** 6,336,150.36
Latitude: 37.76544 **Longitude:** -121.28018
Levee Station or Milepost: 1889+10 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
WR0017_304A
Sheet 1 of 1

Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED	DATE COMPLETED	GROUND ELEVATION	ELEVATION DATUM	TOTAL DEPTH OF BORING
2/12/14	2/12/14	20.0 ft	NAVD 88	11.5 ft

DRILLING CONTRACTOR	DRILLER'S NAME	HELPER'S NAME	TOTAL DEPTH OF FILL
Gregg Drilling & Testing, Inc.	Jeremy Neff	Rick Ryan	0 ft

DRILLING METHOD	DRILL RIG MAKE AND MODEL	CONSULTANT COMPANY
HSA	MARL RHINO M5	Kleinfelder

DRILL BIT SIZE AND TYPE (HOLE DIAMETER)	DRILLING ROD TYPE AND DIAMETER	FIELD LOGGER
6" HSA		G. Lenehan

	CASING TYPE, DIAMETER, INSTALLATION DEPTH	FIELD LOG REVIEWER
[X] VERTICAL [ ] INCLINED		H. Parsa

SAMPLER TYPE(S)	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP	HAMMER EFFICIENCY
SPT (1.375" I.D.)	Auto Drop Hammer, DH 10, 140lb./30-inch drop	89%

BOREHOLE BACKFILL OR COMPLETION	GROUNDWATER READING: DURING DRILLING	AFTER DRILLING (DATE-TIME)
Neat Cement Grout	9.0 feet	

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
20	0		SANDY SILT (ML); olive brown (2.5Y 4/4); moist; 55% no plasticity, no dry strength, rapid dilatancy, low toughness fines; 45% fine sand.	NSD											
	1														
	2														
	3		Below 2.5 feet, loose.		S01A	100	2 3 4 [7]	10							S01A_002_004S
	4														
15	5		SILTY SAND (SM); loose; olive brown (2.5Y 4/4); moist; 65% fine to medium sand; 35% fines.	NSD											
	6				S02A	100	2 3 3 [6]	9					35	HD PA	S02A_005_007S
	7			NSD											
	8				S03A	100	2 2 3 [5]	7							S03A_007_009S
	9			NSD											
10	10		Poorly Graded SAND (SP); loose; olive (5Y 4/3); 97% fine to medium sand; 3% fines.		S04A	50	1 2 3 [5]	7					3	PA	S04A_010_012S
	11														
	12		Total Depth Drilled 11.5 Feet Boring backfilled with neat cement grout: 2 (94 lb.) bags of Portland Cement 15 gallons of water												
	13														
	14														
5	15														
	16														
	17														
	18														
	19														
	20														

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Borehole Location: Field **County:** San Joaquin
Coordinates: **Northing:** 2,102,378.54 **Easting:** 6,336,404.31
Latitude: 37.76617 **Longitude:** -121.27931
Levee Station or Milepost: 1890+26 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
WR0017_305A
Sheet 1 of 1

Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED	DATE COMPLETED	GROUND ELEVATION	ELEVATION DATUM	TOTAL DEPTH OF BORING
2/12/14	2/12/14	22.4 ft	NAVD 88	14.0 ft

DRILLING CONTRACTOR	DRILLER'S NAME	HELPER'S NAME	TOTAL DEPTH OF FILL
Gregg Drilling & Testing, Inc.	Jeremy Neff	Rick Ryan	0 ft

DRILLING METHOD	DRILL RIG MAKE AND MODEL	CONSULTANT COMPANY
HSA	MARL RHINO M5	Kleinfelder

DRILL BIT SIZE AND TYPE (HOLE DIAMETER)	DRILLING ROD TYPE AND DIAMETER	FIELD LOGGER
6" HSA		G. Lenehan

[X] VERTICAL [ ] INCLINED	CASING TYPE, DIAMETER, INSTALLATION DEPTH	FIELD LOG REVIEWER
		H. Parsa

SAMPLER TYPE(S)	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP	HAMMER EFFICIENCY
SPT (1.375" I.D.)	Auto Drop Hammer, DH 10, 140lb./30-inch drop	89%

BOREHOLE BACKFILL OR COMPLETION	GROUNDWATER READING: DURING DRILLING	AFTER DRILLING (DATE-TIME)
Neat Cement Grout	9.0 feet	

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		SANDY SILT (ML); dark brown (10YR 3/3); moist; 51% no plasticity, no dry strength, rapid dilatancy, low toughness fines; 49% fine to medium sand.	NSD											
	1														
	2														
20															
	3		Below 2.5 feet, loose.	X	S01A	100	2 3 3 [6]	9					51	HD PA	S01A_002_004S
	4			NSD											
	5		SILTY SAND (SM); loose; dark brown (10YR 3/3); moist; 70% fine sand; 30% fines.	X	S02A	100	3 3 3 [6]	9							S02A_005_007S
	6														
	7			NSD											
15															
	8		SANDY SILT (ML); loose; dark brown (10YR 3/3); moist; 63% no plasticity, no dry strength, rapid dilatancy, low toughness fines; 37% fine to medium sand.	X	S03A	100	3 5 5	15					63	HD PA	S03A_007_009S
	9			NSD			[10]								
	10		Below 10.0 feet, 80% fine sand; 20% fines.	X	S04B	100	2 2 2 [4]	6							S04B_010_011S
	11		SILTY SAND (SM); very loose; olive brown (2.5Y 4/3); wet; 84% fine to medium sand; 16% fines.		S04A								16	PA	S04A_011_012S
	12			NSD											
10															
	13		Below 12.5 feet, loose.	X	S05A	100	3 3 6 [9]	13							S05A_012_014S
	14														
	15		Total Depth Drilled 14.0 Feet Boring backfilled with neat cement grout: 3 (94 lb.) bags of Portland Cement 15 gallons of water												
	16														
5															
	17														
	18														
	19														
	20														

Final Report Version 2/27/2015

Borehole Location: Field **County:** San Joaquin
Coordinates: **Northing:** 2,102,218.25 **Easting:** 6,336,345.96
Latitude: 37.76573 **Longitude:** -121.27951
Levee Station or Milepost: 1890+43 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
WR0017_306A
Sheet 1 of 1

Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED	DATE COMPLETED	GROUND ELEVATION	ELEVATION DATUM	TOTAL DEPTH OF BORING
2/12/14	2/12/14	22.2 ft	NAVD 88	11.5 ft

DRILLING CONTRACTOR	DRILLER'S NAME	HELPER'S NAME	TOTAL DEPTH OF FILL
Gregg Drilling & Testing, Inc.	Jeremy Neff	Rick Ryan	0 ft

DRILLING METHOD	DRILL RIG MAKE AND MODEL	CONSULTANT COMPANY
HSA	MARL RHINO M5	Kleinfelder

DRILL BIT SIZE AND TYPE (HOLE DIAMETER)	DRILLING ROD TYPE AND DIAMETER	FIELD LOGGER
6" HSA		G. Lenehan

	CASING TYPE, DIAMETER, INSTALLATION DEPTH	FIELD LOG REVIEWER
[X] VERTICAL [ ] INCLINED		H. Parsa

SAMPLER TYPE(S)	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP	HAMMER EFFICIENCY
SPT (1.375" I.D.)	Auto Drop Hammer, DH 10, 140lb./30-inch drop	89%

BOREHOLE BACKFILL OR COMPLETION	GROUNDWATER READING: DURING DRILLING	AFTER DRILLING (DATE-TIME)
Neat Cement Grout	9.5 feet	

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		SILTY SAND (SM); olive brown (2.5Y 4/4); moist; 53% fine to medium sand; 47% fines.	NSD											
20	1														
	2														
	3				S01A S01B	100	2 2 14	24					47	PA	S01B_002_003S S01A_003_004S
	4		SILT with Sand (ML); medium dense; light olive brown (2.5Y 5/4); moist; 80% no plasticity, no dry strength, rapid dilatancy, low toughness fines; 20% fine sand.	NSD			[16]								
	5		SANDY SILT (ML); medium dense; olive brown (2.5Y 4/3); moist; 70% no plasticity, no dry strength, rapid dilatancy, low toughness fines; 30% fine sand.		S02A	100	7 7 4	16							S02A_005_007S
	6						[11]								
15	7			NSD											
	8		Poorly Graded SAND (SP); loose; olive brown (2.5Y 4/3); moist; 98% fine to coarse sand; 2% fines.		S03A	67	3 3 7	15					2	PA	S03A_007_009S
	9			NSD			[10]								
	10		Below 10.0 feet, medium dense; wet; very dark grayish brown (2.5Y 3/2).		S04A	67	3 6 6	18							S04A_010_012S
	11						[12]								
10	12		Total Depth Drilled 11.5 Feet Boring backfilled with neat cement grout: 2 (94 lb.) bags of Portland Cement 15 gallons of water												
	13														
	14														
	15														
	16														
5	17														
	18														
	19														
	20														

Final Report Version 2/27/2015

Borehole Location: Landside Toe **County:** San Joaquin
Coordinates: **Northing:** 2,101,535.20 **Easting:** 6,338,034.40
Latitude: 37.76389 **Longitude:** -121.27365
Levee Station or Milepost: 1909+32 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
WR0017_307A
Sheet 1 of 1

Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED	DATE COMPLETED	GROUND ELEVATION	ELEVATION DATUM	TOTAL DEPTH OF BORING
2/12/14	2/12/14	25.8 ft	NAVD 88	16.5 ft

DRILLING CONTRACTOR	DRILLER'S NAME	HELPER'S NAME	TOTAL DEPTH OF FILL
Gregg Drilling & Testing, Inc.	Jeremy Neff	Rick Ryan	0 ft

DRILLING METHOD	DRILL RIG MAKE AND MODEL	CONSULTANT COMPANY
HSA	MARL RHINO M5	Kleinfelder

DRILL BIT SIZE AND TYPE (HOLE DIAMETER)	DRILLING ROD TYPE AND DIAMETER	FIELD LOGGER
6" HSA		G. Lenehan

[X] VERTICAL [ ] INCLINED	CASING TYPE, DIAMETER, INSTALLATION DEPTH	FIELD LOG REVIEWER
		H. Parsa

SAMPLER TYPE(S)	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP	HAMMER EFFICIENCY
SPT (1.375" I.D.)	Auto Drop Hammer, DH 10, 140lb./30-inch drop	89%

BOREHOLE BACKFILL OR COMPLETION	GROUNDWATER READING: DURING DRILLING	AFTER DRILLING (DATE-TIME)
Neat Cement Grout	9.5 feet	

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
25	0		SILTY SAND (SM); very dark gray (2.5Y 3/1); moist; 80% fine sand; 20% fines; [EMBANKMENT FILL].												
	1			NSD											
	2														
	3		Below 2.5 feet, loose.		S01A	100	3 3 3 [6]	9							S01A_002_004S
	4			NSD											
	5		SILTY SAND (SM); loose; dark olive brown (2.5Y 3/3); moist; 70% fine sand; 30% fines.		S02A	100	2 4 3 [7]	10							S02A_005_007S
20	6														
	7			NSD											
	8		Below 7.5 feet, 66% fine to medium sand; 34% fines.		S03A	100	2 2 4 [6]	9					34	PA	S03A_007_009S
	9			NSD											
	10				S04A	89	4 4 6 [10]	15							S04A_010_012S
15	11		Below 11.0 feet, fine to medium sand.												
	12			NSD											
	13		Poorly Graded SAND (SP); loose; olive (5Y 4/4); wet; 99% fine to medium sand; 1% fines.		S05A	72	3 5 5 [10]	15					1	PA	S05A_012_014S
	14			NSD											
	15		At 15.0 feet, medium dense.		S06A	89	2 6 8 [14]	21							A06A_015_017S
10	16														
	17		Total Depth Drilled 16.5 Feet Boring backfilled with neat cement grout: 3 (94 lb.) bags of Portland Cement 15 gallons of water												
	18														
	19														
	20														

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Borehole Location: Waterside Toe **County:** San Joaquin
Coordinates: **Northing:** 2,101,304.90 **Easting:** 6,338,098.48
Latitude: 37.76326 **Longitude:** -121.27342
Levee Station or Milepost: 1909+22 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
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Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED 2/12/14 **DATE COMPLETED** 2/12/14	**GROUND ELEVATION** 20.9 ft **ELEVATION DATUM** NAVD 88		**TOTAL DEPTH OF BORING** 11.5 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.	**DRILLER'S NAME** Jeremy Neff **HELPER'S NAME** Rick Ryan		**TOTAL DEPTH OF FILL** 0 ft
DRILLING METHOD HSA	**DRILL RIG MAKE AND MODEL** MARL RHINO M5		**CONSULTANT COMPANY** Kleinfelder
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6" HSA	**DRILLING ROD TYPE AND DIAMETER**		**FIELD LOGGER** G. Lenehan
[X] **VERTICAL** [ ] **INCLINED**	**CASING TYPE, DIAMETER, INSTALLATION DEPTH**		**FIELD LOG REVIEWER** H. Parsa
SAMPLER TYPE(S) SPT (1.375" I.D.)	**HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP** Auto Drop Hammer, DH 10, 140lb./30-inch drop		**HAMMER EFFICIENCY** 89%
BOREHOLE BACKFILL OR COMPLETION Neat Cement Grout	**GROUNDWATER READING:** **DURING DRILLING** 10.0 feet	**AFTER DRILLING (DATE-TIME)**	

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		SILTY SAND (SM); very dark gray (2.5Y 3/1); moist; 85% fine to medium sand; 15% fines.												
20	1			NSD											
	2														
	3		Below 2.5 feet, loose; 76% sand; 24% fines.	X	S01A	100	2 4 6 [10]	15					24	PA	S01A_002_004S
	4			NSD											
	5		Below 5.0 feet, medium dense; olive brown (2.5Y 4/3).	X	S02A	100	9 7 5 [12]	18							S02A_005_007S
15	6														
	7			NSD											
	8		Below 7.5 feet, very loose; 78% sand; 22% fines.	X	S03A	100	1 1 1 [2]	3					22	PA	S03A_007_009S
	9			NSD											
	10			X	S04A	11	2 2 2 [4]	6							S04A_010_012S
10	11														
	12		Total Depth Drilled 11.5 Feet Boring backfilled with neat cement grout: 2 (94 lb.) bags of Portland Cement 15 gallons of water												
	13														
	14														
	15														
5	16														
	17														
	18														
	19														
	20														

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Borehole Location: Field **County:** San Joaquin
Coordinates: **Northing:** 2,103,909.15 **Easting:** 6,340,240.45
Latitude: 37.77046 **Longitude:** -121.26609
Levee Station or Milepost: 1943+87 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
WR0017_309A
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Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED	DATE COMPLETED	GROUND ELEVATION	ELEVATION DATUM	TOTAL DEPTH OF BORING
2/12/14	2/12/14	19.6 ft	NAVD 88	11.5 ft

DRILLING CONTRACTOR	DRILLER'S NAME	HELPER'S NAME	TOTAL DEPTH OF FILL
Gregg Drilling & Testing, Inc.	Jeremy Neff	Rick Ryan	0 ft

DRILLING METHOD	DRILL RIG MAKE AND MODEL	CONSULTANT COMPANY
HSA	MARL RHINO M5	Kleinfelder

DRILL BIT SIZE AND TYPE (HOLE DIAMETER)	DRILLING ROD TYPE AND DIAMETER	FIELD LOGGER
6" HSA		G. Lenehan

[X] VERTICAL [ ] INCLINED	CASING TYPE, DIAMETER, INSTALLATION DEPTH	FIELD LOG REVIEWER
		H. Parsa

SAMPLER TYPE(S)	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP	HAMMER EFFICIENCY
SPT (1.375" I.D.)	Auto Drop Hammer, DH 10, 140lb./30-inch drop	89%

BOREHOLE BACKFILL OR COMPLETION	GROUNDWATER READING: DURING DRILLING	AFTER DRILLING (DATE-TIME)
Neat Cement Grout	7.5 feet	

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		Poorly Graded SAND with Silt (SP-SM); dark olive brown (2.5Y 3/3); moist; 92% fine to medium sand; 8% fines.	NSD											
	1														
	2														
	3		Below 2.5 feet, loose.	X	S01A	83	3 5 5	15					8	PA	S01A_002_004S
	4		Below 3.5 feet, light olive brown (2.5Y 5/6).				[10]								
15				NSD											
	5			X	S02A	83	2 4 4	12							S02A_005_007S
	6						[8]								
	7			NSD											
	8		Poorly Graded SAND (SP); loose; light olive brown (2.5Y 5/6); moist; 99% fine to medium sand; 1% fines.	X	S03A	94	1 4 4	12					1	PA	S03A_007_009S
	9						[8]								
10				NSD											
	10		Below 10.0 feet, medium dense; wet; olive brown (2.5Y 4/4).	X	S04A	100	5 6 7	19					1	PA	S04A_010_012S
	11						[13]								
	12		Total Depth Drilled 11.5 Feet Boring backfilled with neat cement grout: 2 (94 lb.) bags of Portland Cement 15 gallons of water												
	13														
	14														
5															
	15														
	16														
	17														
	18														
	19														
0															
	20														

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Borehole Location: Landside Toe **County:** San Joaquin
Coordinates: **Northing:** 2,103,611.49 **Easting:** 6,340,191.81
Latitude: 37.76964 **Longitude:** -121.26625
Levee Station or Milepost: 1943+43 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
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Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED 2/12/14 **DATE COMPLETED** 2/12/14	**GROUND ELEVATION** 23.5 ft **ELEVATION DATUM** NAVD 88		**TOTAL DEPTH OF BORING** 11.5 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.	**DRILLER'S NAME** Jeremy Neff **HELPER'S NAME** Rick Ryan		**TOTAL DEPTH OF FILL** 0 ft
DRILLING METHOD HSA	**DRILL RIG MAKE AND MODEL** MARL RHINO M5		**CONSULTANT COMPANY** Kleinfelder
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6" HSA	**DRILLING ROD TYPE AND DIAMETER**		**FIELD LOGGER** G. Lenehan
[X] **VERTICAL** [ ] **INCLINED**	**CASING TYPE, DIAMETER, INSTALLATION DEPTH**		**FIELD LOG REVIEWER** H. Parsa
SAMPLER TYPE(S) SPT (1.375" I.D.)	**HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP** Auto Drop Hammer, DH 10, 140lb./30-inch drop		**HAMMER EFFICIENCY** 89%
BOREHOLE BACKFILL OR COMPLETION Neat Cement Grout	**GROUNDWATER READING:** **DURING DRILLING** 7.0 feet	**AFTER DRILLING (DATE-TIME)**	

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		SILTY SAND (SM); light olive brown (2.5Y 5/4); moist; 85% fine to medium sand; 15% fines.												
	1			NSD											
	2														
	3		Below 2.5 feet, loose.	X	S01A	83	2 3 5 [8]	12							S01A_002_004S
20	4			NSD											
	5		Poorly Graded SAND (SP); loose; light olive brown (2.5Y 5/4); moist; 97% fine to medium sand; 3% fines.	X	S02A	67	2 3 4 [7]	10					3	PA	S02A_005_007S
	6														
	7			NSD											
	8			X	S03A	89	3 5 5 [10]	15							S03A_007_009S
15	9		Below 8.5 feet, olive (5Y 4/4).	NSD											
	10		Below 10.0 feet, medium dense.	X	S04A	89	3 5 7 [12]	18					3	PA	S04A_010_012S
	11														
	12		Total Depth Drilled 11.5 Feet Boring backfilled with neat cement grout: 2 (94 lb.) bags of Portland Cement 15 gallons of water												
10	13														
	14														
	15														
	16														
	17														
5	18														
	19														
	20														

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Borehole Location: Waterside Toe **County:** San Joaquin
Coordinates: **Northing:** 2,103,337.51 **Easting:** 6,340,140.28
Latitude: 37.76889 **Longitude:** -121.26642
Levee Station or Milepost: 1942+62 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

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Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED 2/13/14 **DATE COMPLETED** 2/13/14	**GROUND ELEVATION** 22.6 ft **ELEVATION DATUM** NAVD 88	**TOTAL DEPTH OF BORING** 11.5 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.	**DRILLER'S NAME** Jeremy Neff **HELPER'S NAME** Rick Ryan	**TOTAL DEPTH OF FILL** 0 ft
DRILLING METHOD HSA	**DRILL RIG MAKE AND MODEL** MARL RHINO M5	**CONSULTANT COMPANY** Kleinfelder
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6" HSA	**DRILLING ROD TYPE AND DIAMETER**	**FIELD LOGGER** G. Lenehan
X VERTICAL ☐ **INCLINED**	**CASING TYPE, DIAMETER, INSTALLATION DEPTH**	**FIELD LOG REVIEWER** H. Parsa
SAMPLER TYPE(S) SPT (1.375" I.D.)	**HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP** Auto Drop Hammer, DH 10, 140lb./30-inch drop	**HAMMER EFFICIENCY** 89%
BOREHOLE BACKFILL OR COMPLETION Neat Cement Grout	**GROUNDWATER READING: DURING DRILLING** 7.0 feet	**AFTER DRILLING (DATE-TIME)**

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		SILTY SAND (SM); olive brown (2.5Y 4/4); moist; 70% fine to medium sand; 30% fines.												
	1			NSD											
	2														
20	3		Below 2.5 feet, loose; 82% sand; 18% fines. At 3.0 feet, 4 inch lens of Poorly Graded SAND with Silt (SP-SM).	X	S01A	89	2 2 3 [5]	7					18	PA	S01A_002_004S
	4			NSD											
	5		Below 5.0 feet, very loose.	X	S02A	89	1 2 2 [4]	6							S02A_005_007S
	6														
	7			NSD											
15	8		Poorly Graded SAND (SP); loose; light olive brown (2.5Y 5/4); wet; 96% fine to medium sand; 4% fines.	X	S03A	89	1 2 4 [6]	9					4	PA	S03A_007_009S
	9			NSD											
	10		Below 10.0 feet, medium dense.	X	S04A	100	5 5 6 [11]	16							S04A_010_012S
	11														
	12		Total Depth Drilled 11.5 Feet Boring backfilled with neat cement grout: 2 (94 lb.) bags of Portland Cement 15 gallons of water												
10	13														
	14														
	15														
	16														
	17														
5	18														
	19														
	20														

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Borehole Location: Field **County:** San Joaquin
Coordinates: Northing: 2,103,530.80 **Easting:** 6,341,622.00
Latitude: 37.76945 **Longitude:** -121.26130
Levee Station or Milepost: 1956+51 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

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Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED 2/13/14 **DATE COMPLETED** 2/13/14	**GROUND ELEVATION** 22.8 ft **ELEVATION DATUM** NAVD 88	**TOTAL DEPTH OF BORING** 11.5 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.	**DRILLER'S NAME** Jeremy Neff **HELPER'S NAME** Rick Ryan	**TOTAL DEPTH OF FILL** 0 ft
DRILLING METHOD HSA	**DRILL RIG MAKE AND MODEL** MARL RHINO M5	**CONSULTANT COMPANY** Kleinfelder
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6" HSA	**DRILLING ROD TYPE AND DIAMETER**	**FIELD LOGGER** G. Lenehan
X VERTICAL ☐ **INCLINED**	**CASING TYPE, DIAMETER, INSTALLATION DEPTH**	**FIELD LOG REVIEWER** H. Parsa
SAMPLER TYPE(S) SPT (1.375" I.D.)	**HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP** Auto Drop Hammer, DH 10, 140lb./30-inch drop	**HAMMER EFFICIENCY** 89%
BOREHOLE BACKFILL OR COMPLETION Neat Cement Grout	**GROUNDWATER READING: DURING DRILLING** 7.0 feet **AFTER DRILLING (DATE-TIME)**	

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		SILTY SAND (SM); olive brown (2.5Y 4/4); moist; 80% fine to medium sand; 20% fines.												
	1			NSD											
	2														
20	3		Below 2.5 feet, loose; 85% sand; 15% fines.	X	S01A	100	1 2 4 [6]	9					15	PA	S01A_002_004S
	4			NSD											
	5		Below 5.0 feet, very loose.	X	S02A	89	1 2 2 [4]	6							S02A_005_007S
	6														
	7			NSD											
15	8		Poorly Graded SAND with Silt (SP-SM); loose; olive brown (2.5Y 4/4); wet; 93% fine to medium sand; 7% fines.	X	S03A	83	2 3 3 [6]	9					7	PA	S03A_007_009S
	9			NSD											
	10			X	S04A	89	3 4 6 [10]	15							S04A_010_012S
	11														
	12		Total Depth Drilled 11.5 Feet Boring backfilled with neat cement grout: 2 (94 lb.) bags of Portland Cement 15 gallons of water												
10	13														
	14														
	15														
	16														
	17														
5	18														
	19														
	20														

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Borehole Location: Landside Toe **County:** San Joaquin
Coordinates: Northing: 2,103,379.25 **Easting:** 6,341,630.19
Latitude: 37.76903 **Longitude:** -121.26126
Levee Station or Milepost: 1957+26 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
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Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED	DATE COMPLETED	GROUND ELEVATION	ELEVATION DATUM	TOTAL DEPTH OF BORING
2/13/14	2/13/14	24.3 ft	NAVD 88	14.0 ft

DRILLING CONTRACTOR	DRILLER'S NAME	HELPER'S NAME	TOTAL DEPTH OF FILL
Gregg Drilling & Testing, Inc.	Jeremy Neff	Rick Ryan	0 ft

DRILLING METHOD	DRILL RIG MAKE AND MODEL	CONSULTANT COMPANY
HSA	MARL RHINO M5	Kleinfelder

DRILL BIT SIZE AND TYPE (HOLE DIAMETER)	DRILLING ROD TYPE AND DIAMETER	FIELD LOGGER
6" HSA		G. Lenehan

	CASING TYPE, DIAMETER, INSTALLATION DEPTH	FIELD LOG REVIEWER
[X] VERTICAL [ ] INCLINED		H. Parsa

SAMPLER TYPE(S)	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP	HAMMER EFFICIENCY
SPT (1.375" I.D.)	Auto Drop Hammer, DH 10, 140lb./30-inch drop	89%

BOREHOLE BACKFILL OR COMPLETION	GROUNDWATER READING: DURING DRILLING	AFTER DRILLING (DATE-TIME)
Neat Cement Grout	10.0 feet	

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		SILTY SAND (SM); dark yellowish brown (10YR 3/4); moist; 85% fine sand; 15% fines.												
	1			NSD											
	2														
	3		Below 2.5 feet, very loose; 76% fine to medium sand; 24% fines.	X	S01A	100	2 1 2 [3]	4					24	PA	S01A_002_004S
20	4			NSD											
	5			X	S02B	100	1 5 7	18							S02B_005_006S
	6		Poorly Graded SAND (SP); medium dense; olive brown (2.5Y 4/3); moist; 96% fine to medium sand; 4% fines.		S02A		[12]								S02A_006_007S
	7			NSD											
	8			X	S03A	72	3 7 6	19					4	PA	S03A_007_009S
15	9			NSD			[13]								
	10			X	S04A	100	4 6 8	21							S04A_010_012S
	11						[14]								
	12			NSD											
	13			X	S05A	100	5 7 8	22							S05A_012_014S
10	14						[15]								
	15		Total Depth Drilled 14.0 Feet Boring backfilled with neat cement grout: 3 (94 lb.) bags of Portland Cement 15 gallons of water												
	16														
	17														
	18														
	19														
5	20														

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Borehole Location: Waterside Toe **County:** San Joaquin
Coordinates: **Northing:** 2,102,989.84 **Easting:** 6,341,628.77
Latitude: 37.76796 **Longitude:** -121.26126
Levee Station or Milepost: 1959+32 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

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Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED 2/13/14 **DATE COMPLETED** 2/13/14	**GROUND ELEVATION** 26.6 ft **ELEVATION DATUM** NAVD 88		**TOTAL DEPTH OF BORING** 14.0 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.	**DRILLER'S NAME** Jeremy Neff **HELPER'S NAME** Rick Ryan		**TOTAL DEPTH OF FILL** 0 ft
DRILLING METHOD HSA	**DRILL RIG MAKE AND MODEL** MARL RHINO M5		**CONSULTANT COMPANY** Kleinfelder
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6" HSA	**DRILLING ROD TYPE AND DIAMETER**		**FIELD LOGGER** G. Lenehan
[X] **VERTICAL** [ ] **INCLINED**	**CASING TYPE, DIAMETER, INSTALLATION DEPTH**		**FIELD LOG REVIEWER** H. Parsa
SAMPLER TYPE(S) SPT (1.375" I.D.)	**HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP** Auto Drop Hammer, DH 10, 140lb./30-inch drop		**HAMMER EFFICIENCY** 89%
BOREHOLE BACKFILL OR COMPLETION Neat Cement Grout	**GROUNDWATER READING:** **DURING DRILLING** 9.5 feet	**AFTER DRILLING (DATE-TIME)**	

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		SANDY SILT (ML); light yellowish brown (2.5Y 6/3); moist; 55% no plasticity, no dry strength, rapid dilatancy, low toughness fines; 45% fine to medium sand.	NSD											
25	1														
	2														
	3		Below 2.5 feet, loose.		S01A	67	5 4 4 [8]	12					55	PA	S01A_002_004S
	4			NSD											
	5		SILT with Sand (ML); medium dense; light yellowish brown (2.5Y 6/3); moist; 80% no plasticity, no dry strength, rapid dilatancy, low toughness fines; 20% fine sand.		S02B	94	9 13 11	36							S02B_005_006S
	6				S02A										S02A_006_007S
20	7		SILT (ML); medium dense; olive brown (2.5Y 4/3); moist; 93% medium dry strength, rapid dilatancy, low toughness fines; 7% fine sand.	NSD			[24]								
	8				S03A	100	4 11 10	31		25	29	4	93 94	HD PA	S03A_007_009S
	9			NSD			[21]								
	10		Below 10.0 feet, 95% fines; 5% sand.		S04A	100	7 7 6	19		32	35	7	95 96	HD PA	S04A_010_012S
15	11														
	12			NSD			[13]								
	13		Poorly Graded SAND (SP); medium dense; light olive brown (2.5Y 5/3); wet; 95% fine to medium sand; 5% fines.		S05A	100	5 6 6	18							S05A_012_014S
	14						[12]								
	15		Total Depth Drilled 14.0 Feet Boring backfilled with neat cement grout: 3 (94 lb.) bags of Portland Cement 15 gallons of water												
10	16														
	17														
	18														
	19														
	20														

Final Report Version 2/27/2015

Borehole Location: Landside Toe **County:** San Joaquin
Coordinates: **Northing:** 2,103,211.87 **Easting:** 6,342,956.32
Latitude: 37.76860 **Longitude:** -121.25667
Levee Station or Milepost: 1972+20 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
WR0017_315A
Sheet 1 of 1

Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

DATE STARTED	DATE COMPLETED	GROUND ELEVATION	ELEVATION DATUM	TOTAL DEPTH OF BORING
2/13/14	2/13/14	26.2 ft	NAVD 88	14.0 ft

DRILLING CONTRACTOR	DRILLER'S NAME	HELPER'S NAME	TOTAL DEPTH OF FILL
Gregg Drilling & Testing, Inc.	Jeremy Neff	Rick Ryan	0 ft

DRILLING METHOD	DRILL RIG MAKE AND MODEL	CONSULTANT COMPANY
HSA	MARL RHINO M5	Kleinfelder

DRILL BIT SIZE AND TYPE (HOLE DIAMETER)	DRILLING ROD TYPE AND DIAMETER	FIELD LOGGER
6" HSA		G. Lenehan

	CASING TYPE, DIAMETER, INSTALLATION DEPTH	FIELD LOG REVIEWER
[X] VERTICAL [ ] INCLINED		H. Parsa

SAMPLER TYPE(S)	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP	HAMMER EFFICIENCY
SPT (1.375" I.D.)	Auto Drop Hammer, DH 10, 140lb./30-inch drop	89%

BOREHOLE BACKFILL OR COMPLETION	GROUNDWATER READING: DURING DRILLING	AFTER DRILLING (DATE-TIME)
Neat Cement Grout	12.0 feet	

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		SILTY SAND (SM); black (5Y 2.5/1); moist; 63% fine to medium sand; 37% fines.												
25	1			NSD											
	2														
	3		Below 2.5 feet, medium dense.		S01A	100	4 9 10 [19]	28					37	PA	S01A_002_004S
	4			NSD											
	5				S02B	100	4 9 16 [25]	37		31	NP	NP	71	HD PA	S02B_005_006S
20	6		SILT with Sand (ML); medium dense; olive brown (2.5Y 4/3); moist; 71% low dry strength, rapid dilatancy, low toughness fines; 29% fine to medium sand; moderate cementation.		S02A										S02A_006_007S
	7			NSD											
	8				S03A	100	6 13 6 [19]	28							S03A_007_009S
	9			NSD											
	10		SILTY SAND (SM); loose; olive (5Y 4/4); moist; 60% fine to medium sand; 40% fines.		S04A	100	2 2 3 [5]	7							S04A_010_012S
15	11														
	12			NSD											
	13		Poorly Graded SAND with Silt (SP-SM); loose; yellowish red (5YR 5/6); wet; 90% fine to medium sand; 10% fines.		S05A	67	3 6 4 [10]	15							S05A_012_014S
	14														
	15		Total Depth Drilled 14.0 Feet Boring backfilled with neat cement grout: 3 (94 lb.) bags of Portland Cement 15 gallons of water												
10	16														
	17														
	18														
	19														
	20														

Final Report Version 2/27/2015

Borehole Location: Waterside Toe **County:** San Joaquin
Coordinates: Northing: 2,103,029.86 **Easting:** 6,342,892.31
Latitude: 37.76810 **Longitude:** -121.25689
Levee Station or Milepost: 1973+11 **Levee Mile:**
Levee Segment Walthall Slough
Survey Method: GPS **Coord. System:** CA State Plane Zone III
Channel / River Name / Feature: Walthall Slough

LOG OF BORING
WR0017_316A
Sheet 1 of 1

Engineering Support Services Urban Levee Geotechnical Evaluations Program

DWR LEVEE U/NU SOIL LOG REV1; WALTHAL BORINGS.GPJ; DWR OFFICIAL LIBRARY 02032014.GLB; 2/27/15

ATTACHMENT 3

Environmental Constraints Analysis, Manteca Dryland Levee Project

ENVIRONMENTAL CONSTRAINTS ANALYSIS

MANTECA DRYLAND LEVEE PROJECT

January 2022

Prepared for

San Joaquin Area Flood Control Agency (SJAFCA)

California Department of Water Resources (DWR)

Prepared by

WOOD RODGERS

BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

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Table of Contents

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List of Abbreviations

APE	Area of Potential Effects
BMPs	Best Management Practices
BSA	Biological Study Area
CAA	Clean Air Act
CARB	California Air Resources Board
CDC	California Department of Conservation
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CEQA	California Environmental Quality Act
City	City of Manteca
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CWA	Clean Water Act
District	San Joaquin Valley Air Pollution Control District
FESA	Federal Endangered Species Act
GHG	Greenhouse Gases
MBTA	Migratory Bird Treaty Act
NAAQS	National Ambient Air Quality Standards
NAHC	Native American Heritage Commission
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
OHP	Office of Historic Preservation
RWQCB	Regional Water Quality Control Board
SHPO	State Historic Preservation Office
SHTAC	Swainson's Hawk Technical Advisory Committee
SIP	State Implementation Plan
SWRCB	State Water Resources Control Board
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

1.0 Introduction

1.1 Project Background / History

In 2014, to achieve 200-year flood protection, and to demonstrate "adequate progress", the cities of Lathrop and Manteca jointly funded agreements with Peterson Brustad Inc. (PBI) to provide 200-year water surface profiles in the San Joaquin River, develop 200-year floodplains (and depths), complete Urban Levee Design Criteria (ULDC) Analysis and Identification of Deficiencies required to provide an urban level of flood protection (ULOP) for Reclamation District 17 (RD 17) levees within their respective cities. These efforts provided Lathrop and Manteca with the critical information necessary to make a "finding of adequate progress" (Adequate Progress) toward providing ULOP 200-year flood protection for the urbanized and urbanizing areas of the cities.

On July 5, 2016, the Manteca City Council adopted the Findings of Adequate Progress toward providing a 200-year ULOP in RD 17. As part of this effort, PBI developed a multi-phase levee improvement plan, which included the extension of the dry land levee in the southern portion of Manteca. A preliminary alignment was developed for the dry land levee extension and Adequate Progress Findings that extended the dry land levee to the east. Although this alignment achieves the project goal of providing 200-year flood protection, there were a number of concerns from property owners in the vicinity of the proposed improvements.

In response to these concerns, the Manteca City Council approved a Professional Services Agreement with Drake Haglan and Associates. The scope of work for this contract included public outreach, project management, and developing conceptual alignments for the purpose of working with stakeholders to build consensus on the preferred alignment for the dry land levee extension.

Drake Haglan and Associates developed seven alternatives for evaluation based upon the following criteria:

- Meets Department of Water Resources criteria for "wise use of floodplains"
- Minimize impacts to farmland
- Minimize impacts to property owner access
- Stay on property lines as much as possible
- Utilize existing easements
- Accommodate entitled properties
- Consensus among stakeholders
- Cost

The final recommended alternative (called Alternative 2A) met all criteria with a projected cost of approximately $12.1 million at the time of the recommendation (2016). Other alternatives that were explored in that study were deemed either non-compliant or cost prohibitive.

In 2018 the Cities of Lathrop and Manteca became members of SJAFCA. As a result, SJAFCA became the sole Local Flood Management Agency (LFMA) for the Mossdale Tract area (area protected by RD 17 levees) with the responsibility to prepare the adequate progress report. Most recently, in June 2019, Larsen Wurzel & Associates prepared the "Mossdale Tract Area: 2019 Annual Adequate Progress Report for Urban Level of Protection Final Report" the "APR" which is available on SJAFCA's website (https://www.sjafca.com/pdf/mossdale/Report0418.pdf). It has been determined the existing levees protecting the Mossdale Tract Area do not meet the updated Department of Water Resources (DWR) ULDC standards adopted in May 2012, and the existing levees are not currently certified to provide 200-year protection. Accordingly, SJAFCA, in close coordination with its member agencies, is pursuing efforts to achieve ULOP by 2025.

The LFMA's plan, described in the APR, for flood protection through the year 2025 consists of two components: (1) RD 17's ongoing Levee Seepage Repair Project (LSRP) and (2) SJAFCA Levee Improvements to achieve ULDC 200-year requirements, which includes an extension of the existing dry land levee.

A review of the (i) project scope, (ii) project schedule, and (iii) the cost of the previously developed alternatives, all as proposed in 2016, demonstrates that they were developed to meet the appropriate standard of protection based on information known at that time. During this last year, information has been shared by the State of California regarding

potential changes in hydraulics and hydrology due to climate change. That information is being considered to determine what changes, if any, need to be made to the previously explored alternatives to ensure that they continue to meet the appropriate standard of protection. This is expected to involve the consideration of one or more new alternative alignments in combination with some of the alternatives already studied.

1.2 Purpose and Need

The project purpose is to build an extension of the dry land levee in the southern portion of Manteca.

The project is needed to achieve ULDC 200-year requirements for the RD 17 levees within their respective cities.

1.3 Alternatives

This document identifies the preliminary constraints in the study area that may directly or indirectly affect alignment options under consideration. Numerous potential alignments for the project were considered by the project development team. Accordingly, SJAFCA, in close coordination with its member agencies, is pursuing efforts to achieve ULOP by 2025 and has selected the preferred alternatives which are discussed below. An exhibit showing the alignment alternatives is included in **Figure 1**.

1.3.1 Preferred Alternatives

The following is a description of the current preferred alternatives under consideration:

Alternative 1C
This alternative consists of a levee embankment with a top elevation of 37.5 feet west of Airport Way and 35.5 feet east of Airport way. The levee embankment follows Alignment 1, which begins at the termination point of the existing dryland levee and extends east, jogging north as necessary to minimize real estate impacts, and ending at the high ground located at Tinnin Road. This results an approximate total length of levee embankment of 8,700ft.

To account for seepage mitigation, this alternative includes a soil-bentonite cutoff wall with an approximate depth of 85 feet from existing ground. This cutoff wall will run from the beginning of new levee embankment (at the termination of the existing dryland levee) and end where the hydraulic loading of the levee is less than two feet, which is between Oleander Avenue and Union Road, for a total cutoff wall length of 4,700 feet.

This alternative will also require raising of the roads which it crosses in order to being them up to the top of levee elevation. Airport Way, Oleander Avenue, and Union Road will all require raising under this alternative.

Modifications to existing irrigation supply infrastructure will also be required where crossings exist. This alternative proposes to install positive closure structures and devices at each one of these crossings, of which two are expected for this alternative.

A graphical depiction of this alternative is included as **Figure 2**.

Alternative 1S
This alternative consists of a levee embankment with a top elevation of 37.5 feet west of Airport Way and 35.5 feet east of Airport way. The levee embankment follows Alignment 1, which begins at the termination point of the existing dryland levee and extends east, jogging north as necessary to minimize real estate impacts, and ending at the high ground located at Tinnin Road. This results an approximate total length of levee embankment of 8,700ft.

To account for seepage mitigation, this alternative includes a 100-foot wide, five-foot-tall (at the landside levee toe) seepage berm. This seepage berm will run from the beginning of new levee embankment (at the termination of the existing dryland levee) and end where the hydraulic loading of the levee is less than two feet, which is between Oleander Avenue and Union Road, for a total berm length of 4,700 feet.

This alternative will also require raising of the roads which it crosses in order to being them up to the top of levee elevation. Airport Way, Oleander Avenue, and Union Road will all require raising under this alternative.

Modifications to existing irrigation supply infrastructure will also be required where crossings exist. This alternative proposes to install positive closure structures and devices at each one of these crossings, of which two are expected for this alternative.

A graphical depiction of this alternative is included as **Figure 3**.

Alternative 2C
This alternative consists of a levee embankment with a top elevation of 37.5 feet west of Airport Way and 35.5 feet east of Airport way. The levee embankment follows Alignment 2, which begins at station 853+50 of the existing dryland levee, continuing eastward to Airport Way and then jogging north-east to avoid impacts to the residences on Fig Avenue. The alignment then continues east until turning south-east and tying into high ground near the intersection of Fig Avenue and Union Road. This results an approximate total length of levee embankment of 12,100 feet.

To account for seepage mitigation, this alternative includes a soil-bentonite cutoff wall with an approximate depth of 85 feet from existing ground. This cutoff wall will run from the beginning of new levee embankment (at station 853+50 of the existing dryland levee) and end where the hydraulic loading of the levee is less than two feet, which was found to be at the intersection with Oleander Avenue, for a total cutoff wall length of 9,200 feet.

This alternative will also require raising of the roads which it crosses in order to being them up to the top of levee elevation. Airport Way and Oleander Avenue will require raising under this alternative.

Modifications to existing irrigation supply infrastructure will also be required where crossings exist. This alternative proposes to install positive closure structures and devices at each one of these crossings, of which one is expected for this alternative. Relocation of an existing drainage ditch will also be required east of Airport Way. This ditch will be relocated south of the new levee embankment, tying into the existing ditch at both the upstream and downstream ends.

A graphical depiction of this alternative is included as **Figure 4**.

Alternative 2S
This alternative consists of a levee embankment with a top elevation of 37.5 feet west of Airport Way and 35.5 feet east of Airport way. The levee embankment follows Alignment 2, which begins at station 853+50 of the existing dryland levee, continuing eastward to Airport Way and then jogging north-east to avoid impacts to the residences on Fig Avenue. The alignment then continues east until turning south-east and tying into high ground near the intersection of Fig Avenue and Union Road. This results an approximate total length of levee embankment of 12,100 feet.

To account for seepage mitigation, this alternative includes a 100-foot wide, five-foot-tall (at the landside toe) seepage berm. This seepage berm will run from the beginning of new levee embankment (at station 853+50 of the existing dryland levee) and end where the hydraulic loading of the levee is less than two feet, which was found to be at the intersection with Oleander Avenue, for a total berm length of 9,200 feet.
This alternative will also require raising of the roads which it crosses in order to being them up to the top of levee elevation. Airport Way and Oleander Avenue will require raising under this alternative.
Modifications to existing irrigation supply infrastructure will also be required where crossings exist. This alternative proposes to install positive closure structures and devices at each one of these crossings, of which one is expected for this alternative. Relocation of an existing drainage ditch will also be required east of Airport Way. This ditch will be relocated south of the new levee embankment, tying into the existing ditch at both the upstream and downstream ends.

A graphical depiction of this alternative is included as **Figure 5**.

1.4 Preliminary Array of Alternatives

In the preliminary stages of this analysis, a preliminary array of alternatives was developed; and as the study progressed, it was determined that some of the alternatives should not be included in the detailed analysis because it

was clear that they would not meet Project objectives by simple inspection. Below is a brief description of each alternative that was considered as part of the preliminary array but was not ultimately included in the detailed constraints analysis.

No Action Alternative
As the name implies, this alternative proposes that no action be taken. This alternative was not included because it does not provide the level of protection required by the ULDC and therefore would not be acceptable to the project stakeholders.

Drake Haglan Alt 2A Alignment
The Drake Haglan Alt 2A alignment was screened out because the alignment results in approximately the same length of new embankment as Alt 2 but does not have the benefit of removing any existing levee from service. This would result in a similar construction cost to the Alt 2 alignments but would provide lesser benefit and was therefore screened out of the analysis effort.

Other Drake Haglan Alternatives
The remaining alternatives from the Drake Haglan study were reviewed and found to be infeasible due to obvious issues with cost, wise use of the floodplain, stakeholder support, or one of the other criteria with which the alternatives were to be evaluated. As such, it was found to be unnecessary to bring these alternatives forward.

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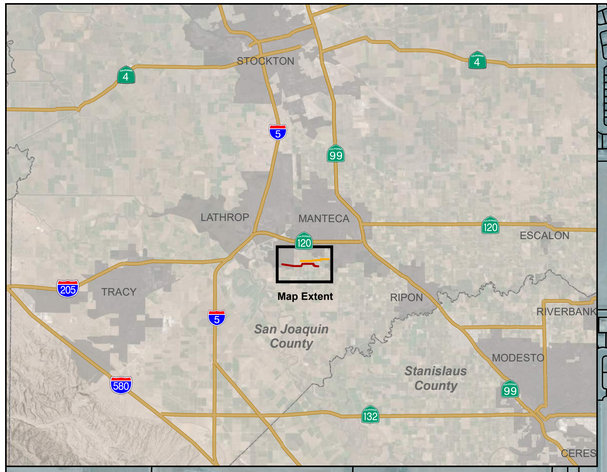

FIGURE 1

ALIGNMENT ALTERNATIVES

MANTECA DRYLAND LEVEE

CITY OF MANTECA, CA

OCTOBER 2021

Legend

- Alternative 1
- Alternative 2
- Existing RD 17 Levee

Current 200 Year Flood Depth

- <1ft
- 1ft - 3ft
- >3ft
- Future 200yr Flood Extent

0 250 500 1,000

Feet

NORTH

WOOD RODGERS

ETTLE ST
SALLMON LN
TOY ST
CALIMBRA LN
TOLBERT AV
OLEANDER AV
MACEDO ST
AL FONSECA LN
BROCCHINI LN
CRUZ ST
LAVENDER ST
PEACH AV
PEACH AV
241-32-018
226-02-001
226-02-002
226-02-011
226-03-001
224-02-245
224-02-207
224-02-208
241-33-004
241-33-022
226-02-014
226-03-005
226-10-025
226-02-029
241-33-021
226-02-031
226-03-002
226-03-003
226-03-007
226-02-013
226-03-006
226-10-026
226-02-032
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226-03-008
241-33-005
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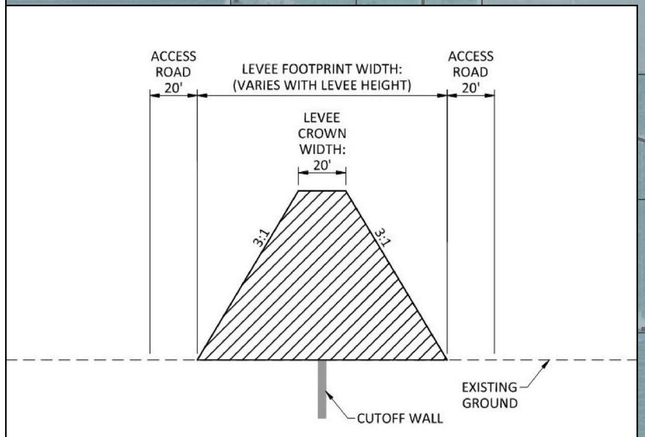
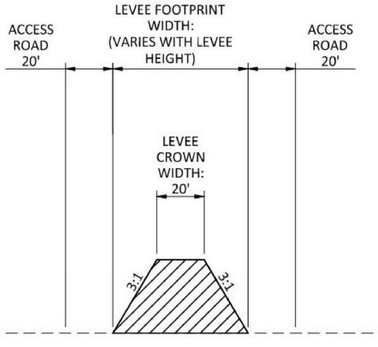
226-03-009
226-03-019
226-02-017
226-02-019
226-02-020
226-02-021
226-02-025
226-02-027
226-02-028
226-03-010
226-03-011
226-03-012
226-03-013
226-03-016
241-33-034
AIRPORT WY
FIG AV
OLEANDER AV
UNION RD
TINNIN RD
NILE AV
A - A
B - B
10+00
15+00
20+00
25+00
30+00
35+00
40+00
45+00
50+00
55+00
60+00
65+00
70+00
80+00
85+00
90+00
95+00
TIE IN TO EXISTING LEVEE
CUTOFF WALL MITIGATION TERMINATES WHERE HYDRAULIC LOADING IS LESS THAN 2'
MODIFICATION TO SSJID PIPE REQUIRED TO ADD POSITIVE CLOSURE ON EACH SIDE OF CROSSING
MODIFICATION TO SSJID PIPE REQUIRED TO ADD POSITIVE CLOSURE ON EACH SIDE OF CROSSING
TIE IN TO HIGH GROUND (ABOVE CURRENT 200 YEAR FLOODPLAIN)



TYPICAL CROSS SECTION A-A

NOT TO SCALE
VERTICAL EXAGGERATION: 5X



TYPICAL CROSS SECTION B-B

NOT TO SCALE
VERTICAL EXAGGERATION: 5X

FIGURE 2
ALTERNATIVE 1-C
CUTOFF WALL
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
OCTOBER 2021

Legend

- Levee Centerline
- Levee Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Parcel

SSJID Facilities

- Drainage Ditch
- Supply Pipeline

Current 200 Year Flood Depth

- <1ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

0 200 400 800
Feet

NORTH

WOOD RODGERS

MAIDEN GRASS AV
GARY OWENS ST
MAEHL DR
AL FONSECA LN
LOVEJOY AV
PACOLA AV
MACEDO ST
BROCCHINI LN
CRUZ ST
SEPHOS ST
LAVENDER ST
DELTAVIEW ST
PEACH AV
PEACH AV
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241-33-004
241-33-022
241-33-021
241-33-005
226-02-001
226-02-002
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226-02-014
226-02-013
226-02-015
226-02-016
226-03-001
226-03-002
226-03-003
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226-03-005
226-03-006
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224-02-245
226-10-025
226-10-026
226-10-001
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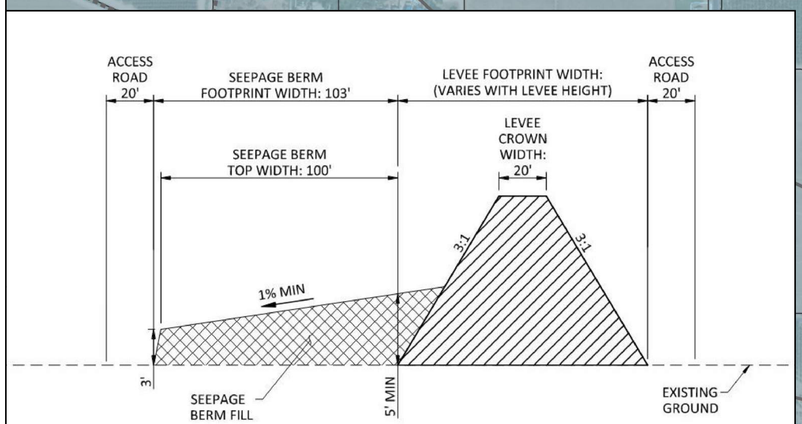
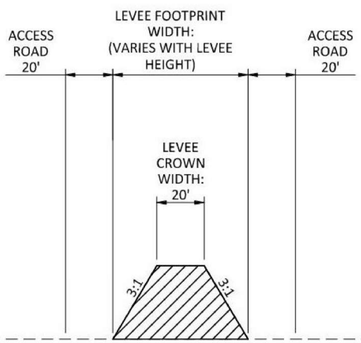
20+00
25+00
30+00
35+00
40+00
45+00
50+00
55+00
60+00
65+00
70+00
80+00
85+00
90+00
95+00
A - A
B - B
AIRPORT WY
OLEANDER AV
FIG AV
NILE AV
UNION RD
TINNIN RD
TIE IN TO HIGH GROUND (ABOVE CURRENT 200 YEAR FLOODPLAIN)
MODIFICATION TO SSJID PIPE REQUIRED TO ADD POSITIVE CLOSURE ON EACH SIDE OF CROSSING
MODIFICATION TO SSJID PIPE REQUIRED TO ADD POSITIVE CLOSURE ON EACH SIDE OF CROSSING
TIE IN TO EXISTING LEVEE
SEEPAGE MITIGATION TERMINATES WHERE HYDRAULIC LOADING IS LESS THAN 2'



TYPICAL CROSS SECTION A-A
NOT TO SCALE
VERTICAL EXAGGERATION: 5X



TYPICAL CROSS SECTION B-B
NOT TO SCALE
VERTICAL EXAGGERATION: 5X

FIGURE 3
ALTERNATIVE 1-S
SEEPAGE BERM
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
OCTOBER 2021

Legend

- Levee Centerline
- Levee Footprint
- Seepage Berm Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Parcel

SSJID Facilities
- Drainage Ditch
- Supply Pipeline

Current 200 Year Flood Depth
- <ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

0 200 400 800
Feet

NORTH

WOOD RODGERS

MCKINLEY AV

DELTAVIEW ST

AIRPORT WAY

PEACH AV

OLEANDER AV

MACEDO ST

BROCCHINI LN

GAMBRA LN

MAEHL DR

A FONSECA LN

CRUZ ST

LOVEJOY AV

SAFFRON DR

UNION RD

FIG AV

NILE AV

241-24-002

241-33-033

241-33-032

241-33-005

241-33-034

226-02-031

226-02-032

226-02-030

226-02-013

226-02-015

226-02-016

226-02-017

226-02-019

226-02-020

226-02-021

226-02-025

226-02-027

226-02-028

226-03-007

226-03-008

226-03-009

226-03-010

226-03-011

226-03-012

226-03-013

226-03-016

226-03-018

226-03-019

TIE IN TO EXISTING LEVEE

DITCH TO BE RELOCATED SOUTH OF LEVEE

PIPE TO BE REMOVED

CUTOFF WALL MITIGATION TERMINATES WHERE HYDRAULIC LOADING IS LESS THAN 2'

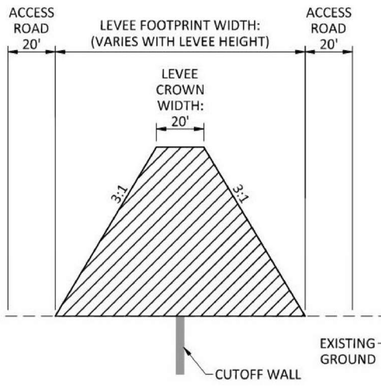
MODIFICATION TO SSJID PIPE REQUIRED TO ADD POSITIVE CLOSURE ON EACH SIDE OF CROSSING

TIE IN TO HIGH GROUND (ABOVE CURRENT 200 YEAR FLOODPLAIN)

10+00 15+00 20+00 25+00 35+00 40+00 45+00 50+00 55+00 60+00 65+00 70+00 75+00 80+00 85+00 90+00 95+00 100+00 105+00 110+00 115+00 120+00 125+00 130+00

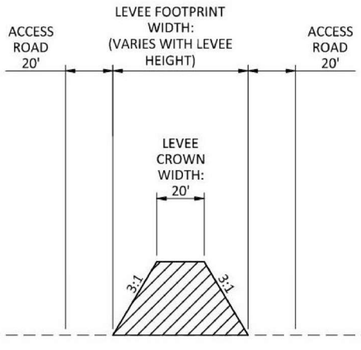
A - A

B - B



TYPICAL CROSS SECTION A-A

NOT TO SCALE
VERTICAL EXAGGERATION: 5X



TYPICAL CROSS SECTION B-B

NOT TO SCALE
VERTICAL EXAGGERATION: 5X

FIGURE 4

ALTERNATIVE 2-C

CUTOFF WALL
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
OCTOBER 2021

Legend

- Levee Centerline
- Levee Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Parcel
- Private Irrigation Pipe

SSJID Facilities

- Drainage Ditch
- Supply Pipeline
- Drainage Ditch Reroute

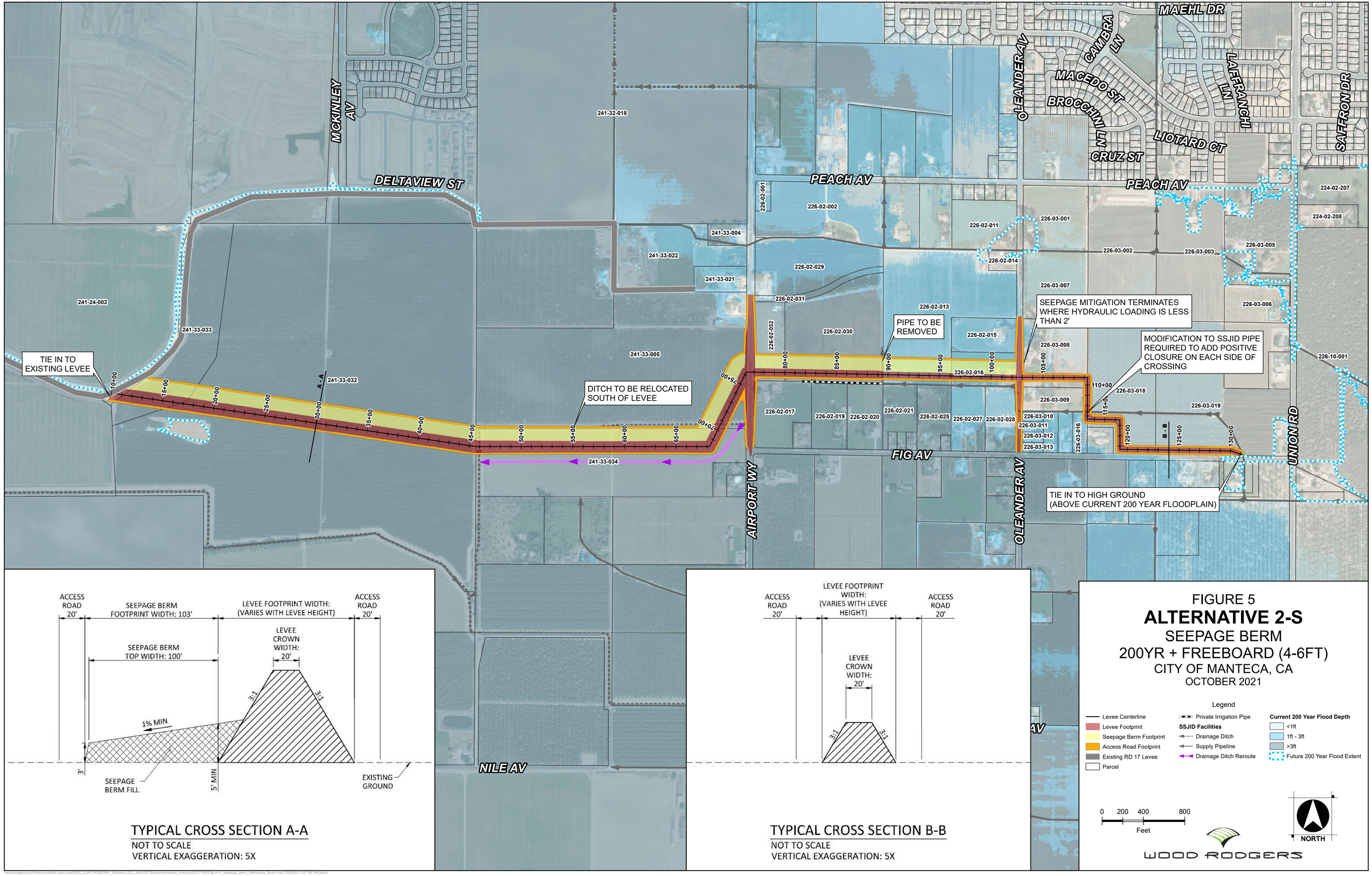
Current 200 Year Flood Depth

- <ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

0 200 400 800
Feet

NORTH

WOOD RODGERS



TYPICAL CROSS SECTION A-A

NOT TO SCALE
VERTICAL EXAGGERATION: 5X

TYPICAL CROSS SECTION B-B

NOT TO SCALE
VERTICAL EXAGGERATION: 5X

FIGURE 5
ALTERNATIVE 2-S
SEEPAGE BERM
200YR + FREEBOARD (4-6FT)
CITY OF MANTECA, CA
OCTOBER 2021

Legend

- Levee Centerline
- Levee Footprint
- Seepage Berm Footprint
- Access Road Footprint
- Existing RD 17 Levee
- Parcel
- Private Irrigation Pipe

SSJID Facilities

- Drainage Ditch
- Supply Pipeline
- Drainage Ditch Reroute

Current 200 Year Flood Depth

- <1ft
- 1ft - 3ft
- >3ft
- Future 200 Year Flood Extent

0 200 400 800
Feet

NORTH

WOOD RODGERS

2.0 Research Methods

2.1 Environmental Constraints Analysis Methodology

A desktop analysis was performed in order to determine potential environmental constraints associated with the implementation of each of the four alternatives. Criteria from Appendix G (Initial Study Checklist) of the California Environmental Quality Act (CEQA) Guidelines was used as a framework to evaluate impacts on different resource areas and was also used as a means to determine what level of CEQA documentation would be required for the proposed project.

The results of that analysis are provided in Chapter 3 of this report, and a summary of potential environmental constraints is provided in Chapter 4. A regulatory consistency analysis was also performed for the proposed project to determine the alternatives' conformance to relevant federal, state, and local regulations under each of the evaluated resource areas. Primary data sources used during the desktop analysis include the following:

- San Joaquin County General Plan and Final Environmental Impact Report (EIR)
- San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (SJMSCP)
- City of Manteca General Plan 2023 (2003)
- City of Manteca Draft General Plan Update and Draft EIR (March 2021)
- California Department of Conservation Farmland Mapping and Monitoring Program
- California Department of Conservation Williamson Act Maps
- California Department of Fish and Wildlife – California Natural Diversity Database
- California Department of Forestry and Fire Protection (CALFIRE) Hazard Severity Zone Maps
- California Department of Toxic Substances (DTSC) EnviroStor Database
- California Department of Transportation Scenic Highway Maps
- California Native Plant Society – Inventory of Rare and Endangered Plants of California
- California State Water Resources Control Board GeoTracker Database
- Feather River Air Quality Management District – *Indirect Source Review Guidelines*
- U.S. Fish and Wildlife Service - Critical Habitat Mapper
- U.S. Fish and Wildlife Service – Information for Planning and Consultation Website
- U.S. Fish and Wildlife Service – National Wetlands Inventory Wetlands Mapper
- California Air Resources Control Board
- Federal Emergency Management Agency – Flood Insurance Rate Maps

2.2 Biological Resources Analysis Methodology

A desktop review was undertaken to assess potential biological constraints within the vicinity of the preferred alignment alternatives (**Figure 6**), which included two steps to collect data on special-status species, vegetation communities, sensitive communities, protected lands, and federally protected aquatic resources with the potential to occur in the project area. First, preliminary database searches were performed to identify aquatic resources and special-status species with the potential to occur in the project area. Second, a preliminary review of recent aerial imagery and land use maps was conducted to collect site-specific data regarding habitat suitability for special-status species, and to see if any protected lands overlap with the project area. Database searches were performed on the following websites:

- U.S. Fish and Wildlife Service's (USFWS) Information Planning and Consultation (IPaC) System (2021a); USFWS Critical Habitat Portal (2021b);
- California Department of Fish and Wildlife (CDFW) California Natural Diversity Database (CNDDB)
- California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants of California
- USFWS National Wetland Inventory
- USFWS National Wetland Inventory (2021c)
- U.S. Geological Survey (USGS) topographical map

A query of the USFWS's IPaC system was performed to identify federally listed species that may occur in or adjacent to the project area. A review of the USFWS's Critical Habitat portal was also conducted to identify designated critical habitat units that fall within the project area. A query of the CNDDB provided a list of processed and unprocessed special-status species occurrences within the Lathrop and Manteca U.S. Geological Survey 7.5-minute quadrangle, as well as all adjacent quads. Additionally, the CNPS database was queried to identify special-status plant species with the potential to occur in the aforementioned quads. Finally, USFWS National Wetland Inventory data and USGS topographical maps were used to aid in the digitization of vegetation communities and potential aquatic resources within the project area. The raw data returned from the database queries is provided in Appendix A. In addition to the database queries, a review of land ownership layers in CNDDB BIOS was conducted to locate protected lands, including wildlife refuges and conservation easements.

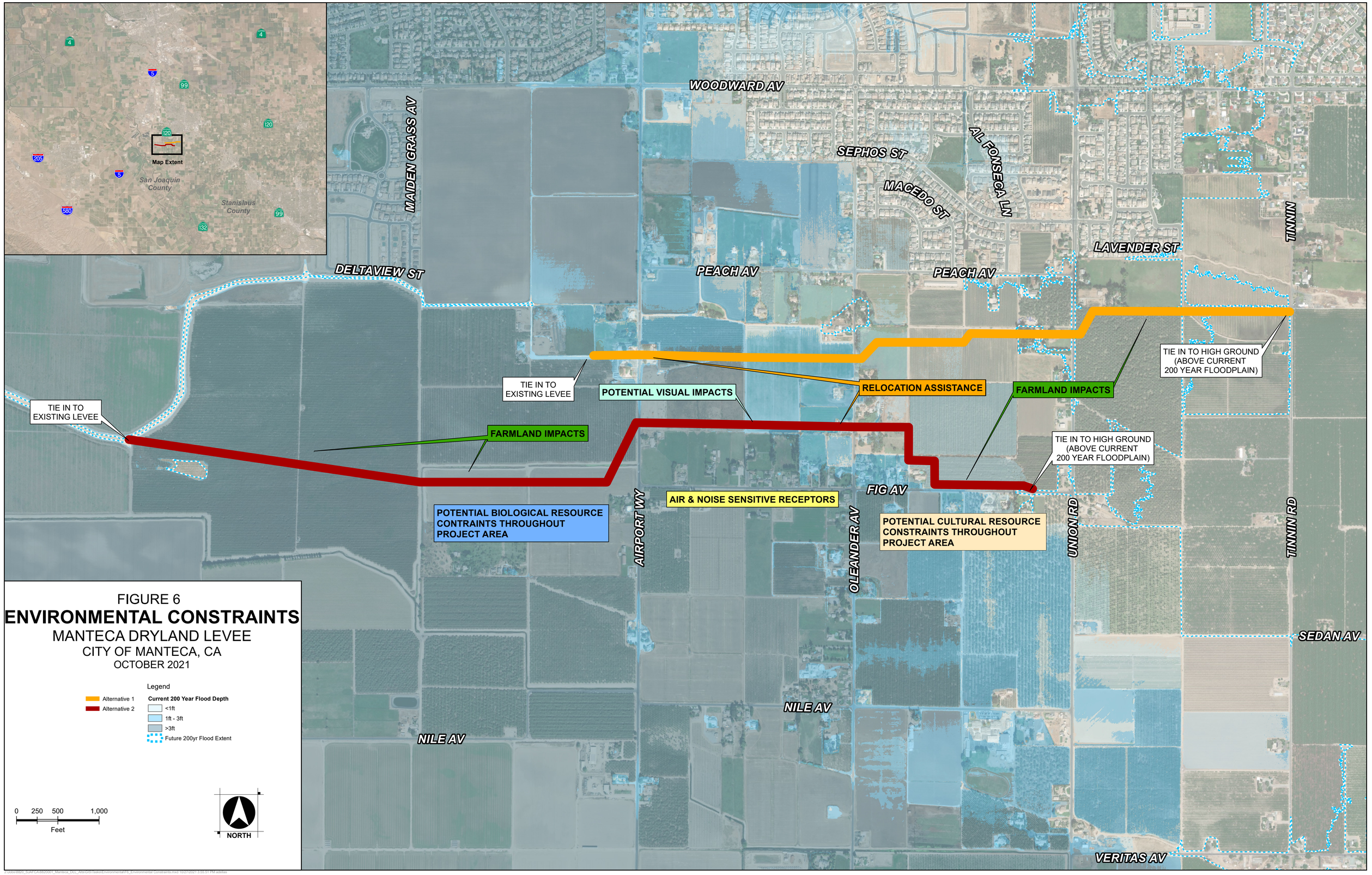


FIGURE 6

ENVIRONMENTAL CONSTRAINTS

MANTECA DRYLAND LEVEE

CITY OF MANTECA, CA

OCTOBER 2021

Legend

- Alternative 1
- Alternative 2

Current 200 Year Flood Depth

- <1ft
- 1ft - 3ft
- >3ft
- Future 200yr Flood Extent

0 250 500 1,000

Feet

NORTH

J:\Jobs\8820_SJAFCA\8820001_Manteca_DLL_Alts\GIS\Task\Environmental\F6_Environmental Constraints.mxd 10/27/2021 3:55:51 PM adellas

3.0 Results: Environmental Resource Category Analysis

The following sections include an analysis of physical, biological, social, and economic factors that may cause environmental impacts associated with project implementation. Environmental constraints associated with this project are shown in Figure 2.

3.1 AESTHETICS

CONSTRAINTS DISCUSSION

There are no designated scenic vistas or scenic highways located within or near to the preferred alternatives project vicinity. However, implementation of the proposed project may alter or degrade existing visual character of the area for rural residential user groups. The project would occur within a non-urbanized area and may cause substantial changes to views for residences along Airport Way, Fig Road, and/or Oleander Avenue due to construction of the proposed project.

RECOMMENDATIONS

The project would have the potential to substantially change aesthetics and visual resources within the preferred alternatives project area, due to vegetation removal and placement of the elevated levee prism. Specific impacts by the proposed project should be evaluated individually during the environmental document phase when a greater certainty of the limits of project construction, vegetation removal, and preliminary design is known. Should substantive visual impacts be necessary, suitable mitigation in the form of on-site replanting, viewsheds, or similar landscape efforts would be available. Therefore, it is recommended that additional analysis and documentation be completed to determine the extent of visual impacts and affected viewer groups due to implementation of the proposed project's build alternative. The analysis of the project effects to visual resource should be included in the project's environmental document.

3.2 AGRICULTURE AND FOREST RESOURCES

CONSTRAINTS DISCUSSION

Land use within the project vicinity is designated by the City of Manteca (City) General Plan (2003) as Very Low Density Residential (VLDR), Low Density Residential (LDR), Open Space (OS), Public/Quasi Public (PQP) and Urban Reserve-Agriculture (UR-AG). Currently, the City is in the process of updating its General Plan and some land use designations may change during this process. According to the California Department of Conservation (CDC), Division of Land Resource Protection, Farmland Mapping and Monitoring Program (FMMP), San Joaquin County Important Farmland Map 2018, the preferred alternatives would fall within the follow farmland categories: Prime Farmland, Farmland of Statewide Importance, and Rural Residential Land. No designated forest lands, timberland, or timberland zoned for timberland production are located within the City.

The preferred alternative alignments would fall within areas designated by the CDC as Prime Farmland, and Farmland of Statewide Importance. However, according to the San Joaquin Valley Gateway (2015), no Williamson Act Parcels are found within the preferred alternative alignments. Under the City General Plan Policy RC-P-30, the City will participate in the county-wide program to mitigate for conversion of Prime Farmland or Farmland of Statewide Importance farmland resources. Under Chapter 9-1080 of the San Joaquin County Municipal Code, any rezoning of agricultural areas to non-agricultural uses would require agricultural mitigation.

Additionally, the federal Farmland Protection Policy Act (FPPA), requires federal agencies to examine the impact of the programs or projects before they can approve any activity that would convert farmland. If federal funding is used for the proposed project, the federal agency or agencies using federal funding would be subject to the FPPA and would be required to complete a Farmland Conversion Impact Rating Form (form AD-1006).

RECOMMENDATIONS

The proposed project is expected to require permanent ROW acquisitions and would have the potential for permanent conversion of Prime Farmland and Farmland of Statewide Importance to non-agricultural use. Under San Joaquin County Code, these effects to agricultural resources would require compensatory mitigation to reduce project effects to a less than significant level. Therefore, it is recommended that additional analysis of project effects to farmland resources be conducted at the time a preferred build alternative is chosen. If federal funding is acquired for the project, a Farmland Conversion Impact Rating Form should be completed consistent with the FPPA, and submitted to the local Natural Resource Conservation Service for federal approval of the project's level of effect to farmland resources. All analysis of project effects to farmland resources should then be included in the project's environmental document.

3.3 AIR QUALITY

CONSTRAINTS DISCUSSION

Federal Regulations
The Clean Air Act (CAA) as amended in 1990 is the federal law that governs air quality. Its counterpart in California is the California Clean Air Act of 1988. These laws set standards for the quantity of pollutants that can be in the air. At the federal level, these standards are called National Ambient Air Quality Standards (NAAQS). Standards have been established for six criteria pollutants that have been linked to potential health concerns; the criteria pollutants are: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), lead (Pb), and sulfur dioxide (SO_2).

State Regulations
Responsibility for achieving California's air quality standards, which are more stringent than federal standards, is placed on the California Air Resources Board (CARB) and local air districts, and is to be achieved through district-level air quality management plans that will be incorporated into the State Implementation Plan (SIP). In California, the EPA has delegated authority to prepare SIPs to the CARB, which, in turn, has delegated that authority to individual air districts.

The CARB has traditionally established state air quality standards, maintaining oversight authority in air quality planning, developing programs for reducing emissions from motor vehicles, developing air emission inventories, collecting air quality and meteorological data, and approving state implementation plans.

Responsibilities of air districts include overseeing stationary source emissions, approving permits, maintaining emissions inventories, maintaining air quality stations, overseeing agricultural burning permits, and reviewing air quality–related sections of environmental documents required by CEQA.

The CARB is required to designate areas of the state as attainment, non-attainment, or unclassified for any state standard. An "attainment" designation for an area signifies that pollutant concentrations do not violate the standard for that pollutant in that area. A "non-attainment" designation indicates that a pollutant concentration violated the standard at least once within a calendar year. The area air quality attainment status of San Joaquin County is shown on Table 1.

Local Regulations
The project, located within San Joaquin County, is in the San Joaquin Valley Air Basin and is subject to the San Joaquin Valley Air Pollution Control District (SJVAPC District) requirements and regulations.

Table 1: NAAQS and CAAQS Attainment Status for San Joaquin County

Pollutant	Designation/Classification	
	Federal Standards	State Standards
Ozone – 8-Hour	Nonattainment	Nonattainment
PM_{10}	Attainment	Nonattainment
$PM_{2.5}$	Nonattainment	Nonattainment

Pollutant	Designation/Classification	
	Federal Standards	State Standards
Carbon Monoxide	Unclassified/Attainment	Attainment
Nitrogen Dioxide	Unclassified/Attainment	Attainment
Sulfur Dioxide	Unclassified/Attainment	Attainment
Sulfates	No Federal Standard	Attainment
Lead	Unclassified/Attainment	Attainment
Hydrogen Sulfide	No Federal Standard	Unclassified
Visibility Reducing Particles	No Federal Standard	Unclassified
Sources: CARB 2018		

As a levee project, the operation of the completed project is not anticipated to contribute to air quality impacts. However, construction activities associated with the project would result in temporary incremental increases in air pollutants, such as ozone precursors and particulate matter due to operation of gas-powered equipment and earth moving activities. The District has adopted CEQA thresholds of significance for criteria pollutants including thresholds for construction. The project would be required to maintain air quality effects within the District thresholds of significance or would be required to provide effective mitigation measures to reduce air quality effects to a less than significant level. The District has also developed the "Land-Use Design Elements and Mitigation Measures" table to help in application of suitable mitigation measures based upon project type.

RECOMMENDATIONS

The project is not anticipated to cause operational long-term air quality impacts; however, the project would cause temporary incremental emissions from construction. Therefore, additional air quality analyses for construction air quality effects consistent with the District air quality thresholds of significance would be necessary to determine whether mitigation measures would be necessary to reduce potentially significant effects to a less than significant level. It is anticipated that if any potentially significant effects would occur, they could be reduced to a less than significant level. All additional analysis and documentation will be included within the project's environmental document.

3.4 BIOLOGICAL RESOURCES

CONSTRAINTS DISCUSSION

Numerous sensitive biological resources are present within the preferred alternatives project area. This section provides an overview of vegetation communities and sensitive biological resources that occur or have the potential to occur within the within and immediately surrounding the preferred alternatives vicinity.

The project is located in the City of Manteca, San Joaquin County in the California Dry Steppe Province ecological subregion, Great Valley Section, and ecological subsections Sodic Claypan Terraces and Manteca-Merced Alluvium of California (USDA 2007).

Vegetation Communities
The BSA is dominated by developed agricultural landscape and rural-residential disturbed/ruderal habitats. Land cover and vegetation communities within the BSA area designated as: barren, urban, disturbed/ruderal, annual grassland, orchard/vineyard, cropland, and irrigation ditch. No natural drainages, water features, wetlands, or associated riparian habitats occur within the preferred alternatives project area.

Barren
Barren habitat are man-made infrastructures and are defined by the absence of any vegetation. Any habitat with <2% total vegetation cover by herbaceous, desert, or non-wildland species and <10% cover by tree or shrub species would be considered barren habitat (CDFW 1988). Urban habitat within the BSA consists of the roadways, gravel roadside shoulders, sidewalk, curbs, and gutters.

Urban
Urban habitats have a variety of vegetation structure and is generally categorized as five types of vegetation areas: tree grove, street strip, shade tree/lawn, lawn, and shrub cover. Urban habitat within the BSA consists of rural-residential lots composed of ornamental planting and non-native grass lawns intermixed with agricultural grasslands, cropland, and orchards.

Disturbed / Ruderal
The disturbed/ruderal land cover type is defined as areas that have been subject to previous or ongoing disturbances such as along roadsides, roadside drainages, and other anthropogenic disturbances. This vegetation communities consists of non-native grasses, such as wild oat (*Avena fatua*), perennial ryegrass (*Festuca perennis*), ripgut brome (*Bromus diandrus*), and forbs along roadsides and through the non-wetland roadside drainages including: milk thistle (*Silybin marianum*), yellow star-thistle (*Centaurea solstitialis*), field bindweed (*Convolvulus arvensis*), sow thistle (*Sonchus asper ssp. asper*), cheeseweed (*Malva parviflora*), and western ragweed (*Ambrosia psilosrachya*).

Annual Grassland
Annual grassland habitat are open grasslands composed primarily of introduced non-native annual plant species. Within the BSA, annual grassland habitats are composed of wild oat, ripgut brome, and perennial ryegrass, mixed with weedy forbs such as field bindweed, yellow star-thistle, cheeseweed, and western ragweed.

Orchard/Vineyard
This habitat type is recognizable by a single species or tree or shrub dominated developed habitat. Depending on the tree type and pruning methods they are usually low, bushy trees with an open understory to facilitate harvest. Trees such as citrus, avocados, and olives are evergreen, others are deciduous. The understory is usually composed of low growing grasses and other herbaceous plants, but may be managed to prevent understory growth totally or partially, such as along tree rows (CDFW 1988).

Cropland
Vegetation in this habitat includes a variety of sizes, shapes, and growing patterns. Field corn can reach ten feet while strawberries are only a few inches high. Although most crops are planted in rows, alfalfa hay and small grains (rice, barley, and wheat) form dense stands with up to 100 percent canopy closure. Most croplands support annuals, planted in spring and harvested during summer or fall. Cropland habitats do not conform to normal habitat stages. Instead, cropland is regulated by the crop cycle in California. These habitats can either be annual or perennial, vary according to location in the state, and germinate at various times of the year (CDFW 1988).

Irrigation Canal
Irrigation canals traverse throughout the project area, and transport seasonal irrigation flows from other vegetation communities such as cropland and orchard/vineyard. The National Wetlands Inventory categorizes most of these features excavated, semi-permanently flooded, unconsolidated bottom, riverine habitat. As ephemeral features, these waters features would not be considered waters of the U.S., but may be considered waters of the state under jurisdiction of the Central Valley Regional Water Quality Control Board.

State and Federally Listed Special Status Species
Based upon preliminary literature research conducted through the USFWS Information for Planning and Consultation (IPaC) official species list generator, the CDFW California Natural Diversity Database (CNDDB), the California Native Plant Society (CNPS) Electronic Inventory of Rare and Endangered Plants, San Joaquin County Multi-Species Conservation and Open Space Plan (SJMSCP) and the habitat requirements of each species, the following federal, state, and SJMSCP listed wildlife and plant species would be considered to have the potential to occur within the preferred alternatives project area.

Special Status Wildlife Species

Burrowing Owl (*Athene cunicularia*) – CDFW SSC
Burrowing owl is not a state or federal listed species, but is a CDFW Species of Special Concern (SSC), and is a Covered Species under the SJ. Potentially suitable grassland and cropland habitat occur throughout the project area, and could serve as suitable nesting or foraging habitat for the species. The species does have known recent occurrences

within the project vicinity. Therefore, the species is considered to have a low potential to occur within the project area. To avoid potential direct effects to the species, protocol habitat assessments should be completed, in accordance with the California Burrowing Owl Consortium "Burrowing Owl Survey Protocol and Mitigation Guidelines" (1993) as part of the project to confirm if active burrowing owl nest sites are within the project footprint. If active burrowing owl nest sites are identified, the project would be required to provide appropriate mitigation efforts to reduce direct effects to the species in accordance with the guidelines stated above. Prior to construction, the project proponent would need to conduct additional evaluation to determine if consultation with CDFW would be necessary for potential project related impacts to burrowing owl.

Loggerhead Shrike (*Lanius ludovicianus*) – CDFW SSC

Loggerhead Shrike is not a state or federal listed species, but is a CDFW Species of Special Concern (SSC). Potentially suitable grassland, cropland, orchard/vineyard habitat occur throughout the project area, and could serve as suitable nesting or foraging habitat for the species. The species does have known recent occurrences within the project vicinity. Therefore, the species is considered to have a low potential to occur within the project area. To avoid direct effects to the species, project construction in the vicinity of potential nesting habitat would need to be limited to the migratory bird non-nesting season (September 1st – January 31st). If construction would occur during the migratory bird nesting season, pre-construction nesting bird surveys would need to occur to determine if the species is nesting within the project footprint or within designated CDFW buffers. Prior to construction, the project proponent would need to conduct additional evaluation to determine if consultation with CDFW would be necessary for potential project related impacts to loggerhead shrike.

Song Sparrow "Modesto Population" (*Melospiza melodia*) – CDFW SSC

Song sparrow "Modesto Population" is not a state or federal listed species but is a CDFW Species of Special Concern (SSC). Potentially suitable irrigation canals habitat occurs throughout the project area and could serve as suitable nesting or foraging habitat for the species. The species does not have known recent occurrences within the project vicinity; but the species presumed extant does extend throughout the project area. Therefore, the species is considered to have a low potential to occur within the project area. To avoid direct effects to the species, project construction in the vicinity of potential nesting habitat would need to be limited to the migratory bird non-nesting season (September 1st – January 31st). If construction would occur during the migratory bird nesting season, pre-construction nesting bird surveys would need to occur to determine if the species is nesting within the project footprint or within designated CDFW buffers. Prior to construction, the project proponent would need to conduct additional evaluation to determine if consultation with CDFW would be necessary for potential project related impacts to song sparrow "Modesto Population".

Swainson's Hawk (*Buteo swainsoni*) – State Threatened

Swainson's hawk is state-listed threatened species. Swainson's hawk migrates annually from wintering areas in South America to breeding locations in northwestern Canada, the western U.S., and Mexico. In California, Swainson's hawks nest throughout the Sacramento Valley in large trees in riparian habitats and in isolated trees in or adjacent to agricultural fields. The breeding season extends from late March through late August, with peak activity from late May through July There are many large diameter potentially suitable nesting trees throughout the project area, and ample grassland, cropland, and orchard foraging habitat. There are numerous known recent occurrences within 5 miles of the project area. Therefore, the species is considered to have a moderate to high potential to occur within the project area. To avoid direct effects to the species, project construction in the vicinity of potential nesting habitat would need to be limited to the species non-nesting season (September 1st – March 31st). If construction would occur during the species nesting season, pre-construction Swainson's hawk protocol nesting surveys would need to occur to determine if the species is nesting within the project footprint or within ¼-mile of project activities. Prior to construction, the project proponent would need to conduct additional evaluation to determine if consultation with CDFW under California Endangered Species Act Section 2081 for incidental take would be necessary for potential project related impacts to Swainson's hawk.

Western Bumble Bee (*Bombus occidentalis*) – State Candidate Endangered

Western bumble bee is a state-listed candidate endangered species and is also listed as "Under Review" for listing on the Federal Register. The species has been wide declines in the western U.S. from a wide variety of anthropogenic factors including habitat change, nesting site availability, loss of overwintering habitat, and pesticide use. The western bumble bee has three basic habitat requirements: suitable nesting sites for the colonies, nectar and pollen from floral resources available throughout the duration of the colony period (spring, summer and fall), and suitable overwintering

sites for the queens. Suitable habitat occurs throughout the project area and habitat assessments would need to occur to determine specific habitat requirements. Prior to construction, the project proponent would need to conduct additional evaluation and habitat assessment to determine if consultation with CDFW under California Endangered Species Act Section 2081 for incidental take would be necessary for potential project related impacts to western bumble bee.

Migratory Birds

Migratory birds and their nests are protected under the MBTA and CFG Code Sections 3503, 3503.5, and 3515. To avoid direct effects to the migratory nesting bird, project construction in the vicinity of potential nesting habitat would need to be limited to the migratory bird non-nesting season (September 1st – January 31st). If construction would occur during the migratory bird nesting season, pre-construction nesting bird surveys would need to occur to determine if the species is nesting within the project footprint or within designated CDFW buffers. Prior to construction, the project proponent would need to conduct additional evaluation to determine if consultation with CDFW would be necessary for potential project related impacts to migratory nesting birds.

Special Status Plant Species

Plants are considered to be of special concern based on (1) federal, state, or local laws regulating their development; (2) limited distributions; and/or (3) the presence of habitat required by the special status plants occurring on site. After special status plant focused surveys, habitat assessment, and literature review, all special status plant species are presumed absent from the BSA. Based upon available habitat, no special status plant species returned from official species list requests would have the potential to occur within the project area. In compliance with CEQA, a biological technical report would be prepared for the project, including habitat assessment surveys, which would confirm or deny habitat requirements for special status plant species.

Natural Communities of Concern and Special Aquatic Sites

No natural drainages, water features, wetlands, or associated riparian habitats are known to occur within the preferred alternatives project area. All vegetation communities identified are known as developed habitats and would not be considered as natural communities of concern and would not require state or federal permitting compliance for project impacts. Prior to construction, the project proponent would need to conduct additional biological field evaluations to confirm no special aquatic sites or natural communities of concern are within the project footprint.

RECOMMENDATIONS

The project would have the potential to cause effects to sensitive biological resources, which may be considered significant. It is anticipated that if any potentially significant effects would occur due to implementation of the proposed project, project effects could be reduced to a less than significant level with incorporation of mitigation measures. Therefore, it is recommended that additional analysis of project effects to biological resources be conducted at the time a preferred build alternative is chosen and should be summarized within a biological technical report. Results of the technical analysis and recommended measures to mitigate biological resource impacts will be included in the project's environmental document.

3.5 CULTURAL RESOURCES

CONSTRAINTS DISCUSSION

The Manteca 2023 Draft General Plan notes high cultural sensitivity within the City near the San Joaquin River and Walthall Slough. The western terminus of the preferred alternatives project area would be in close proximity to the Walthall Slough. In accordance with the Draft General Plan, the project proponent would consult with the Central California Information Center at California State University Stanislaus to conduct cultural resources record search of potential cultural resources within the project's designated Area of Potential Effects (APE). In conjunction with this search, a letter requesting a search of the Sacred Land File at Native American Heritage Commission would also be required to be issued.

In order to ensure that all cultural resources in the preferred alternatives project area are identified and all potential impacts to those resources are evaluated, full archaeological and historic resource surveys and reports should be prepared for the proposed project. Identification of the APE, additional background research, Native American Consultation, and a pedestrian survey of the project by a professionally qualified staff would be part of these technical studies. Additional surveys and subsurface testing may be necessary and could include Extended Phase 1 or Phase 2 archaeological investigations if highly sensitive areas are determined presence from background research.

RECOMMENDATIONS

There are no known built environment historic resources in the project area. A full assessment of the potential for prehistoric or historic archaeology would need to be conducted during the environmental document phase to assess the project area sensitivity for subsurface resources. This effort will include obtaining a cultural resources record search, consultation with local Native American Tribes, and an archaeological survey of the APE, Should archaeology be identified, or if sensitivity for subsurface archaeology is moderate or high, mitigation measures may be included to reduce potential impacts to cultural resources.

3.6 ENERGY

CONSTRAINTS DISCUSSION

The project would comply with all applicable local, state, and federal guidelines regarding energy resources. The project in not anticipated to result in environmental effects due to wasteful, inefficient, or unnecessary consumption of energy resources during construction or operation of the proposed project. Additionally, the project is not anticipated to conflict with or obstruct state or local plans for renewable energy or efficiency.

RECOMMENDATIONS

No constraints relating to energy resources are known to occur with the proposed project. However, analysis of energy resources should be conducted at the time a preferred build alternative is chosen and will be included in the project's environmental document. No additional studies are anticipated relating to energy.

3.7 GEOLOGY AND SOILS

CONSTRAINTS DISCUSSION

The project is located in the San Joaquin Valley portion of the Great Valley Geomorphic Province, which is characterized by a thick sequence of sedimentary rock units overlain by alluvial sediments derived primarily from erosion of the Sierra Nevada mountains to the east. Overlying the bedrock units in the mid-basin areas of the San Joaquin Valley are Late Pleistocene and Holocene age alluvial deposits. The majority of the preferred alternatives project area is composed of Tinnin loamy coarse sand, Delhi loamy sand, Veritas fine sandy loam, and Columbia fine sandy loam soil types.

According to the CDC Fault Activity Map of California (CDC 2015), there are no known active faults within or directly adjacent to the preferred alternatives project area. The nearest fault is the Vernalis Fault (Quaternary) approximately 6 miles west of the project area. Additionally, the project would not be located in an area known for landslides, be located on a geologic area or soil known to be unstable or be located on known expansive soils. Therefore, it is unlikely the project would substantially change the existing conditions such that it would result in new risks to expose people or structures to potential substantial adverse effects, including risk of loss, injury, or death involving rupture of a known fault, strong seismic ground shaking, seismic-related ground failure, or landslides.

The project would consist of major soil movement and ground disturbance, which could contribute to soil erosion and loss of topsoil, potentially leading to environmental effects. Additionally, as with any project that will have ground disturbance and excavation activities, unknown paleontological resources could be found during project construction.

In accordance with the Manteca General Plan, any development project would be required to conduct a records search to determine if the project area contains known paleontological resources, and/or determine the potential for discovery.

RECOMMENDATIONS

The proposed project would have the potential to cause adverse effects related to soil erosion, loss of topsoil, and the potential to affect unique paleontological resources within the preferred alternatives project area. Therefore, it is recommended that additional analysis of project effects related to geology, soils, and paleontological resources be conducted at the time a preferred build alternative is chosen. Results of the analysis and recommended measures to mitigate any geology and soils impacts will be included in the project's environmental document.

3.8 GREENHOUSE GAS EMISSIONS

CONSTRAINTS DISCUSSION

In August 2008, the SJVAPC District's Governing Board adopted the Climate Change Action Plan (CCAP). The CCAP directed the District Air Pollution Control Officer to develop guidance to assist lead agencies, project proponents, permit applicants, and interested parties in assessing and reducing the impacts of project specific greenhouse gas (GHG) emissions on global climate change,

On December 17, 2009, the SJVAPC District adopted the guidance: Guidance for Valley Land-use Agencies in Addressing GHG Emission Impacts for New Projects under CEQA and the policy: District Policy – Addressing GHG Emission Impacts for Stationary Source Projects Under CEQA When Serving as the Lead Agency. The guidance and policy rely on the use of performance-based standards, otherwise known as Best Performance Standards (BPS), to assess significance of project specific greenhouse gas emissions on global climate change during the environmental review process, as required by CEQA.

Use of BPS is a method of streamlining the CEQA process of determining significance and is not a required emission reduction measure. Projects implementing BPS would be determined to have a less than cumulatively significant impact. Otherwise, demonstration of a 29 percent reduction in GHG emissions, from business-as-usual, is required to determine that a project would have a less than cumulatively significant impact. The guidance does not limit a lead agency's authority in establishing its own process and guidance for determining significance of project related impacts on global climate change.

RECOMMENDATIONS

The project is not anticipated to generate GHG emissions through operation of the completed project. However, GHG emissions would be generated during construction through the use of gas-powered construction vehicles. GHG emissions generated from construction-related activities should be analyzed to determine if projected levels are within the SJVAPC District's CEQA thresholds of significance, and if the project would conflict with the District CCAP. Therefore, it is recommended that technical analysis of project effects related to GHG emissions and compliance with the applicable SJVAPC District regulations and thresholds be conducted at the time a preferred build alternative is chosen. Results of the analysis and recommended measures to mitigate any GHG impacts will be included in the project's environmental document.

3.9 HAZARDS AND HAZARDOUS MATERIALS

CONSTRAINTS DISCUSSION

A review of the California Department of Toxic Substances (DTSC) Envirostor database (DTSC 2021) and State Water Resources Control Board (SWRCB) Geotracker database (SWRCB 2021) found no known cleanup sites within or adjacent to the preferred alternatives project area. Additionally, a review of the CalFIRE, fire hazard severity zones, determined the preferred alternatives project area is within an "Unzoned" Local Responsibility Area. Sensitive receptors within 1-mile of the preferred alternatives project area would include rural residences, and the Nile Garden

Elementary School (approximately 0.5-mile south of the preferred alternative project area). No hospitals or other sensitive receptors are known to occur within 1 mile of the preferred alternatives project area.

Significance determinations for impacts related to hazards and hazardous waste are based on professional standards and project-specific criteria. Some of the project-specific considerations related to hazards and hazardous materials would be:

- Use of heavy equipment for grading, filling, and the hauling of materials that may require the use of common materials that have hazardous properties, e.g., petroleum-based fuels;
- Storage of hazardous materials in accordance with applicable laws and regulations;
- Disturbed soils within the preferred alternatives project area may have agricultural contaminants, and may contain aerially deposited lead near roadways;
- Accidental release or spills of hazardous materials; and,
- Potential exposure of construction workers and the general public to unknown hazardous materials encountered within the preferred alternatives project area

RECOMMENDATIONS

No known hazardous materials or hazards are known to occur within the proposed project site. However, with any project that requires grading and excavation, there is always a chance to uncover unknown hazardous materials or hazards. Additional analysis would be conducted during the environmental document phase including a visual site assessment and review of known hazardous records. Results of the technical analysis and recommended measures to mitigate hazards and hazardous materials impacts will be included in the project's environmental document.

3.10 HYDROLOGY AND WATER QUALITY

CONSTRAINTS DISCUSSION

Hydrology
According to literature research and an examination of the USFWS Wetlands Mapper, no natural drainages, water features, wetlands, or associated riparian habitats are known to occur within the preferred alternatives project area. Agricultural canals throughout the preferred alternatives project area, are the only surface water feature identified. These waters would be considered waters of the state under the jurisdiction of the Central Valley Regional Water Quality Control Board (Fresno Office), and would be subject to water quality requirements under the Porter-Cologne Water Quality Control Act. The Porter-Cologne Act defines waters of the State as "any surface water or ground water, including saline waters, within the boundaries of the state."
All project alternatives would have over 1 acre of and therefore, would be regulated under the State through waste discharge requirements (WDRs), authorized under California's Porter-Cologne Water Quality Control Act (Porter-Cologne Act). The RWQCBs issue WDRs so that projects which may discharge wastes to land or water conform to the regional water quality objectives, and policies and procedures of the applicable water quality control plans (basin plans).

Groundwater
Seasonal groundwater level data was reviewed through the Groundwater Information Center Interactive Map Web Application (https://gis.water.ca.gov/app/gicima/) provided by the California DWR. In the preferred alternatives project area, ground water depth ranges from 8 feet to 20 feet from ground surface. General groundwater depth may be influenced by local pumping, rainfall, and irrigation patterns. The proposed project is within the San Joaquin Valley Groundwater Basin, and more specifically, the Eastern San Joaquin Subbasin. The Eastern San Joaquin Subbasin is defined by the San Joaquin River to the west and bounded by the Sierra Nevada Mountains to the east.

Flooding
According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) the preferred alternatives project area is within FEMA Zone A, designated as a Special Flood Hazard Area subject to inundation by

the 1% annual chance of flood, and Zone X, designated as Other Flood Areas, with 0.2% annual chance of flood (see Appendix B for FEMA FIRM Panels).

Temporary and short-term impacts on hydrology and water quality could occur from ground-disturbing activities and other construction-related activities including, violation of water quality standards or waste discharge requirements. Operational impacts could occur to changes in local or regional hydrology including the potential to substantially alter existing drainage patterns of the site or area.

RECOMMENDATIONS

It is recommended that additional technical analysis relating to potential hydrology and water quality impacts be assessed for the construction and operation of the chosen project alternative. The analysis of operational effects would focus on how the presence of the new levee system might affect hydrology and water quality. Potential groundwater effects have been noted as a concern of landowners within the preferred alternatives project area and vicinity. Geotechnical analysis of the proposed project is recommended to be completed in a future phase of the project to determine any short- or long-term effects to groundwater. In addition, impacts should be assessed in light of existing regulatory requirements that would serve to mitigate potential impacts. The effectiveness of existing regulations in mitigating potential impacts often is affected by discretionary requirements, site characteristics, or project features not detailed yet, and design-level considerations. Analysis of construction-related effects would focus on short-term hydrology and water quality effects on those drainage features that would be subject to ground disturbance during construction. Results of the technical analysis and recommended measures to mitigate hydrology and water quality impacts will be included in the project's environmental document.

3.11 LAND USE AND PLANNING

CONSTRAINTS DISCUSSION

Manteca General Plan 2023
The City General Plan 2023 was adopted in 2003. Currently, the City is in the process of approval and adoption of the Draft General Plan Update and Draft EIR which has gone through the public comment period and is anticipated to be adopted within 2021. The City General Plan designates land use and zoning within the City Planning Unit. The General Plan designates land use within and adjacent to the preferred alternative project area as, Very Low Density Residential (VLDR), Low Density Residential (LDR), Open Space (OS), Public/Quasi Public (PQP) and Urban Reserve-Agriculture (UR-AG).

The Delta Plan
The Sacramento-San Joaquin Delta Reform Act of 2009 established the Delta Stewardship Council (Council) to achieve more effective governance while providing for the sustainable management of the Delta ecosystem and a more reliable water supply, using an adaptive management framework. The milestone legislation created the Council, and gave it the direction and authority to serve two primary governance roles: (1) set a comprehensive, legally enforceable direction for how the State manages important water and environmental resources in the Delta through the adoption of a Delta Plan, and (2) ensure coherent and integrated implementation of that direction through coordination and oversight of State and local agencies proposing to fund, carry out, and approve Delta-related activities. The preferred alternatives project area does fall within the designated legal delta boundary but would occur within areas designated for development by the Delta Plan.

Land use designations and/or land use zoning are not anticipated to change as a result of the proposed project. The project would occur within a rural/agricultural area and is not anticipated to divide an established community. The project would adhere to the land use designations in the Manteca General Plan, San Joaquin County General Plan, and SJMSCP. Partial and/or full acquisition of property within the project area is anticipated. Constraints related to acquisition of property is discussed further in section 3.14 "Population and Housing".

RECOMMENDATIONS

The project would not physically divide an established community and is not anticipated to conflict with any land plan, policy, or regulation. Additional analysis for consistency with the City's General Plan Update and General Plan EIR should occur to ensure consistency when the General Plan Update and EIR are adopted. Results of the analysis and recommended measures to mitigate land use or planning impacts will be summarized in the project's environmental document.

3.12 MINERAL RESOURCES

CONSTRAINTS DISCUSSION

The California Department of Conservation Surface Mining and Reclamation Act of 1975 (§ 2710), also known as SMARA, provides a comprehensive surface mining and reclamation policy that permits the continued mining of minerals, as well as the protection and subsequent beneficial use of the mined and reclaimed land. The purpose of SMARA is to ensure that adverse environmental effects are prevented or minimized and that mined lands are reclaimed to a usable condition and are readily adaptable for alternative land uses.

According to the SMARA, a designated Mineral Resource Zone (MRZ) category 3, "Areas containing mineral deposits the significance of which cannot be evaluated from available data" occurs at the western terminus of the preferred alternatives project area. Due to the designated MRZ-3 status of this mineral resource zone, the value to the region and the residents of the state would be unknown. Therefore, the proposed project is not anticipated to result in the loss of availability of known mineral resources, result in the loss of availability of a locally important mineral resource recovery site, or cause adverse effects to mineral resources.

RECOMMENDATIONS

The project is not anticipated to result in the loss of known mineral resources. A complete analysis for consistency with the City's General Plan Update and General Plan EIR should occur to ensure consistency with all mineral resource policies during the environmental document phase of the project. No additional studies are anticipated relating to mineral resources.

3.13 NOISE

CONSTRAINTS DISCUSSION

Noise-sensitive land uses generally include those uses where exposure to noise would result in adverse effects, as well as uses where quiet is an essential element of their intended purpose. The Manteca General Plan update 2030 includes noise-sensitive land uses as: residential land uses and schools. Land use within the project vicinity is designated by the City General Plan (2003) as Very Low Density Residential (VLDR), Low Density Residential (LDR), Open Space (OS), Public/Quasi Public (PQP) and Urban Reserve-Agriculture (UR-AG). Some of the current preferred alternatives would occur within close proximity (between 500 and 1000 feet) to residential homes along the proposed alternative alignments. However, the proposed alternatives would not currently come within close proximity to any known schools.

The proposed project would require compliance with the goals and policies of the Manteca General Plan, and also with the City Municipal Code Noise Ordinance. Thresholds of significance would need to be analyzed in accordance with CEQA Appendix G, through the analysis of the project's construction-related noise and vibration within the vicinity of noise-sensitive receptors within the preferred alternative project area. However, the completed project is not anticipated to cause operational noise impacts within the project area.

RECOMMENDATIONS

The proposed project is not anticipated to generate long-term vehicular or noise quality effects. However, the preferred alternatives under consideration would have the potential to cause construction-related noise effects within the project vicinity and to nearby sensitive receptors (residential properties). Therefore, it is recommended that technical analysis of construction-related noise and vibration be assessed during the environmental document phase for the chosen project alternative. Results of the technical analysis and recommended measures to mitigate any noise impacts will be summarized in the project's environmental document.

3.14 POPULATION AND HOUSING

CONSTRAINTS DISCUSSION

CEQA guidelines, Section 15126.2(d), require that environmental documents "…discuss the ways in which the project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment…"

The project would construct an extension of the existing dry land levee to achieve ULDC 200-year requirements. The project is not anticipated to induce substantial unplanned population growth within the area, either directly or indirectly. Rather, the proposed project would provide ULDC 200-year flood protection for existing and planned residential areas within the City.

It is anticipated that the preferred alignment alternatives would require permanent acquisition of residential properties within the currently proposed alignments. However, the preferred alternatives are not anticipated to displace substantial numbers of people or housing. Any relocations would require conformance with applicable California Government Code, Chapter 16, Section 7260, et seq. relating to relocation assistance for persons, businesses, farms, or nonprofit operations due to acquisition of real property by a public entity for public use.

RECOMMENDATIONS

The project is not anticipated to induce unplanned growth; however, the preferred alternatives under consideration would have the potential to cause relocation of residential property and persons. Therefore, it is recommended that further analysis be conducted relating to population, housing, and community impacts for the chosen project alternative. Results of the analysis and recommended measures to mitigate housing and/or community impacts will be included in the project's environmental document.

3.15 PUBLIC SERVICES

CONSTRAINTS DISCUSSION

Land use within the project vicinity is designated by the City General Plan (2003) as Very Low Density Residential (VLDR), Low Density Residential (LDR), Open Space (OS), Public/Quasi Public (PQP) and Urban Reserve-Agriculture (UR-AG). Implementation of the proposed project would construct an extension of the existing dry land levee to achieve ULDC 200-year requirements. Project construction and operation are anticipated to result in physical environmental effects within the project area, associated with provision of the new government facility. However, construction and operation of the new levee extension is not anticipated to cause substantial effects to the environment relating to the acceptable service ratios, response times, or other performance objectives for public services including fire protection, police protection, schools, parks, or other public facilities. The project would be constructed consistent with all applicable local, state, and federal plans and programs and is not anticipated to cause adverse impacts relating to public services.

RECOMMENDATIONS

The proposed project alternatives are not anticipated to cause adverse environmental impacts relating to the provision of government facilities or public services. However, if any potentially significant physical environmental effects would occur, it is anticipated they could be reduced to a less than significant level. A complete analysis of local, state and federal plans and policies regarding government and public services should occur to ensure consistency with all public service policies during the environmental document phase of the project. No additional studies are anticipated relating to public services.

3.16 RECREATION

CONSTRAINTS DISCUSSION

The proposed project would construct an extension of the existing dry land levee to achieve ULDC 200-year requirements. The construction and/or operation of the completed project is not anticipated to increase the use of existing parks or other recreational facilities due to the location and nature of the project. Additionally, according to the Manteca General Plan Land Use map, the current preferred alternatives would not affect, directly or indirectly, any designated park or recreational lands.

RECOMMENDATIONS

The proposed preferred alternatives are not anticipated to cause environmental impacts relating to recreational facilities, or the use of recreational facilities. However, a complete analysis regarding recreational facilities within the vicinity of the chosen preferred alternative should occur during the environmental document phase of the project to ensure no effects to recreational facilities would occur. No additional studies are anticipated relating to recreation.

3.17 TRANSPORTATION/TRAFFIC

CONSTRAINTS DISCUSSION

The proposed project would construct an extension of the existing dry land levee to achieve ULDC 200-year requirements. The project is not anticipated to have no transportation elements, other than conformance with existing roads where necessary, and would not be a part of the transportation network. Therefore, the project is not anticipated to conflict with a program, plan, ordinance, or policy addressing the circulation system, and no project effects relating to transportation are anticipated. Where the project must conform to existing roadways, construction activities may require detours or delays in traffic flows. However, construction-related effects to local traffic patterns are anticipated to be temporary and intermittent in nature. Additionally, the project would be designed in a manner not to increase hazards due to geometric design features. Furthermore, construction and operation of the project is not anticipated to result in inadequate emergency access. The project is not a transportation project and would not conflict with CEQA Guidelines section 15064.3.

RECOMMENDATIONS

The proposed preferred alternatives are not anticipated to cause adverse impacts relating to transportation or traffic. The project would have no transportation elements other than conformance with existing roads where necessary and would not be part of the transportation network. However, a technical analysis regarding preliminary design of roadway elements as part of the chosen preferred alternative should occur during the environmental document phase of the project to ensure no adverse effects relating to transportation facilities would occur. Results of the analysis and recommended measures will be included in the project's environmental document.

3.18 TRIBAL CULTURAL RESOURCES

CONSTRAINTS DISCUSSION

The Manteca 2023 Draft General Plan notes high cultural sensitivity within the City near the San Joaquin River and Walthall Slough. The western terminus of the preferred alternatives project area would be in close proximity to the Walthall Slough. In accordance with the Draft General Plan, the project proponent would consult with the Central California Information Center at California State University Stanislaus to conduct cultural resources record search of potential cultural resources within the project's designated APE. In conjunction with this search, a letter requesting a search of the Sacred Land File at Native American Heritage Commission should also be issued.

In order to ensure that all cultural resources in the preferred alternative project area are identified and all potential impacts to those resources are evaluated, full archaeological and historic resource surveys and reports should be prepared for the proposed project. Identification of the APE, additional background research, Native American Consultation, and a pedestrian survey of the project by a professionally qualified staff would be part of these technical studies. Additional surveys and subsurface testing may be necessary and could include Extended Phase 1 or Phase 2 archaeological investigations if highly sensitive areas are determined presence from background research.

RECOMMENDATIONS

There are no known tribal cultural resources with the preferred alternatives project area. A full assessment of the potential for prehistoric archaeology would need to be conducted during the environmental document phase to assess the project area sensitivity for subsurface resources. This effort will include obtaining a cultural resources record search, consultation with local Native American Tribes, and an archaeological survey of the APE. Should archaeology be identified, or if sensitivity for subsurface archaeology is moderate or high, mitigation measures may be included to reduce potential impacts to tribal cultural resources.

3.19 UTILITIES AND SERVICE SYSTEMS

CONSTRAINTS DISCUSSION

The proposed project would construct an extension of the existing dry land levee to achieve ULDC 200-year requirements. The preferred alternatives alignments range from approximately 1.6 miles to approximately 2.3 miles in length. Construction of any preferred alternative is anticipated to require relocation or construction of new utilities and service systems. The specific types, locations, and extent of construction and relocation would need to occur as part of the chosen preferred alternative final design and right of way negotiations. The extent of construction and relocation of utilities and service systems is anticipated to have the potential of environmental effect. However, if potential effects to the environment would occur, it is anticipated any project effects could be reduced to a less than significant level with the incorporation of feasible mitigation measures.

It is anticipated that the chosen preferred build alternative would generate solid waste during construction; however, the operation of the completed project is not anticipated to result in solid waste generation. Solid waste generated by the proposed project construction is not anticipated to be in excess of State or local standards or in excess of the capacity of local infrastructure. Therefore, the proposed project is not anticipated to impair attainment of solid waste reduction goals and would comply with all federal, state, and local statutes and regulations regarding solid waste.

RECOMMENDATIONS

The project is anticipated to have the potential to cause effects to the environment due to relocation and/or construction of utilities and service systems as a result of the chosen build alternative. Therefore, it is recommended that technical analysis of project effects related to utility relocations and construction of new or replacement service systems be conducted at the time a preferred build alternative is chosen. It is anticipated that if any potentially significant effects would occur due to implementation of the proposed project, project effects could be reduced to a less than significant

level with incorporation of mitigation measures. Results of the analysis and recommended measures to mitigate impacts will be included in the project's environmental document.

3.20 WILDFIRE

DISCUSSION

According to the California Department of Forestry and Fire Protection (CAL FIRE) Fire Hazard Severity Zone Map for San Joaquin County (CAL FIRE 2007), the preferred alternatives project area would not be within a Very High, High, or Moderate Fire Hazard Severity Zone. Therefore, the proposed preferred alternatives are not anticipated to exacerbate wildfire risks due to slope, prevailing winds, or other factors; are not anticipated to require infrastructure that may exacerbate fire risk, or result in temporary or ongoing impacts to the environment, and are not anticipated to expose people or structures to significant risks including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability or drainage changes.

RECOMMENDATIONS

The proposed preferred alternatives are not anticipated to cause environmental impacts relating to wildfire. However, a complete analysis of wildfire risks associated with the chosen build alternative should be conducted during the environmental document phase of the project. No additional studies are anticipated relating to wildfire.

4.0 Environmental Documentation, Permits and Approvals

The following table is a summary of the constraints analysis provide above to each of the CEQA Guidelines Appendix G checklist resource categories and where additional analysis would be necessary.

Table 2. Summary of Environmental Constraints

Resource Category	Constraints Summary
Aesthetics	Additional technical analysis required during PA&ED phase for potential impacts to aesthetics and visual resources.
Agriculture and Forest Resources	Additional analysis required during PA&ED phase for potential impacts to prime farmland and farmland of statewide importance.
Air Quality	Additional technical analysis required during PA&ED phase for potential construction-related air quality impacts.
Biological Resources	Additional technical analysis required during PA&ED phase for potential impacts to biological resources.
Cultural Resources	Additional analysis required during PA&ED phase for potential impacts to archaeological and historic cultural resources.
Energy	Project impacts relating to energy resources not anticipated. Discussion to be included in environmental document.
Geology and Soils	Additional technical analysis required during PA&ED phase for potential construction-related geology and soils impacts.
Greenhouse Gas Emissions	Additional technical analysis required during PA&ED phase for potential construction-related GHG impacts.
Hazards and Hazardous Materials	Additional technical analysis required during PA&ED phase for potential impacts from construction related hazards and potential soil contamination.
Hydrology and Water Quality	Additional analysis required during PA&ED phase for potential impacts from construction/operational changes to hydrology and water quality.
Land Use and Planning	Project impacts relating to land use and planning not anticipated. Discussion to be included in environmental document.
Mineral Resources	Significant impacts relating to mineral resources not anticipated. Discussion to be included in environmental document.
Noise	Additional analysis required during PA&ED phase for potential impacts relating to construction related noise quality impacts.
Population and Housing	Additional analysis required during PA&ED phase for potential impacts relating to private property acquisition and relocations.
Public Services	Project impacts relating to public services not anticipated. Discussion to be included in environmental document.
Recreation	Project impacts relating to recreation not anticipated. Discussion to be included in environmental document.
Transportation/Traffic	Project impacts relating to transportation/traffic not anticipated. Discussion to be included in environmental document.
Tribal Cultural Resources	Additional technical analysis required during PA&ED phase for potential impacts to tribal cultural resources.
Utilities and Service Systems	Additional analysis required during PA&ED phase for potential impacts relating to relocation and construction of utilities and service systems.
Wildfire	Project impacts relating to wildfire not anticipated. Discussion to be included in environmental document.

4.1 Environmental Document Type

California Environmental Quality Act

Due to the scope and nature of the project, the project has the potential to result in significant and unavoidable impacts to the environment, individually or cumulatively. With the potential for significant and unavoidable environmental effects, the recommended project level CEQA document to be prepared by the CEQA lead agency would be an Environmental Impact Report (EIR).

National Environmental Policy Act

If a federal nexus (other than obtaining Section 404 Clean Water Act permit) such as federal funding is identified, additional environmental study and environmental document in compliance with the National Environmental Policy Act (NEPA) would be required.

4.2 Environmental Technical Studies

To support the environmental document, the following is a summary of technical studies that would likely be required:

- Visual Impact Assessment
- Community Impact Assessment
    - Relocation Impact Assessment
    - Farmland Impact Assessment
- Biological Resources Report
- Aquatic Resources Delineation Report
- Cultural Resources Inventory Report
- Preliminary Geotechnical Report
- Phase I Hazardous Waste Initial Site Assessment
- Water Quality Assessment Report
- Location Hydraulic Study
- Floodplain Evaluation Study Report

4.3 Permits and Approvals

Several federal, state, and local permits and/or authorizations are anticipated for the proposed project. Table 3 summarizes the potential permits and approvals that may be associated with the proposed project. The regulations and ordinances listed below represent a preliminary assessment of permitting requirements, which would be refined through subsequent project design and preparation of a detailed project description.

All of the proposed alternatives would directly and indirectly affect sensitive natural resources, including waters of the state and potential waters of the U.S. All potential waters of the U.S., including wetlands, identified within the study area may be regulated by the USACE through section 404 of the CWA and by the RWQCB through Section 401. All ecological systems associated with drainages (i.e. potential waters of the U.S.), and drainage features with bed and bank topography may also be regulated by Sections 1600-1616 of the California Fish and Game Code. In conjunction with the USACE Section 404 permit, impacts on wetlands and waters would likely require a Section 401 Water Quality Certification or Waste Discharge Requirement from RWQCB and CDFW Section 1602 Streambed Alteration Agreement.

Also, for all alternatives, the proposed project has the potential to affect more than 1.0 acre of soil, triggering the requirement of a National Pollutant Discharge Elimination System (NPDES) General Permit from the RWQCB for water of the U.S and Waste Discharge Requirements for waters of the state.

The proposed project has the potential to adversely affect special-status species, and species listed as "Covered Species" under the SJMSCP. No federal listed species were determined to have the potential to occur within the project area from the desktop analysis. However, wildlife species are transient and habitat conditions can change through time. Direct and/or indirect impacts to federal and state listed species and their habitat would require take authorization

through the SJMSCP which covers both FESA Section 10(a)(1)(b) and CESA Section 2081(b) Incidental Take Permits.

Table 3. Environmental Permits and Approvals

Agency	Type of Permit or Approval	Regulated Activity
Federal		
U.S. Army Corps of Engineers	Clean Water Act, Section 404	Discharges of dredged or fill material into waters of the U.S., including wetlands (if determined present)
State Historic Preservation Officer	National Historic Preservation Act, Section 106 Consultation	Consultation and coordination regarding potential effects on properties listed in, or eligible for listing in the National Register of Historic Places
State		
California Department of Fish and Wildlife	California Fish and Game Code, Section 1602	Streambed Alteration Agreement (SAA)
Regional Water Quality Control Board	CWA, Section 402	Section 402 National Pollutant Discharge Elimination System (NPDES) Construction General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities, Waste Discharge Requirements for Dewatering and Other Low Threat Discharges to Surface Waters
Regional Water Quality Control Board	CWA, Section 401	Section 401 Water Quality Certification for discharge of dredged or fill material into Waters of the U.S. and State
Regional Water Quality Control Board	Waste Discharge Requirements	For discharge of dredged or fill materials to waters of the state ONLY (non-waters of the U.S.)
Local		
California Native American Heritage Commission (NAHC)	NAHC Consultation (AB 52)	Consultation and coordination regarding potential effects on Native American burials or artifacts
San Joaquin County Multi-Species Conservation and Open Space Plan	SJMSCP Consistency Determination	SJMSCP Review Form, SJMSCP Conditions of Project Approval, and Agreement to Implement SHMSCP Incidental Take Minimization Measures and Pay Fees.
San Joaquin Air Pollution Control District	Authority to Construct/ Permit to Operate	Certification that construction emissions will meet all applicable requirements and will not interfere with air quality standards Certification that equipment complies with applicable rules and regulations

Table 4. Alternatives Required and Potential Environmental Permitting

Proposed Alternatives	Required Permitting and Approvals	Potential Permitting and Approvals
Alternative 1C	National Historic Preservation Act Section 106 NAHC AB52 Consultation RWQCB CWA, Section 402 RWQCB Waste Discharge Requirements SJMSCP Consistency Determination SJAPCD Authority to Construct/Permit to Operate	USACE CWA, Section 404 RWQCB CWA, Section 401 CDFW, Section 1602 SAA
Alternative 1S	National Historic Preservation Act Section 106 NAHC AB52 Consultation RWQCB CWA, Section 402 RWQCB Waste Discharge Requirements SJMSCP Consistency Determination SJAPCD Authority to Construct/Permit to Operate	USACE CWA, Section 404 RWQCB CWA, Section 401 CDFW, Section 1602 SAA
Alternative 2C	National Historic Preservation Act Section 106 NAHC AB52 Consultation RWQCB CWA, Section 402 RWQCB Waste Discharge Requirements SJMSCP Consistency Determination SJAPCD Authority to Construct/Permit to Operate	USACE CWA, Section 404 RWQCB CWA, Section 401 CDFW, Section 1602 SAA
Alternative 2S	National Historic Preservation Act Section 106 NAHC AB52 Consultation RWQCB CWA, Section 402 RWQCB Waste Discharge Requirements SJMSCP Consistency Determination SJAPCD Authority to Construct/Permit to Operate	USACE CWA, Section 404 RWQCB CWA, Section 401 CDFW, Section 1602 SAA

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Appendix A:
Official 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: July 14, 2021
Consultation Code: 08ESMF00-2021-SLI-2325
Event Code: 08ESMF00-2021-E-06671
Project Name: Manteca Dryland Levee

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, under the jurisdiction of the U.S. Fish and Wildlife Service (Service) 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 Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Please follow the link below to see if your proposed project has the potential to affect other species or their habitats under the jurisdiction of the National Marine Fisheries Service:

http://www.nwr.noaa.gov/protected_species/species_list/species_lists.html

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 ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system 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:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

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 Tracking Number 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

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

San Francisco Bay-Delta Fish And Wildlife
650 Capitol Mall
Suite 8-300
Sacramento, CA 95814
(916) 930-5603

Project Summary

Consultation Code: 08ESMF00-2021-SLI-2325
Event Code: 08ESMF00-2021-E-06671
Project Name: Manteca Dryland Levee
Project Type: STREAM / WATERBODY / CANALS / LEVEES / DIKES
Project Description: Alternatives Analysis for Manteca DLL
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@37.76486265,-121.24785321887067,14z

Counties: San Joaquin County, California

Endangered Species Act Species

There is a total of 8 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.

Mammals

NAME	STATUS
Riparian Brush Rabbit *Sylvilagus bachmani riparius* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6189	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

Amphibians

NAME	STATUS
California Red-legged Frog *Rana draytonii* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander *Ambystoma californiense* Population: U.S.A. (Central CA DPS) There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/2076	Threatened

Fishes

NAME	STATUS
Delta Smelt *Hypomesus transpacificus*	Threatened

There is **final** critical habitat for this species. The location of the critical habitat is not available.
Species profile: https://ecos.fws.gov/ecp/species/321

Insects

NAME	STATUS
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus*	Threatened

There is **final** critical habitat for this species. The location of the critical habitat is not available.
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. The location of the critical habitat is not available.
Species profile: https://ecos.fws.gov/ecp/species/498

Vernal Pool Tadpole Shrimp *Lepidurus packardi*	Endangered

There is **final** critical habitat for this species. The location of the critical habitat is not available.
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.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay-Delta Fish And Wildlife
650 Capitol Mall
Suite 8-300
Sacramento, CA 95814
Phone: (916) 930-5603 Fax: (916) 930-5654
http://kim_squires@fws.gov

In Reply Refer To: July 14, 2021
Consultation Code: 08FBDT00-2021-SLI-0208
Event Code: 08FBDT00-2021-E-00504
Project Name: Manteca Dryland Levee

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 ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system 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:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

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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 Tracking Number 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

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This species list is provided by:

San Francisco Bay-Delta Fish And Wildlife
650 Capitol Mall
Suite 8-300
Sacramento, CA 95814
(916) 930-5603

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
(916) 414-6600

Project Summary

Consultation Code: 08FBDT00-2021-SLI-0208
Event Code: 08FBDT00-2021-E-00504
Project Name: Manteca Dryland Levee
Project Type: STREAM / WATERBODY / CANALS / LEVEES / DIKES
Project Description: Alternatives Analysis for Manteca DLL
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@37.76486265,-121.24785321887067,14z

Counties: San Joaquin County, California

Endangered Species Act Species

There is a total of 9 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.

---

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.

Mammals

NAME	STATUS
Riparian Brush Rabbit *Sylvilagus bachmani riparius* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6189	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

Amphibians

NAME	STATUS
California Red-legged Frog *Rana draytonii* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander *Ambystoma californiense* Population: U.S.A. (Central CA DPS) There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/2076	Threatened

Fishes

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/321	Threatened

Insects

NAME	STATUS
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/7850	Threatened

Crustaceans

NAME	STATUS
Vernal Pool Fairy Shrimp *Branchinecta lynchi* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/498	Threatened
Vernal Pool Tadpole Shrimp *Lepidurus packardi* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/2246	Endangered

Flowering Plants

NAME	STATUS
Large-flowered Fiddleneck *Amsinckia grandiflora* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/5558	Endangered

Critical habitats

There is 1 critical habitat wholly or partially within your project area under this office's jurisdiction.

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* https://ecos.fws.gov/ecp/species/321#crithab	Final

Selected Elements by Common Name

California Department of Fish and Wildlife

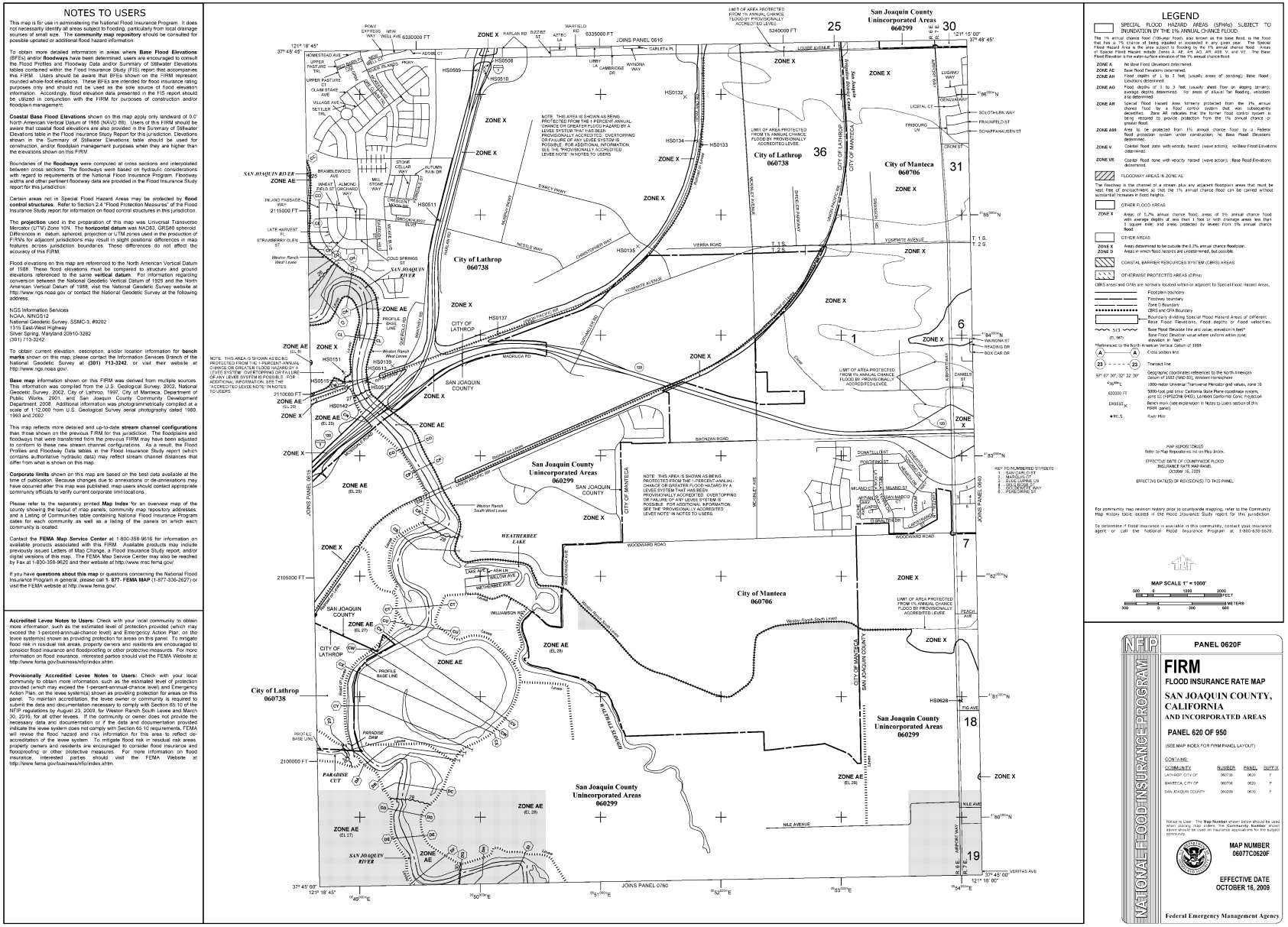
California Natural Diversity Database

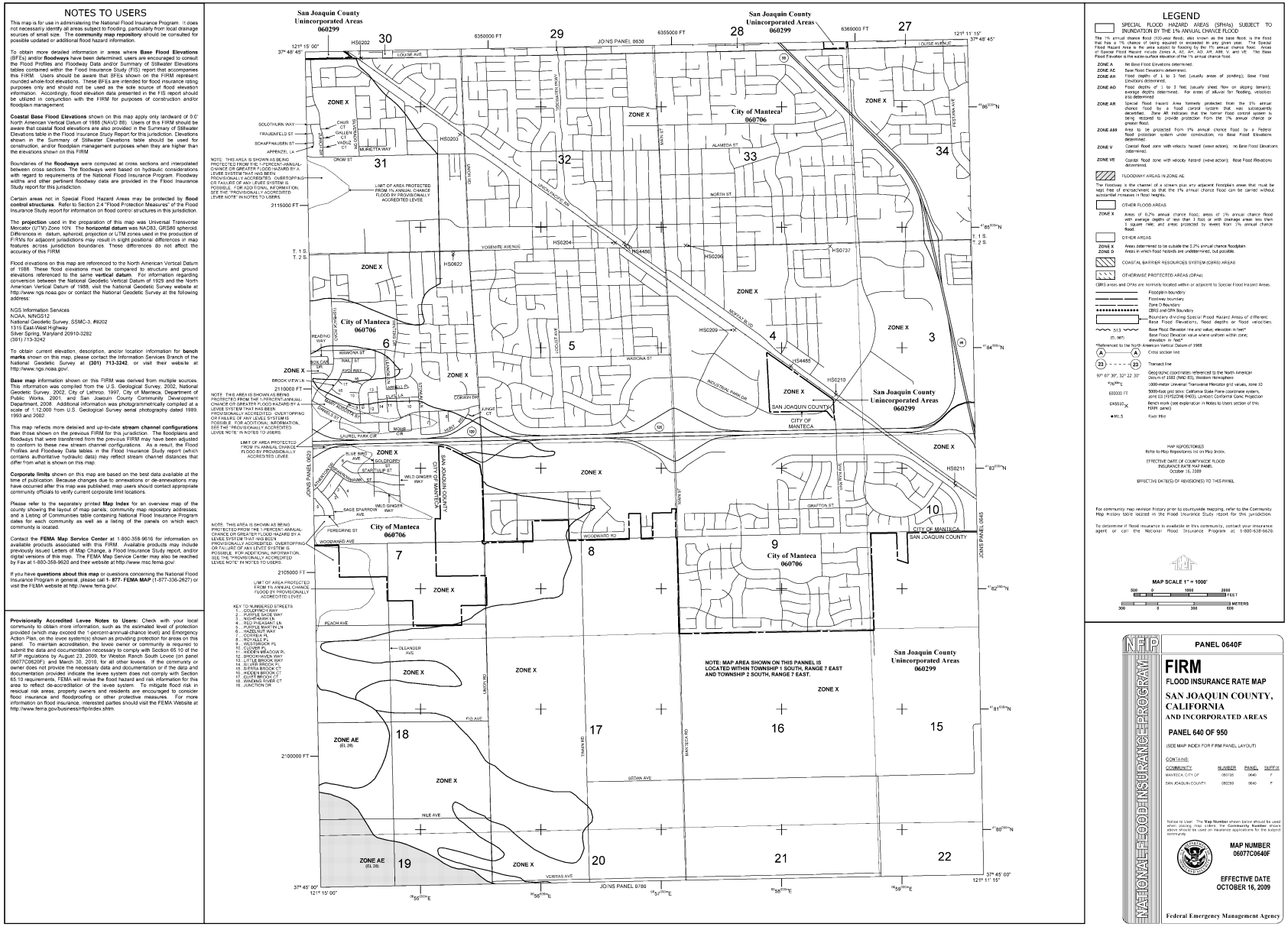
Query Criteria: Quad IS (Manteca (3712172) OR Lathrop (3712173))

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
burrowing owl *Athene cunicularia*	ABNSB10010	None	None	G4	S3	SSC
California tiger salamander - central California DPS *Ambystoma californiense pop. 1*	AAAAA01181	Threatened	Threatened	G2G3	S2S3	WL
caper-fruited tropidocarpum *Tropidocarpum capparideum*	PDBRA2R010	None	None	G1	S1	1B.1
Delta button-celery *Eryngium racemosum*	PDAPI0Z0S0	None	Endangered	G1	S1	1B.1
loggerhead shrike *Lanius ludovicianus*	ABPBR01030	None	None	G4	S4	SSC
longfin smelt *Spirinchus thaleichthys*	AFCHB03010	Candidate	Threatened	G5	S1	
moestan blister beetle *Lytta moesta*	IICOL4C020	None	None	G2	S2	
riparian brush rabbit *Sylvilagus bachmani riparius*	AMAEB01021	Endangered	Endangered	G5T1	S1	
slough thistle *Cirsium crassicaule*	PDAST2E0U0	None	None	G1	S1	1B.1
song sparrow ("Modesto" population) *Melospiza melodia*	ABPBXA3010	None	None	G5	S3?	SSC
steelhead - Central Valley DPS *Oncorhynchus mykiss irideus pop. 11*	AFCHA0209K	Threatened	None	G5T2Q	S2	
Swainson's hawk *Buteo swainsoni*	ABNKC19070	None	Threatened	G5	S3	
tricolored blackbird *Agelaius tricolor*	ABPBXB0020	None	Threatened	G1G2	S1S2	SSC
valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	IICOL48011	Threatened	None	G3T2	S3	
western bumble bee *Bombus occidentalis*	IIHYM24250	None	Candidate Endangered	G2G3	S1	
Wright's trichocoronis *Trichocoronis wrightii var. wrightii*	PDAST9F031	None	None	G4T3	S1	2B.1
yellow-headed blackbird *Xanthocephalus xanthocephalus*	ABPBXB3010	None	None	G5	S3	SSC

Record Count: 17

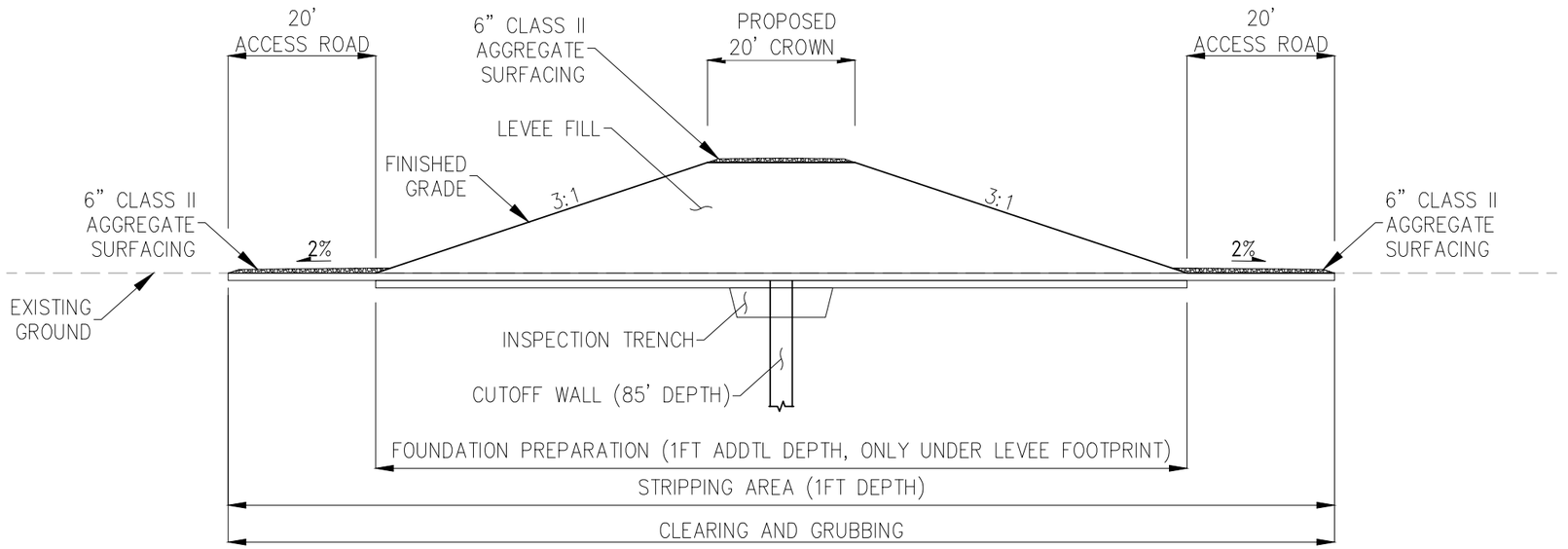
Appendix B:
FEMA FIRM Panels


NOTES TO USERS
This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.
To obtain more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.
Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.
Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.
Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.
The projection used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 10N. The horizontal datum was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.
Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:
NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
To obtain current elevation, description, and/or location information for bench marks shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit their website at http://www.ngs.noaa.gov/.
Base map information shown on this FIRM was derived from multiple sources. This information was compiled from the U.S. Geological Survey, 2002, National Geodetic Survey, 2002, City of Lathrop, 1997, City of Manteca, Department of Public Works, 2001, and San Joaquin County Community Development Department, 2008. Additional information was photogrammetrically compiled at a scale of 1:12,000 from U.S. Geological Survey aerial photography dated 1989, 1993 and 2002.
This map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.
Please refer to the separately printed Map Index for an overview map of the county showing the layout of map panels; community map repository addresses; and a listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.
Contact the FEMA Map Service Center at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and their website at http://www.msc.fema.gov/.
If you have questions about this map or questions concerning the National Flood Insurance Program in general, please call 1- 877- FEMA MAP (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.
Accredited Levee Notes to Users: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at: http://www.fema.gov/businesses/nfip/index.shtm.
Provisionally Accredited Levee Notes to Users: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations by August 23, 2009, for Weston Ranch South Levee and March 30, 2010, for all other levees. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicate the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at: http://www.fema.gov/businesses/nfip/index.shtm.
San Joaquin County Unincorporated Areas 060299
City of Lathrop 060738
City of Manteca 060706
LIMIT OF AREA PROTECTED FROM 1% ANNUAL CHANCE FLOOD BY PROVISIONALLY ACCREDITED LEVEE
NOTE: THIS AREA IS SHOWN AS BEING PROTECTED FROM THE 1-PERCENT-ANNUAL-CHANCE OR GREATER FLOOD HAZARD BY A LEVEE SYSTEM THAT HAS BEEN PROVISIONALLY ACCREDITED. OVERTOPPING OR FAILURE OF ANY LEVEE SYSTEM IS POSSIBLE. FOR ADDITIONAL INFORMATION, SEE THE "PROVISIONALLY ACCREDITED LEVEE NOTE" IN NOTES TO USERS.
NOTE: THIS AREA IS SHOWN AS BEING PROTECTED FROM THE 1-PERCENT-ANNUAL-CHANCE OR GREATER FLOOD HAZARD BY A LEVEE SYSTEM. OVERTOPPING OR FAILURE OF ANY LEVEE SYSTEM IS POSSIBLE. FOR ADDITIONAL INFORMATION, SEE THE "ACCREDITED LEVEE NOTE" IN NOTES TO USERS.
JOINS PANEL 0510
JOINS PANEL 0760
JOINS PANEL 0580
LEGEND
SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
ZONE A — No Base Flood Elevations determined.
ZONE AE — Base Flood Elevations determined.
ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
FLOODWAY AREAS IN ZONE AE
The Floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
OTHER FLOOD AREAS
ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood
OTHER AREAS
ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.
COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
OTHERWISE PROTECTED AREAS (OPAs)
CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA Boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, Flood depths or Flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
A — Cross section line
23 — Transect line
97° 07' 30", 32° 22' 30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
1000-meter Universal Transverse Mercator grid values, zone 10
600000 FT — 5000-foot grid ticks: California State Plane coordinate system, zone III (FIPSZONE 0403), Lambert Conformal Conic Projection
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile
MAP REPOSITORIES
Refer to Map Repositories list on Map Index.
EFFECTIVE DATE OF COMPREHENSIVE FLOOD INSURANCE RATE MAP PANEL
October 16, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-1620.
MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS
PANEL 0620F
FIRM
FLOOD INSURANCE RATE MAP
SAN JOAQUIN COUNTY, CALIFORNIA
AND INCORPORATED AREAS
PANEL 620 OF 950
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY — NUMBER — PANEL — SUFFIX
LATHROP, CITY OF — 060738 — 0620 — F
MANTECA, CITY OF — 060706 — 0620 — F
SAN JOAQUIN COUNTY — 060299 — 0620 — F
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER
06077C0620F
EFFECTIVE DATE
OCTOBER 16, 2009
Federal Emergency Management Agency
NATIONAL FLOOD INSURANCE PROGRAM


NOTES TO USERS
This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.
To obtain more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.
Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.
Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.
Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.
The projection used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 10N. The horizontal datum was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.
Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:
NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
To obtain current elevation, description, and/or location information for bench marks shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit their website at http://www.ngs.noaa.gov/.
Base map information shown on this FIRM was derived from multiple sources. This information was compiled from the U.S. Geological Survey, 2002, National Geodetic Survey, 2002, City of Lathrop, 1997, City of Manteca, Department of Public Works, 2001, and San Joaquin County Community Development Department, 2008. Additional information was photogrammetrically compiled at a scale of 1:12,000 from U.S. Geological Survey aerial photography dated 1989, 1993 and 2002.
This map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.
Please refer to the separately printed Map Index for an overview map of the county showing the layout of map panels; community map repository addresses; and a listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.
Contact the FEMA Map Service Center at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and their website at http://www.msc.fema.gov/.
If you have questions about this map or questions concerning the National Flood Insurance Program in general, please call 1- 877- FEMA MAP (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.
Provisionally Accredited Levee Notes to Users: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations by August 23, 2009, for Weston Ranch South Levee (on panel 06077C0629F) and March 30, 2010, for all other levees. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicate the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.
San Joaquin County Unincorporated Areas 060299
City of Manteca 060706
CITY OF MANTECA
SAN JOAQUIN COUNTY
JOINS PANEL 0630
JOINS PANEL 0780
JOINS PANEL 0645
NOTE: MAP AREA SHOWN ON THIS PANNEL IS LOCATED WITHIN TOWNSHIP 1 SOUTH, RANGE 7 EAST AND TOWNSHIP 2 SOUTH, RANGE 7 EAST.
LEGEND
SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
ZONE A
ZONE AE
ZONE AH
ZONE AO
ZONE AR
ZONE A99
ZONE V
ZONE VE
FLOODWAY AREAS IN ZONE AE
OTHER FLOOD AREAS
ZONE X
OTHER AREAS
ZONE X
ZONE D
COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
OTHERWISE PROTECTED AREAS (OPAs)
MAP REPOSITORIES
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP PANEL October 16, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
MAP SCALE 1" = 1000'
PANEL 0640F
FIRM
FLOOD INSURANCE RATE MAP
SAN JOAQUIN COUNTY, CALIFORNIA
AND INCORPORATED AREAS
PANEL 640 OF 950
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
MANTECA, CITY OF 060705 0640 F
SAN JOAQUIN COUNTY 060299 0640 F
MAP NUMBER 06077C0640F
EFFECTIVE DATE OCTOBER 16, 2009
Federal Emergency Management Agency

ATTACHMENT 4

Quantity Estimate Cross Sections, Manteca Dryland Levee Project Alternatives Analysis



CUTOFF WALL QUANTITY CROSS SECTION

SCALE: 1"=20'

NOTES

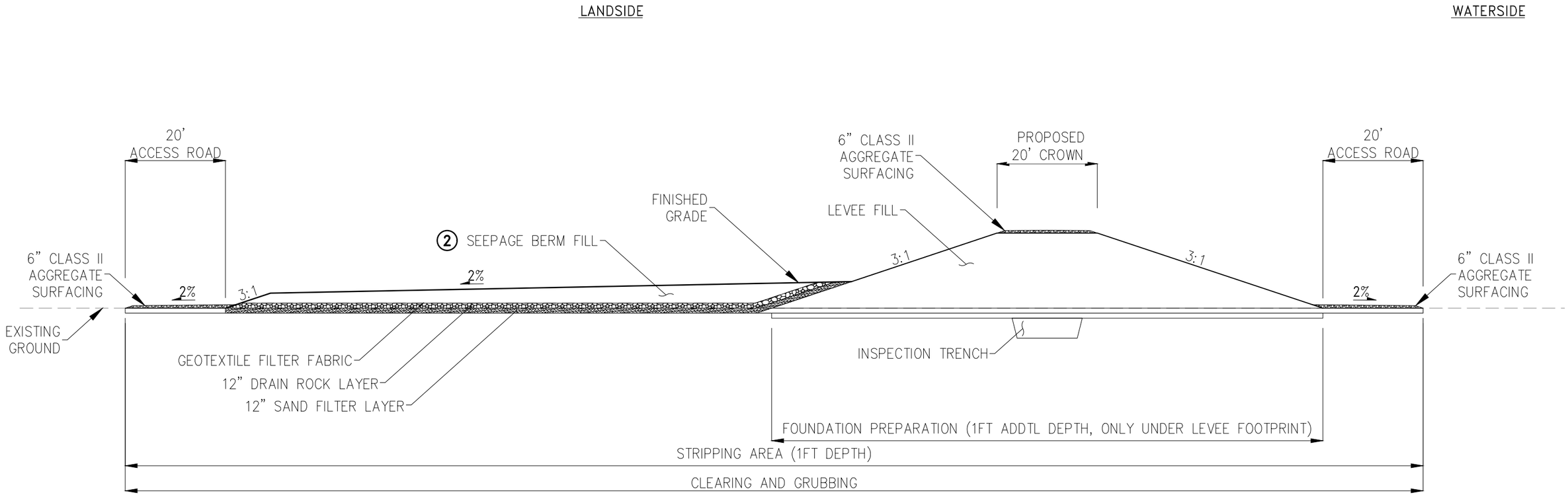
1. **EXISTING GROUND SURFACE USES CVFED LiDAR DATA (2008)**
2. MATERIAL FROM THE INSPECTION TRENCH AND FOUNDATION PREPARATION EXCAVATIONS IS ASSUMED TO BE HAULED AND DISPOSED OF OFFSITE.
3. THE MINIMUM TOP OF LEVEE (MTOL) ELEVATION IS EQUAL TO THE CURRENT 200YR WSE + FREEBOARD (5FT WEST OF AIRPORT ROAD, 3FT EAST OF AIRPORT ROAD) + UNCERTAINTY (1FT).

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS
3301 C St, Bldg. 100-B Tel 916.341.7760
Sacramento, CA 95816 Fax 916.341.7767

MANTECA DRYLAND LEVEE ALTERNATIVES ANALYSIS

CUTOFF WALL MITIGATION OPTION

QUANTITY ESTIMATE CROSS SECTION



100' SEEPAGE BERM QUANTITY CROSS SECTION

SCALE: 1"=20'

NOTES

1. EXISTING GROUND SURFACE USES CVFED LiDAR DATA (2008)
2. MATERIAL FROM THE INSPECTION TRENCH AND FOUNDATION PREPARATION EXCAVATIONS IS ASSUMED TO BE REUSED AS FILL FOR THE SEEPAGE BERM.
3. THE MINIMUM TOP OF LEVEE (MTOL) ELEVATION IS EQUAL TO THE CURRENT 200YR WSE + FREEBOARD (5FT WEST OF AIRPORT ROAD, 3FT EAST OF AIRPORT ROAD) + UNCERTAINTY (1FT).

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MANTECA DRYLAND LEVEE ALTERNATIVES ANALYSIS

SEEPAGE BERM MITIGATION OPTION

QUANTITY ESTIMATE CROSS SECTION

ATTACHMENT 5

Opinion of Probable Project Costs, Manteca Dryland Levee Project, Alternatives Analysis

MANTECA DRYLAND LEVEE
ALTERNATIVES ANALYSIS
SUMMARY OF ESTIMATED COSTS

WOOD RODGERS

Alternative	Estimated Cost										
	Land and Damages	Environ-mental Mitigation	Relocations	Levees/Flood Control Features	Airport Way Roadwork	Oleander Avenue Roadwork	Union Road Roadwork	Sub-Total	Planning, Engineering, & Design (8%)	Construction Management (6%)	Total
Alternative 1C (Length = 8,734 ft)	$14,549,000	$885,700	$2,390,200	$9,203,700	$607,700	$247,400	$205,200	$28,088,900	$1,728,500	$1,296,400	**$31,113,800**
Alternative 1S (Length = 8,734 ft)	$15,342,600	$1,071,600	$2,390,200	$11,859,000	$607,700	$247,400	$205,200	$31,723,700	$1,952,200	$1,464,200	**$35,140,100**
Alternative 2C (Length = 12,122 ft)	$13,191,100	$1,577,000	$1,782,500	$19,758,500	$648,900	$338,300	$0	$37,296,300	$2,295,200	$1,721,400	**$41,312,900**
Alternative 2S (Length = 12,122 ft)	$15,060,500	$1,999,300	$1,782,500	$25,792,200	$648,900	$338,300	$0	$45,621,700	$2,807,500	$2,105,600	**$50,534,800**

MANTECA DRYLAND LEVEE
ALTERNATIVES ANALYSIS
OPINION OF PROBABLE PROJECT COSTS
ALTERNATIVE 1C

WOOD RODGERS

Item No.	Item	Quantity	Unit	Unit Price	Cost	Contingency (%)	Contingency ($)	Cost w/Contingency
1	**Lands**							
1.1	Land Acquisition (Agricultural/Flood Control Feature)	12.2	AC	$45,000	$549,000	30%	$164,700	$713,700
1.2	Land Acquisition (Agricultural/O&M Easement)	8.1	AC	$45,000	$364,500	30%	$109,350	$473,850
1.3	Borrow Site Royalties	18.0	AC	$20,000	$360,000	30%	$108,000	$468,000
1.4	Land Acquisition (Residential)	1.0	LS	$9,918,000	$9,918,000	30%	$2,975,400	$12,893,400
	Subtotal - Land and Damages				***$11,191,500***		***$3,357,500***	***$14,549,000***
2	**Mitigation - Environmental**							
2.1	Environmental Mitigation	1	LS	7%	$681,303	30%	$204,391	$885,694
	Subtotal - Mitigation				***$681,400***		***$204,400***	***$885,700***
3	**Relocations**							
3.1	Mobilization and Demobilization	1	LS	5%	$87,551	30%	$26,265	$113,816
3.2	Utility Pole Relocation	14	EA	$30,000	$420,000	30%	$126,000	$546,000
3.3	SSJID Pipe Positive Closure Modifications	2	EA	$600,000	$1,200,000	30%	$360,000	$1,560,000
3.4	SSJID Drainage Ditch Relocation	0	LF	$120	$0	30%	$0	$0
3.5	SSJID Pipe Removal/Abandonment	0	LS	$50,000	$0	30%	$0	$0
3.6	Private Irrigation Allowance	8,734	LF	$15	$131,010	30%	$39,303	$170,313
	Subtotal - Relocations				***$1,838,600***		***$551,600***	***$2,390,200***
4	**Levees/Flood Control Features**							
4.1	Mobilization and Demobilization	1	LS	5%	$337,128	30%	$101,139	$438,267
4.2	Traffic Control (Rural)	1	LS	1%	$66,758	30%	$20,027	$86,786
4.3	Storm Water Pollution Control	1	LS	3%	$194,441	30%	$58,332	$252,773
4.4	Project Fencing	17,468	LF	$4	$61,138	30%	$18,341	$79,479
4.5	Clearing and Grubbing	21	AC	$4,000	$84,000	30%	$25,200	$109,200
4.6	Levee Stripping	21	AC	$5,000	$105,000	30%	$31,500	$136,500
4.7	Tree Removal (< 12" Diameter)	900	EA	$300	$270,000	30%	$81,000	$351,000
4.8	Tree Removal (> 12" Diameter)	40	EA	$600	$24,000	30%	$7,200	$31,200
4.9	Levee Fill (Embankment)	140,644	CY	$4	$562,576	30%	$168,773	$731,349
4.10	Seepage Berm Fill	0	CY	$4	$0	30%	$0	$0
4.11	Cutoff Wall - Soil Bentonite (< 50ft)	0	SF	$6	$0	30%	$0	$0
4.12	Cutoff Wall - Soil Bentonite (> 50ft)	399,500	SF	$7	$2,796,500	30%	$838,950	$3,635,450
4.13	Class 2 Aggregate Surfacing	10,999	CY	$90	$989,910	30%	$296,973	$1,286,883
4.14	Levee Erosion Control Seeding	9	AC	$4,500	$40,500	30%	$12,150	$52,650
4.15	Haul and Dispose of Unsuitable Material	38,586	CY	$15	$578,790	30%	$173,637	$752,427
4.16	Borrow Site Clearing and Grubbing	18	AC	$4,000	$72,000	30%	$21,600	$93,600
4.17	Borrow Site Stripping	18	AC	$5,000	$90,000	30%	$27,000	$117,000
4.18	Borrow Site Excavation and Hauling	145,009	CY	$3	$435,027	30%	$130,508	$565,535
4.19	Borrow Site Erosion Control Seeding	18	AC	$4,500	$81,000	30%	$24,300	$105,300
4.20	Levee Excavation	36,366	CY	$8	$290,928	30%	$87,278	$378,206
4.21	Drain Rock	0	CY	$100	$0	30%	$0	$0
4.22	Sand Filter Layer	0	CY	$100	$0	30%	$0	$0
4.23	Geotextile Filter Fabric	0	SY	$5	$0	30%	$0	$0
	Subtotal - Levees/Flood Control Features				***$7,079,700***		***$2,124,000***	***$9,203,700***
5	**Airport Way Roadwork**							
5.1	Mobilization and Demobilization	1	LS	5%	$21,430	30%	$6,500	$28,000
5.2	Traffic Control	1	LS	1%	$4,286	30%	$1,300	$5,600
5.3	SWPPP	1	LS	3%	$12,858	30%	$3,900	$16,800
5.4	AC Paving Removal (Airport)	54,400	SF	$2.25	$122,400	30%	$36,800	$159,200
5.5	Roadway Raise Fill (Airport)	6,148	CY	$4.00	$24,592	30%	$7,400	$32,000
5.6	Paving Replacement (Airport)	54,400	SF	$5.00	$272,000	30%	$81,600	$353,600
5.7	Striping (Airport)	1,600	LF	$6.00	$9,600	30%	$2,900	$12,500
	Subtotal - Airport Way Roadwork				***$467,200***		***$140,400***	***$607,700***
6	**Oleander Avenue Roadwork**							
6.1	Mobilization and Demobilization	1	LS	5%	$8,707	30%	$2,700	$11,500
6.2	Traffic Control	1	LS	1%	$1,741	30%	$600	$2,400
6.3	SWPPP	1	LS	3%	$5,224	30%	$1,600	$6,900
6.4	AC Paving Removal (Oleander)	21,600	SF	$2.25	$48,600	30%	$14,600	$63,200
6.5	Roadway Raise Fill (Oleander)	3,036	CY	$4.00	$12,144	30%	$3,700	$15,900
6.6	Paving Replacement (Oleander)	21,600	SF	$5.00	$108,000	30%	$32,400	$140,400
6.7	Striping (Oleander)	900	LF	$6.00	$5,400	30%	$1,700	$7,100
	Subtotal - Oleander Avenue Roadwork				***$189,900***		***$57,300***	***$247,400***
7	**Union Road Roadwork**							
7.1	Mobilization and Demobilization	1	LS	5%	$7,221	30%	$2,200	$9,500
7.2	Traffic Control	1	LS	1%	$1,444	30%	$500	$2,000
7.3	SWPPP	1	LS	3%	$4,333	30%	$1,300	$5,700
7.4	AC Paving Removal (Union)	19,200	SF	$2.25	$43,200	30%	$13,000	$56,200
7.5	Roadway Raise Fill (Union)	107	CY	$4.00	$428	30%	$200	$700
7.6	Paving Replacement (Union)	19,200	SF	$5.00	$96,000	30%	$28,800	$124,800
7.7	Striping (Union)	800	LF	$6.00	$4,800	30%	$1,500	$6,300
	Subtotal - Union Road Roadwork				***$157,500***		***$47,500***	***$205,200***
	ESTIMATED ALTERNATIVE 1C SUB-TOTAL				**$21,605,800**		**$6,482,700**	**$28,088,900**
8	**Planning, Engineering and Design**							
8.1	Planning, Engineering and Design (8%)				$1,728,464	0%	$0	$1,728,500
9	**Construction Management**							
9.1	Construction Management (6%)				$1,296,348	0%	$0	$1,296,400
	ESTIMATED ALTERNATIVE 1C TOTAL				**$24,630,612**		**$6,482,700**	**$31,113,800**
	ESTIMATED ALTERNATIVE 1C TOTAL (w/Escalation @ 3.3% for 3-years)				**$27,069,042.59**		**$7,124,487.30**	**$34,194,100**

MANTECA DRYLAND LEVEE
ALTERNATIVES ANALYSIS
OPINION OF PROBABLE PROJECT COSTS
ALTERNATIVE 1S

WOOD RODGERS

Item No.	Item	Quantity	Unit	Unit Price	Cost	Contingency (%)	Contingency ($)	Cost w/Contingency
1	**Lands**							
1.1	Land Acquisition (Agricultural/Flood Control Feature)	22.7	AC	$45,000	$1,021,500	30%	$306,450	$1,327,950
1.2	Land Acquisition (Agricultural/O&M Easement)	8.1	AC	$45,000	$364,500	30%	$109,350	$473,850
1.3	Borrow Site Royalties	24.9	AC	$20,000	$498,000	30%	$149,400	$647,400
1.4	Land Acquisition (Residential)	1.0	LS	$9,918,000	$9,918,000	30%	$2,975,400	$12,893,400
	Subtotal - Land and Damages				***$11,802,000***		***$3,540,600***	***$15,342,600***
2	**Mitigation - Environmental**							
2.1	Environmental Mitigation	1	LS	7%	$824,285	30%	$247,286	$1,071,571
	Subtotal - Mitigation				***$824,300***		***$247,300***	***$1,071,600***
3	**Relocations**							
3.1	Mobilization and Demobilization	1	LS	5%	$87,551	30%	$26,265	$113,816
3.2	Utility Pole Relocation	14	EA	$30,000	$420,000	30%	$126,000	$546,000
3.3	SSJID Pipe Positive Closure Modifications	2	EA	$600,000	$1,200,000	30%	$360,000	$1,560,000
3.4	SSJID Drainage Ditch Relocation	0	LF	$120	$0	30%	$0	$0
3.5	SSJID Pipe Removal/Abandonment	0	LS	$50,000	$0	30%	$0	$0
3.6	Private Irrigation Allowance	8,734	LF	$15	$131,010	30%	$39,303	$170,313
	Subtotal - Relocations				***$1,838,600***		***$551,600***	***$2,390,200***
4	**Levees/Flood Control Features**							
4.1	Mobilization and Demobilization	1	LS	5%	$434,393	30%	$130,318	$564,711
4.2	Traffic Control (Rural)	1	LS	1%	$86,018	30%	$25,806	$111,824
4.3	Storm Water Pollution Control	1	LS	3%	$250,539	30%	$75,162	$325,701
4.4	Project Fencing	17,468	LF	$4	$61,138	30%	$18,341	$79,479
4.5	Clearing and Grubbing	31	AC	$4,000	$124,000	30%	$37,200	$161,200
4.6	Levee Stripping	31	AC	$5,000	$155,000	30%	$46,500	$201,500
4.7	Tree Removal (< 12" Diameter)	1,200	EA	$300	$360,000	30%	$108,000	$468,000
4.8	Tree Removal (> 12" Diameter)	50	EA	$600	$30,000	30%	$9,000	$39,000
4.9	Levee Fill (Embankment)	138,425	CY	$4	$553,700	30%	$166,110	$719,810
4.10	Seepage Berm Fill	48,527	CY	$4	$194,108	30%	$58,232	$252,340
4.11	Cutoff Wall - Soil Bentonite (< 50ft)	0	SF	$6	$0	30%	$0	$0
4.12	Cutoff Wall - Soil Bentonite (> 50ft)	0	SF	$7	$0	30%	$0	$0
4.13	Class 2 Aggregate Surfacing	10,999	CY	$90	$989,910	30%	$296,973	$1,286,883
4.14	Levee Erosion Control Seeding	19	AC	$4,500	$85,500	30%	$25,650	$111,150
4.15	Haul and Dispose of Unsuitable Material	0	CY	$15	$0	30%	$0	$0
4.16	Borrow Site Clearing and Grubbing	25	AC	$4,000	$100,000	30%	$30,000	$130,000
4.17	Borrow Site Stripping	25	AC	$5,000	$125,000	30%	$37,500	$162,500
4.18	Borrow Site Excavation and Hauling	200,578	CY	$3	$601,734	30%	$180,520	$782,254
4.19	Borrow Site Erosion Control Seeding	25	AC	$4,500	$112,500	30%	$33,750	$146,250
4.20	Levee Excavation	36,366	CY	$8	$290,928	30%	$87,278	$378,206
4.21	Drain Rock	20,889	CY	$100	$2,088,900	30%	$626,670	$2,715,570
4.22	Sand Filter Layer	21,760	CY	$100	$2,176,000	30%	$652,800	$2,828,800
4.23	Geotextile Filter Fabric	60,578	SY	$5	$302,890	30%	$90,867	$393,757
	Subtotal - Levees/Flood Control Features				***$9,122,300***		***$2,736,700***	***$11,859,000***
5	**Airport Way Roadwork**							
5.1	Mobilization and Demobilization	1	LS	5%	$21,430	30%	$6,500	$28,000
5.2	Traffic Control	1	LS	1%	$4,286	30%	$1,300	$5,600
5.3	SWPPP	1	LS	3%	$12,858	30%	$3,900	$16,800
5.4	AC Paving Removal (Airport)	54,400	SF	$2.25	$122,400	30%	$36,800	$159,200
5.5	Roadway Raise Fill (Airport)	6,148	CY	$4.00	$24,592	30%	$7,400	$32,000
5.6	Paving Replacement (Airport)	54,400	SF	$5.00	$272,000	30%	$81,600	$353,600
5.7	Striping (Airport)	1,600	LF	$6.00	$9,600	30%	$2,900	$12,500
	Subtotal - Airport Way Roadwork				***$467,200***		***$140,400***	***$607,700***
6	**Oleander Avenue Roadwork**							
6.1	Mobilization and Demobilization	1	LS	5%	$8,707	30%	$2,700	$11,500
6.2	Traffic Control	1	LS	1%	$1,741	30%	$600	$2,400
6.3	SWPPP	1	LS	3%	$5,224	30%	$1,600	$6,900
6.4	AC Paving Removal (Oleander)	21,600	SF	$2.25	$48,600	30%	$14,600	$63,200
6.5	Roadway Raise Fill (Oleander)	3,036	CY	$4.00	$12,144	30%	$3,700	$15,900
6.6	Paving Replacement (Oleander)	21,600	SF	$5.00	$108,000	30%	$32,400	$140,400
6.7	Striping (Oleander)	900	LF	$6.00	$5,400	30%	$1,700	$7,100
	Subtotal - Oleander Avenue Roadwork				***$189,900***		***$57,300***	***$247,400***
7	**Union Road Roadwork**							
7.1	Mobilization and Demobilization	1	LS	5%	$7,221	30%	$2,200	$9,500
7.2	Traffic Control	1	LS	1%	$1,444	30%	$500	$2,000
7.3	SWPPP	1	LS	3%	$4,333	30%	$1,300	$5,700
7.4	AC Paving Removal (Union)	19,200	SF	$2.25	$43,200	30%	$13,000	$56,200
7.5	Roadway Raise Fill (Union)	107	CY	$4.00	$428	30%	$200	$700
7.6	Paving Replacement (Union)	19,200	SF	$5.00	$96,000	30%	$28,800	$124,800
7.7	Striping (Union)	800	LF	$6.00	$4,800	30%	$1,500	$6,300
	Subtotal - Union Road Roadwork				***$157,500***		***$47,500***	***$205,200***
	ESTIMATED ALTERNATIVE 1S SUB-TOTAL				**$24,401,800**		**$7,321,400**	**$31,723,700**
8	**Planning, Engineering and Design**							
8.1	Planning, Engineering and Design (8%)				$1,952,144	0%	$0	$1,952,200
9	**Construction Management**							
9.1	Construction Management (6%)				$1,464,108	0%	$0	$1,464,200
	ESTIMATED ALTERNATIVE 1S TOTAL				**$27,818,052**		**$7,321,400**	**$35,140,100**
	ESTIMATED ALTERNATIVE 1S TOTAL (w/Escalation @ 3.3% for 3-years)				**$30,572,039.15**		**$8,046,218.60**	**$38,619,000**

MANTECA DRYLAND LEVEE
ALTERNATIVES ANALYSIS
OPINION OF PROBABLE PROJECT COSTS
ALTERNATIVE 2C

WOOD RODGERS

Item No.	Item	Quantity	Unit	Unit Price	Cost	Contingency (%)	Contingency ($)	Cost w/Contingency
1	**Lands**							
1.1	Land Acquisition (Agricultural/Flood Control Feature)	25.8	AC	$45,000	$1,161,000	30%	$348,300	$1,509,300
1.2	Land Acquisition (Agricultural/O&M Easement)	11.2	AC	$45,000	$504,000	30%	$151,200	$655,200
1.3	Borrow Site Royalties	60.6	AC	$20,000	$1,212,000	30%	$363,600	$1,575,600
1.4	Land Acquisition (Residential)	1.0	LS	$7,270,000	$7,270,000	30%	$2,181,000	$9,451,000
	Subtotal - Land and Damages				***$10,147,000***		***$3,044,100***	***$13,191,100***
2	**Mitigation - Environmental**							
2.1	Environmental Mitigation	1	LS	7%	$1,213,016	30%	$363,905	$1,576,921
	Subtotal - Mitigation				***$1,213,100***		***$364,000***	***$1,577,000***
3	**Relocations**							
3.1	Mobilization and Demobilization	1	LS	5%	$65,292	30%	$19,587	$84,879
3.2	Utility Pole Relocation	5	EA	$30,000	$150,000	30%	$45,000	$195,000
3.3	SSJID Pipe Positive Closure Modifications	1	EA	$600,000	$600,000	30%	$180,000	$780,000
3.4	SSJID Drainage Ditch Relocation	2,700	LF	$120	$324,000	30%	$97,200	$421,200
3.5	SSJID Pipe Removal/Abandonment	1	LS	$50,000	$50,000	30%	$15,000	$65,000
3.6	Private Irrigation Allowance	12,122	LF	$15	$181,830	30%	$54,549	$236,379
	Subtotal - Relocations				***$1,371,200***		***$411,400***	***$1,782,500***
4	**Levees/Flood Control Features**							
4.1	Mobilization and Demobilization	1	LS	5%	$723,752	30%	$217,126	$940,878
4.2	Traffic Control (Rural)	1	LS	1%	$143,317	30%	$42,995	$186,312
4.3	Storm Water Pollution Control	1	LS	3%	$417,429	30%	$125,229	$542,658
4.4	Project Fencing	24,244	LF	$4	$84,854	30%	$25,456	$110,310
4.5	Clearing and Grubbing	37	AC	$4,000	$148,000	30%	$44,400	$192,400
4.6	Levee Stripping	37	AC	$5,000	$185,000	30%	$55,500	$240,500
4.7	Tree Removal (< 12" Diameter)	3,000	EA	$300	$900,000	30%	$270,000	$1,170,000
4.8	Tree Removal (> 12" Diameter)	20	EA	$600	$12,000	30%	$3,600	$15,600
4.9	Levee Fill (Embankment)	444,332	CY	$4	$1,777,328	30%	$533,198	$2,310,526
4.10	Seepage Berm Fill	0	CY	$4	$0	30%	$0	$0
4.11	Cutoff Wall - Soil Bentonite (< 50ft)	0	SF	$6	$0	30%	$0	$0
4.12	Cutoff Wall - Soil Bentonite (> 50ft)	784,550	SF	$7	$5,491,850	30%	$1,647,555	$7,139,405
4.13	Class 2 Aggregate Surfacing	15,265	CY	$90	$1,373,850	30%	$412,155	$1,786,005
4.14	Levee Erosion Control Seeding	21	AC	$4,500	$94,500	30%	$28,350	$122,850
4.15	Haul and Dispose of Unsuitable Material	69,281	CY	$15	$1,039,215	30%	$311,765	$1,350,980
4.16	Borrow Site Clearing and Grubbing	61	AC	$4,000	$244,000	30%	$73,200	$317,200
4.17	Borrow Site Stripping	61	AC	$5,000	$305,000	30%	$91,500	$396,500
4.18	Borrow Site Excavation and Hauling	488,272	CY	$3	$1,464,816	30%	$439,445	$1,904,261
4.19	Borrow Site Erosion Control Seeding	61	AC	$4,500	$274,500	30%	$82,350	$356,850
4.20	Levee Excavation	64,923	CY	$8	$519,384	30%	$155,815	$675,199
4.21	Drain Rock	0	CY	$100	$0	30%	$0	$0
4.22	Sand Filter Layer	0	CY	$100	$0	30%	$0	$0
4.23	Geotextile Filter Fabric	0	SY	$5	$0	30%	$0	$0
	Subtotal - Levees/Flood Control Features				***$15,198,800***		***$4,559,700***	***$19,758,500***
5	**Airport Way Roadwork**							
5.1	Mobilization and Demobilization	1	LS	5%	$22,881	30%	$6,900	$29,800
5.2	Traffic Control	1	LS	1%	$4,576	30%	$1,400	$6,000
5.3	SWPPP	1	LS	3%	$13,728	30%	$4,200	$18,000
5.4	AC Paving Removal (Airport)	54,400	SF	$2.25	$122,400	30%	$36,800	$159,200
5.5	Roadway Raise Fill (Airport)	13,404	CY	$4.00	$53,616	30%	$16,100	$69,800
5.6	Paving Replacement (Airport)	54,400	SF	$5.00	$272,000	30%	$81,600	$353,600
5.8	Striping (Airport)	1,600	LF	$6.00	$9,600	30%	$2,900	$12,500
	Subtotal - Airport Way Roadwork				***$498,900***		***$149,900***	***$648,900***
6	**Oleander Avenue Roadwork**							
6.1	Mobilization and Demobilization	1	LS	5%	$11,919	30%	$3,600	$15,600
6.2	Traffic Control	1	LS	1%	$2,384	30%	$800	$3,200
6.3	SWPPP	1	LS	3%	$7,152	30%	$2,200	$9,400
6.4	AC Paving Removal (Oleander)	31,200	SF	$2.25	$70,200	30%	$21,100	$91,300
6.5	Roadway Raise Fill (Oleander)	1,096	CY	$4.00	$4,384	30%	$1,400	$5,800
6.6	Paving Replacement (Oleander)	31,200	SF	$5.00	$156,000	30%	$46,800	$202,800
6.8	Striping (Oleander)	1,300	LF	$6.00	$7,800	30%	$2,400	$10,200
	Subtotal - Oleander Avenue Roadwork				***$259,900***		***$78,300***	***$338,300***
7	**Union Road Roadwork**							
7.1	Mobilization and Demobilization	1	LS	5%	$0	30%	$0	$0
7.2	Traffic Control	1	LS	1%	$0	30%	$0	$0
7.3	SWPPP	1	LS	3%	$0	30%	$0	$0
7.4	AC Paving Removal (Union)	0	SF	$2.25	$0	30%	$0	$0
7.5	Roadway Raise Fill (Union)	0	CY	$4.00	$0	30%	$0	$0
7.6	Paving Replacement (Union)	0	SF	$5.00	$0	30%	$0	$0
7.8	Striping (Union)	0	LF	$6.00	$0	30%	$0	$0
	Subtotal - Union Road Roadwork				***$0***		***$0***	***$0***
	ESTIMATED ALTERNATIVE 2C SUB-TOTAL				**$28,688,900**		**$8,607,400**	**$37,296,300**
8	**Planning, Engineering and Design**							
8.1	Planning, Engineering and Design (8%)				$2,295,112	0%	$0	$2,295,200
9	**Construction Management**							
9.1	Construction Management (6%)				$1,721,334	0%	$0	$1,721,400
	ESTIMATED ALTERNATIVE 2C TOTAL				**$32,705,346**		**$8,607,400**	**$41,312,900**
	ESTIMATED ALTERNATIVE 2C TOTAL (w/Escalation @ 3.3% for 3-years)				**$35,943,175.25**		**$9,459,532.60**	**$45,402,900**

MANTECA DRYLAND LEVEE
ALTERNATIVES ANALYSIS
OPINION OF PROBABLE PROJECT COSTS
ALTERNATIVE 2S

WOOD RODGERS

Item No.	Item	Quantity	Unit	Unit Price	Cost	Contingency (%)	Contingency ($)	Cost w/Contingency
1	**Lands**							
1.1	Land Acquisition (Agricultural/Flood Control Feature)	51.0	AC	$45,000	$2,295,000	30%	$688,500	$2,983,500
1.2	Land Acquisition (Agricultural/O&M Easement)	11.2	AC	$45,000	$504,000	30%	$151,200	$655,200
1.3	Borrow Site Royalties	75.8	AC	$20,000	$1,516,000	30%	$454,800	$1,970,800
1.4	Land Acquisition (Residential)	1.0	LS	$7,270,000	$7,270,000	30%	$2,181,000	$9,451,000
	Subtotal - Land and Damages				***$11,585,000***		***$3,475,500***	***$15,060,500***
2	**Mitigation - Environmental**							
2.1	Environmental Mitigation	1	LS	7%	$1,537,914	30%	$461,374	$1,999,288
	Subtotal - Mitigation				***$1,538,000***		***$461,400***	***$1,999,300***
3	**Relocations**							
3.1	Mobilization and Demobilization	1	LS	5%	$65,292	30%	$19,587	$84,879
3.2	Utility Pole Relocation	5	EA	$30,000	$150,000	30%	$45,000	$195,000
3.3	SSJID Pipe Positive Closure Modifications	1	EA	$600,000	$600,000	30%	$180,000	$780,000
3.4	SSJID Drainage Ditch Relocation	2,700	LF	$120	$324,000	30%	$97,200	$421,200
3.5	SSJID Pipe Removal/Abandonment	1	LS	$50,000	$50,000	30%	$15,000	$65,000
3.6	Private Irrigation Allowance	12,122	LF	$15	$181,830	30%	$54,549	$236,379
	Subtotal - Relocations				***$1,371,200***		***$411,400***	***$1,782,500***
4	**Levees/Flood Control Features**							
4.1	Mobilization and Demobilization	1	LS	5%	$944,767	30%	$283,430	$1,228,197
4.2	Traffic Control (Rural)	1	LS	1%	$187,083	30%	$56,125	$243,207
4.3	Storm Water Pollution Control	1	LS	3%	$544,901	30%	$163,470	$708,371
4.4	Project Fencing	24,244	LF	$4	$84,854	30%	$25,456	$110,310
4.5	Clearing and Grubbing	63	AC	$4,000	$252,000	30%	$75,600	$327,600
4.6	Levee Stripping	63	AC	$5,000	$315,000	30%	$94,500	$409,500
4.7	Tree Removal (< 12" Diameter)	4,600	EA	$300	$1,380,000	30%	$414,000	$1,794,000
4.8	Tree Removal (> 12" Diameter)	25	EA	$600	$15,000	30%	$4,500	$19,500
4.9	Levee Fill (Embankment)	439,973	CY	$4	$1,759,892	30%	$527,968	$2,287,860
4.10	Seepage Berm Fill	106,701	CY	$4	$426,804	30%	$128,041	$554,845
4.11	Cutoff Wall - Soil Bentonite (< 50ft)	0	SF	$6	$0	30%	$0	$0
4.12	Cutoff Wall - Soil Bentonite (> 50ft)	0	SF	$7	$0	30%	$0	$0
4.13	Class 2 Aggregate Surfacing	15,265	CY	$90	$1,373,850	30%	$412,155	$1,786,005
4.14	Levee Erosion Control Seeding	46	AC	$4,500	$207,000	30%	$62,100	$269,100
4.15	Haul and Dispose of Unsuitable Material	0	CY	$15	$0	30%	$0	$0
4.16	Borrow Site Clearing and Grubbing	76	AC	$4,000	$304,000	30%	$91,200	$395,200
4.17	Borrow Site Stripping	76	AC	$5,000	$380,000	30%	$114,000	$494,000
4.18	Borrow Site Excavation and Hauling	611,083	CY	$3	$1,833,249	30%	$549,975	$2,383,224
4.19	Borrow Site Erosion Control Seeding	76	AC	$4,500	$342,000	30%	$102,600	$444,600
4.20	Levee Excavation	64,923	CY	$8	$519,384	30%	$155,815	$675,199
4.21	Drain Rock	41,023	CY	$100	$4,102,300	30%	$1,230,690	$5,332,990
4.22	Sand Filter Layer	42,732	CY	$100	$4,273,200	30%	$1,281,960	$5,555,160
4.23	Geotextile Filter Fabric	118,965	SY	$5	$594,825	30%	$178,448	$773,273
	Subtotal - Levees/Flood Control Features				***$19,840,200***		***$5,952,100***	***$25,792,200***
5	**Airport Way Roadwork**							
5.1	Mobilization and Demobilization	1	LS	5%	$22,881	30%	$6,900	$29,800
5.2	Traffic Control	1	LS	1%	$4,576	30%	$1,400	$6,000
5.3	SWPPP	1	LS	3%	$13,728	30%	$4,200	$18,000
5.4	AC Paving Removal (Airport)	54,400	SF	$2.25	$122,400	30%	$36,800	$159,200
5.5	Roadway Raise Fill (Airport)	13,404	CY	$4.00	$53,616	30%	$16,100	$69,800
5.6	Paving Replacement (Airport)	54,400	SF	$5.00	$272,000	30%	$81,600	$353,600
5.7	Striping (Airport)	1,600	LF	$6.00	$9,600	30%	$2,900	$12,500
	Subtotal - Airport Way Roadwork				***$498,900***		***$149,900***	***$648,900***
6	**Oleander Avenue Roadwork**							
6.1	Mobilization and Demobilization	1	LS	5%	$11,919	30%	$3,600	$15,600
6.2	Traffic Control	1	LS	1%	$2,384	30%	$800	$3,200
6.3	SWPPP	1	LS	3%	$7,152	30%	$2,200	$9,400
6.4	AC Paving Removal (Oleander)	31,200	SF	$2.25	$70,200	30%	$21,100	$91,300
6.5	Roadway Raise Fill (Oleander)	1,096	CY	$4.00	$4,384	30%	$1,400	$5,800
6.6	Paving Replacement (Oleander)	31,200	SF	$5.00	$156,000	30%	$46,800	$202,800
6.7	Striping (Oleander)	1,300	LF	$6.00	$7,800	30%	$2,400	$10,200
	Subtotal - Oleander Avenue Roadwork				***$259,900***		***$78,300***	***$338,300***
7	**Union Road Roadwork**							
7.1	Mobilization and Demobilization	1	LS	5%	$0.00	30%	$0	$0
7.2	Traffic Control	1	LS	1%	$0	30%	$0	$0
7.3	SWPPP	1	LS	3%	$0	30%	$0	$0
7.4	AC Paving Removal (Union)	0	SF	$2.25	$0	30%	$0	$0
7.5	Roadway Raise Fill (Union)	0	CY	$4.00	$0	30%	$0	$0
7.6	Paving Replacement (Union)	0	SF	$5.00	$0	30%	$0	$0
7.7	Striping (Union)	0	LF	$6.00	$0	30%	$0	$0
	Subtotal - Union Road Roadwork				***$0***		***$0***	***$0***
	ESTIMATED ALTERNATIVE 2S SUB-TOTAL				**$35,093,200**		**$10,528,600**	**$45,621,700**
8	**Planning, Engineering and Design**							
8.1	Planning, Engineering and Design (8%)				$2,807,456	0%	$0	$2,807,500
9	**Construction Management**							
9.1	Construction Management (6%)				$2,105,592	0%	$0	$2,105,600
	ESTIMATED ALTERNATIVE 2S TOTAL				**$40,006,248**		**$10,528,600**	**$50,534,800**
	ESTIMATED ALTERNATIVE 2S TOTAL (w/Escalation @ 3.3% for 3-years)				**$43,966,866.55**		**$11,570,931.40**	**$55,537,800**