APPENDIX E

South County Infrastructure Project
Updated Preliminary Geotechnical Basis of Design Report

UPDATED DRAFT PRELIMINARY GEOTECHNICAL BASIS OF DESIGN REPORT

Olivehurst Public Utilities District

South Yuba Sewer and Water Infrastructure Project

Olivehurst, CA

April 2021

Prepared for:

JACOBS

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Blackburn File No. 3842.X
April 30, 2021

Mr. Steve DeCou
Vice President and Principal Project Manager
Jacobs Engineering Group, Inc.
2485 Natomas Park Drive, Suite 600
Sacramento, CA 95833

Subject: **UPDATED DRAFT PRELIMINARY GEOTECHNICAL BASIS OF DESIGN REPORT**
Olivehurst Public Utilities District
South Yuba Sewer and Water Infrastructure Project
Olivehurst, California

Dear Mr. DeCou,

Blackburn Consulting (Blackburn) is pleased to submit this Updated Draft Preliminary Geotechnical Basis of Design Report for the Olivehurst Public Utilities District (OPUD) South Yuba County Sewer and Water Infrastructure project in Olivehurst, California. Blackburn prepared this report in accordance with our May 14, 2020 Proposal and August 21, 2020 Agreement. This updated report includes responses to Jacobs review comments. It does not include information on borings completed since our original report, because laboratory tests are pending.

Thank you for selecting Blackburn to be on your design team. Please call if you have questions or require additional information.

Sincerely,

BLACKBURN CONSULTING

Prepared by:	Reviewed by:
Rob Pickard, C.E.G.	Bob Lokteff, G.E., P.E.
Senior Engineering Geologist	Principal Geotechnical Engineer

Copies: 1 to Addressee (PDF).

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1 INTRODUCTION

1.1 Purpose

Blackburn Consulting (Blackburn) prepared this Updated Draft Preliminary Geotechnical Basis of Design Report (Draft Preliminary GBODR) for the Olivehurst Public Utility District (OPUD) South Yuba Sewer and Water Infrastructure Project (Project) in Olivehurst, California. This report includes the responses to Jacobs' review comments. It does not include information on borings completed since our original report, because laboratory tests are pending. This report contains descriptions of the surface and subsurface conditions, site geology, and preliminary geotechnical design considerations.

Blackburn prepared this report for Jacobs Engineering Group (Jacobs) and the project design team to use during preliminary design. This report shall not be used for final design or relied upon by others, or for different locations or improvements without the written consent of Blackburn. The design considerations in this report are based on limited information and knowledge of the project alignment and structure locations. Blackburn will perform additional subsurface exploration, laboratory testing, engineering analysis and prepare a Final GBODR for final design.

This report contains separate sections for Sewer and Water Pipelines, Trenchless Pipeline Crossings, Pump Stations and Lift Stations, WWTP Improvements, and Water Tank and Booster Station. Each section contains subsections on subsurface conditions, laboratory test results, site geology and seismicity, ground water, and design considerations (except for trenchless crossings). Jacobs Engineering Group, Inc. is providing geotechnical design recommendations for the trenchless crossings separate from this report. Geotechnical information pertinent to each project component is repeated in each report section as necessary to facilitate ease of preliminary design by different companies that are using this report.

1.2 Scope of Services

To prepare this report, Blackburn:

- Discussed the proposed improvements with Mr. Steve DeCou and Ms. Myra Au (Jacobs); Mr. Sean Minard (MHM); Joe Domenichelli, Sara Rogers, and Daryl Heigher (Domenichelli and Associates); and Jim Carson (Affinity Engineering).
- Reviewed the Draft Preliminary Plan and Profile sheets provided by MHM.
- Reviewed available geotechnical information for the Olivehurst WWTP and Caltrans Log of Test Borings for bridge structures near the project alignment.
- Observed the subsurface conditions in forty-three borings drilled along the project alignment in August and September 2020 and in five test pits excavated at the Olivehurst Wastewater Treatment Plant on October 19, 2020.
- Performed laboratory tests on representative soil samples obtained from the exploratory borings.
- Performed preliminary engineering analysis and calculations to develop our preliminary design considerations.
- Reviewed and responded to Jacobs' comments on our December 11, 2020 Draft Preliminary Geotechnical Basis of Design Report.

1.3 Project Description and Location

The proposed project components include:

- About 8½ miles of 8" to 24" diameter sewer gravity and force main,
- About 9 miles of 24" diameter water force water main,
- One Highway 70 water line trenchless crossing,
- One Highway 70 sewer line trenchless crossing,
- Two Highway 65 sewer line trenchless crossings,
- Six to eight sewer and/or water line creek/canal crossings,
- Eight new sewer pump/lift stations.
- Olivehurst WWTP improvements consisting of a new secondary clarifier, concrete-lined equalization basin, and on-site piping.
- A new water well site including a 1 MG steel storage tank, booster station and on-site piping near the Hard Rock Hotel and Casino.

Figure 1 shows the general location of the proposed improvements and Figure 2 shows the site location.

2 PROJECT GEOLOGY AND SOIL SURVEY

2.1 Geology and Soil Survey

We reviewed geology maps and the United States Department of Agriculture's (USDA) Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm). The "Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierra Foothills, California" (Helley and Harwood, 1985) shows the project is underlain by:

- Holocene Alluvium - unweathered gravel, sand, and silt deposited by present-day stream and river systems.
- Holocene Basin Deposits - Undivided as silt and clay derived from the same sources as modern alluvium. Thickness in the valley varies from 3 to 6 ft. along the perimeter up to 200 ft. in the center.
- Upper Member, Modesto Formation - unconsolidated, unweathered gravel, sand, silt, and clay. Deposits belonging to the upper member of the Modesto are only a few meters thick and generally form a thin veneer deposited on older alluvial deposits.
- Upper Member, Riverbank Formation - Unconsolidated but compact, dark-brown to red alluvium composed of gravel, sand, silt and clay.

Figure 3 shows the geologic formations within the project area.

The Fault Activity Map of California[1] does not identify Historic or Holocene age faults (displacement within the last 11,700 years) within or adjacent to the project site. The nearest mapped fault is the Late

[1] Jennings, Charles W., and Bryant, William A., 2010 Fault Activity Map of California: California Geological Survey, Geologic Data Map No. 6.

Quaternary Foothills Fault System, Spenceville fault, located about 12 miles to the east. The nearest active mapped fault is the Cleveland Hill Fault located approximately 25 miles north of the site.
The USDA web soil survey indicates that the site is underlain by mostly San Joaquin loam (Map Unit 214, 217) and also Hollenbeck silty clay loam (Map Unit 131, 134), Conejo Loam (Map Units 141, 142, 143), and Oakdale Sandy loam (Map Unit 197, 198). Table 2.1 presents classification properties of these soil units according to the USDA soil survey.

Table 2.1: USDA Soil Properties

Map Unit Name/Symbol	Depth (in)	USCS Classification	Percent fines	Liquid Limit	Plasticity Index
San Joaquin loam/214, 217	0 to 25	Silt, Silty Clay, Lean Clay	50 to 70	15 to 50	0 to 35
Hollenbeck silty clay loam/131, 134	0 to 43	Lean Clay, Fat Clay	85 to 95	40 to 60	20 to 35
Conejo loam/141,142,143	0 to 65	Lean Clay	58 to 79	31 to 49	13 to 25
Oakdale Sandy loam/197, 198	0 to 70	Silty Sand, Clayey Sand	15 to 50	20 to 30	0 to 10

Figure 4 shows where these USDA soil units underlie the project site.

3 SEWER AND WATER PIPELINES

3.1 Site Location and Description

The proposed Project sewer and water pipeline alignments extend along the following streets in and near Olivehurst in South Yuba County, California:

- Olivehurst Avenue between 11th Avenue and 14th Avenue.
- Mary Avenue.
- McGowan Parkway between Mary Avenue and Rancho Road.
- Olive Avenue from McGowan Parkway approximately 500 ft north, where it crosses Highway 65 to the cul de sac at the north end of Rancho Road.
- Rancho Road, from the northern cul de sac south to where it crosses Highway 65 to Morrison Road.
- Forty Mile Road from the Toyota Amphitheater to Rancho Road.
- Rossler Road from Forty Mile Road approximately 1250 ft north, where it crosses Highway 65 to the cul de sac at the south end of Shimer Road.
- Shimer Road.

Pipeline depths will generally range from 5 to 18 feet below the ground surface (bgs) based on input from design team members. However, final pipe sizes and depths have not been determined.

The pipeline alignment is generally level, with ground surface elevations ranging from about 60 to 70 feet and up to about 76 feet in the south.

The western portion of the pipeline along Olivehurst Ave, Mary Ave, McGowan Pkwy, and Olive Ave extends predominantly through residential portions of Olivehurst. Photos 1 through 3 show the conditions along these streets.

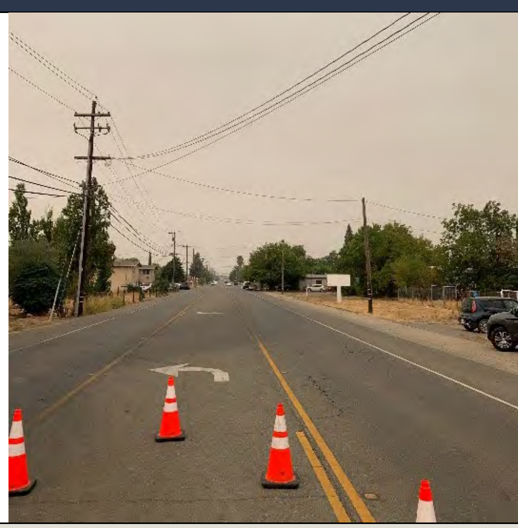
Photo 1: Olivehurst Avenue

Looking north on Olivehurst Avenue from 9th Ave.

Photo 2: Mary Avenue

Looking south along Project alignment near Station 118+00.

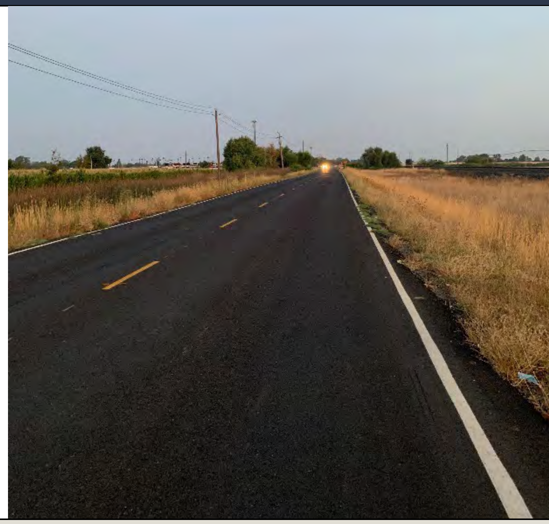
Photo 3: McGowan Avenue



Looking west along Project alignment near Station 206+60.

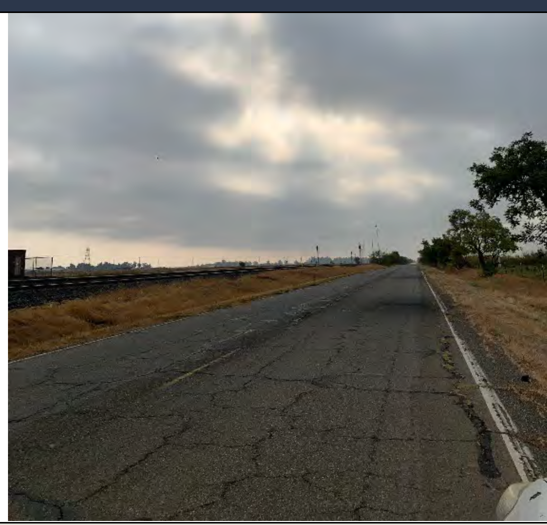
The eastern and southern pipeline alignments extend along rural roads (Rancho Rd, Morrison Rd, Forty Mile Rd, and Shimer Rd). The roads in these portions of the alignment are generally flanked by a drainage ditch on one or both sides. Photos 4 through 8 show the conditions along these streets.

Photo 4: Rancho Road



Looking northwest along Project alignment near Station 329+60.

Photo 5: Rancho Road

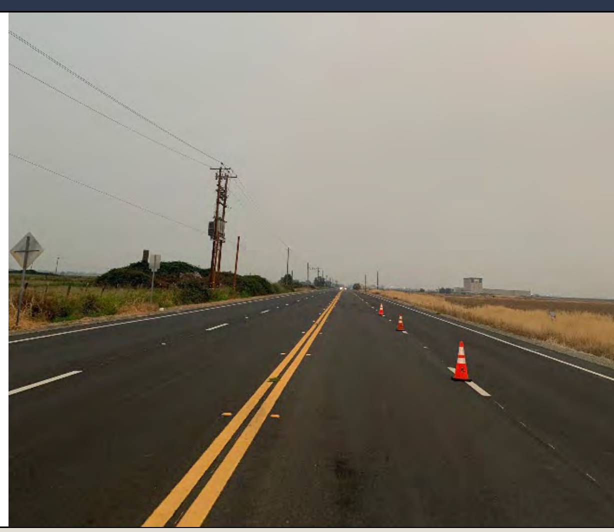


Looking southeast along Project alignment near Station 442+30.

Photo 6: Shimer Road

Looking south along Project Alignment towards intersection of Shimer Road and Plute Road near station 33+00.

Photo 7: Forty Mile Road



Looking north along Project alignment near Station 119+90.

Photo 8: Forty Mile Road

Looking north along Project alignment near Station 404+60.

Appendix A1 shows the proposed pipeline alignments and Figure 2 shows the pipeline alignments, our approximate subsurface exploratory boring locations (all pipeline boring locations have been drilled and laboratory testing is ongoing)and the proposed improvements.

3.2 Geology, Soil Survey, Faulting

See Section 2.1 for a discussion of geology and faulting along the pipeline alignment. Figure 3 shows the mapped geologic units within the project site. Figure 4 shows the USDA soil types mapped within the project area. Figure 2.1 shows the mapped geologic formations and USDA soil types within each pipeline segment.

3.3 Field Work and Laboratory Testing

3.3.1 Exploratory Borings

Blackburn drilled, logged and sampled 43 borings along the pipeline alignments to characterize the site subsurface conditions. Our subcontractor, Taber Drilling, drilled the borings to depths ranging from about 15 to 50 feet below the existing ground elevation. Appendix A1 shows the proposed site improvements and approximate boring locations. The borings logs are included in Appendix A2 (does not include borings where laboratory testing is ongoing).

Taber drilled the borings using a combination of 4-inch diameter solid-stem auger and mud-rotary. Soil samples were obtained by Taber at various intervals using a 3.0-inch O.D. Modified California (MC) sampler (equipped with 2.4-inch diameter steel liners) or 2–inch O.D. Standard Penetration (SPT) sampler. Samples were driven with an automatic hammer, weighing 140-pounds and falling approximately 30-inches per blow. We also collected bulk samples at various depths within the borings.

Blackburn's project engineers/geologists Daniel Contreras, Luke Morrell, and Sophie Stuart logged the borings and retained samples for laboratory testing.

3.3.2 Laboratory Testing

We performed the following laboratory tests on representative soil samples from the exploratory borings:

- Unit weight and moisture content tests for in-situ soil property characterization.
- Sieve analysis and Plasticity index for soil classification.
- Direct shear and unconfined compression tests for soil strength analysis.
- Soil corrosivity (pH, resistivity, sulfate and chlorides) for corrosion considerations.

Refer to Section 3.5.8 for a description and evaluation of the corrosivity test results.

The boring logs in Appendix A2 show unit weight and moisture content results. Appendix A3 presents the other laboratory test results.

3.4 Subsurface Findings

3.4.1 General Subsurface Soil Conditions

We predominantly encountered very stiff to hard clay and sandy clay in borings drilled along the proposed alignment. We encountered medium dense to very dense sand and clayey sand lenses in scattered areas throughout the alignment. Some of the soil layers contained gravel.

Table 3.1 summarizes the subsurface soil conditions we encountered along the pipeline alignment.

Table 3.1: Subsurface Soil Conditions

Street	Reach ID (Approximate Station)*	Boring ID	Boring Depth	Approximate Boring Station	Approximate Existing Pavement		Approximate Depth to GW (ft)	Mapped Geologic Unit*	USDA Soil Type*	General Subsurface Soil Conditions within upper 20 feet**
					AC (in)	AB (in)				
Mary Ave	Reach 1 (100+00 - 139+81)	P-1	21.5	102+00	6.5	Not Encountered	Not Encountered	Riverbank Formation	214	Very stiff to hard lean clay and sandy lean clay within the upper 15 ft., underlain by medium dense clayey sand and very stiff sandy clay.
		P-2	21.5	118+00	4	3	Not Encountered		217	
		P-3	21.5	132+70	1	6	Not Encountered		217	
McGowan Pkwy	Reach 2 (200+00 - 222+00)	LS-2	-	lab pending	-	-	-	Riverbank Formation	-	Hard sandy lean clay in upper 5 ft., underlain by hard lean clay with sand and medium stiff lean clay.
		P-4	15.0	206+60	6	15	Not Encountered		217	
		TC-1A	-	planned future boring	-	-	-		-	
		TC-1C	-	planned future boring	-	-	-		-	
	Reach 3 (222+00 - 232+00)	LS-3	-	planned future boring	-	-	-	Holocene Alluvium	-	Hard silt and lean clay in upper 9 ft., underlain by hard lean clay.
		P-5	21.5	229+60	3	3	Not Encountered		198	
	Reach 4 (232+00 - 264+36)	P-6	16.5	237+30	4	6	Not Encountered	Riverbank Formation and Basin Deposits	217	Lean clay to sandy lean clay.
		P-7	16.5	245+50	3	4	Not Encountered		217	
Olive Ave	Reach 5 (10+00 - 16+20)	TC-2AA	51.5	19+60	6	Not Encountered	29	Basin Deposits	134	Very stiff to hard lean clay and sandy lean clay.
Rancho Rd	Reach 6 (300+00 - 318+00)	TC-2C	51.5	300+10	2.5	12	27.5	Riverbank Formation	134	Hard lean clay, lean clay with sand, and silt.
		P-8	15.0	309+90	NA	NA	Not Encountered		214	
	Reach 7 (318+00 - 326+50)	TC-7A	51.5	321+30	9	12	23	Modesto Formation	214	Stiff to hard lean clay and lean clay with sand within the upper 15 ft., underlain by hard silt to sandy silt and lean clay.
		TC-7B	51.5	323+30	8.5	16	15		142	
	Reach 8 (326+50 - 396+00)	TC-8A	51.5	329+60	9	9	14	Riverbank Formation and Modesto Formation	142	Very stiff to hard lean clay and lean clay with sand within the upper 10 to 15 ft., underlain by approximately 1 to 6 ft. of medium dense to dense sand to clayey sand and stiff to very stiff sandy lean clay (pockets with gravel)
		TC-8B	51.5	331+10	8	16	15		142	
		P-9	15.0	340+60	NA	NA	Not Encountered		214	
		TC-9A	51.5	349+70	8	16	25		142	
		TC-9B	51.5	351+20	6	12	25		142	

Table 3.1: Subsurface Soil Conditions

Street	Reach ID (Approximate Station)*	Boring ID	Boring Depth	Approximate Boring Station	Approximate Existing Pavement AC (in)	Approximate Existing Pavement AB (in)	Approximate Depth to GW (ft)	Mapped Geologic Unit*	USDA Soil Type*	General Subsurface Soil Conditions within upper 20 feet**
		P-10	15.0	357+60	NA	NA	Not Encountered		214	
		LS-4	-	lab pending	-	-	-		214	
		P-11	21.5	376+10	NA	NA	Not Encountered		214	
		P-12	14.5	388+10	9	15	Not Encountered		214	
	Reach 9 (396+00 - 401+00)	TC-10A	51.5	400+00	7	10	24	Riverbank Formation	214	Very stiff to hard silt and clay with varying amounts of sand.
	Reach 10 (401+00 - 448+00)	TC-10B	51.5	402+60	NA	NA	24	Riverbank Formation	214	Stiff to hard lean clay to sandy lean clay in upper 12 to 16 ft., underlain by medium dense to dense sand to clayey sand (depth to sand generally decreases up station). Very dense clayey gravel present near Kimball creek.
		LS-5	-	lab pending	-	-	-		214	
		P-13	21.5	410+00	NA	NA	Not Encountered		214	
		TC-14	41.5	427+90	8	12	28		214	
		P-14	21.0	442+30	3	10	Not Encountered		214	
	Reach 11 (448+00 – 484+00)	P-15	16.5	450+10	NA	NA	Not Encountered	Riverbank Formation	131	Hard lean clay within the upper 5 ft, underlain by approximately 10 ft of medium dense clayey sand and hard sandy clay over hard lean clay.
		LS-6	-	planned future boring	-	-	-		131	
		P-16	21.5	468+40	4	32	Not Encountered		131	
		P-17	21.5	483+80	NA	NA	Not Encountered		214	
	Reach 12 (***)	P-18	15.0	***	NA	NA	Not Encountered	Riverbank Formation	214	Hard lean clay.
40 Mile Rd	Reach 14 (70+00 - 125+00)	P-24	15.0	70+00	7	10	Not Encountered	Basin Deposits and Riverbank Formation	214	Very stiff to hard lean clay, lean clay with sand, silt, silt with sand within the upper 20 ft. (Very dense poorly-graded sand with silt below 18 ft. in Boring P-26)
		P-25	20.0	78+30	7	10	Not Encountered		214	
		TC-13	51.4	85+80	6.5	12	26		214	
		P-26	21.5	94+60	6.5	14	Not Encountered		131	
		P-27	21.0	119+90	6	12	Not Encountered		214	
	Reach 15 (125+00 - 155+00)	P-28	21.5	139+00	6	12	Not Encountered	Riverbank Formation	214	Very stiff to hard lean clay to sandy lean clay within the upper 8 to 10 ft., underlain by a layer of very stiff to hard silt with sand which is approximately 13 ft. thick in boring TC-12B and pinches out to the

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Table 3.1: Subsurface Soil Conditions

Street	Reach ID (Approximate Station)*	Boring ID	Boring Depth	Approximate Boring Station	Approximate Existing Pavement AC (in)	Approximate Existing Pavement AB (in)	Approximate Depth to GW (ft)	Mapped Geologic Unit*	USDA Soil Type*	General Subsurface Soil Conditions within upper 20 feet**
		TC-12A	51.5	147+50	3	4	24	and Modesto Formation	142	south (by boring P-28). Underlain by approximately 3 to 6 ft. of medium dense to very dense clayey sand over medium dense poorly-graded sand to poorly-graded sand with clay.
		TC-12B	51.5	149+80	7	12	17		142	
		LS-8	-	planned future boring	-	-	-		-	-
	Reach 16 (155+00 - 188+00)	P-29	16.5	163+50	6	12	Not Encountered	Riverbank Formation	214	Hard sandy lean clay and gravelly lean clay within the upper 4 to 5 ft., underlain by medium dense to dense clayey sand and stiff sandy lean clay to approximately 14 to 15 ft. deep.
		P-30	14.5	180+10	NA	NA	Not Encountered		214	
	Reach 17 (188+00 - 203+00)	P-32	15.0	196+90	NA	NA	Not Encountered	Riverbank Formation	214	Very stiff silt with sand within the upper 3 ft., underlain by hard lean clay and lean clay with sand to depth of 15 ft.
Rossler Rd	Reach 18 (550+00 - 562+70)	TC-4A	-	planned future boring	-	-	-	Riverbank Formation	-	
		TC-4B	-	planned future boring	-	-	-	Riverbank Formation	-	-
Olivehurst Ave	***	OS-1	21.5	***	6	6	Not Encountered	Riverbank Formation	217	Very stiff to hard lean clay and sandy lean clay within the upper 9 ft., underlain by approximately 6 ft of very dense clayey sand over very stiff lean clay. Hard sandy silt greater than 20 ft. below ground surface.
	***	OS-2	21.5	***	9	Not Encountered	Not Encountered	Riverbank Formation	217	Very stiff to hard lean clay and sandy lean clay.
		LS-1		lab pending	-	-	-		-	

*Refer to Section 2.1 for description of geologic formation and USDA mapped soil type.
**Depths are approximate.
***Stationing not available at time of this report.

3.4.2 Groundwater

We generally observed groundwater at depths of 23 to 29 feet below the ground surface in borings drilled August through September 2020. In three borings near Reeds Creek on Rancho Road, we observed groundwater at depths of 14 to 15 feet. We encountered groundwater 17 feet below the ground surface in one boring on Forty Mile Road just north of Kimball Creek.

Table 3.2 lists the borings and depths where we encountered groundwater.

Table 3.2: Groundwater Summary

Boring	Approximate Station	Boring Depth (ft)	Approximate Depth to Water (ft)
TC-2AA	19+60	51.5	29
TC-2C	300+10	51.5	27.5
TC-7A	321+30	51.5	23
TC-7B	323+30	51.5	15
TC-8A	329+60	51.5	14
TC-8B	331+10	51.5	15
TC-9A	349+70	51.5	25
TC-9B	351+20	51.5	25
TC-10A	400+00	51.5	24
TC-10B	402+60	51.5	24
TC-12A	147+50	51.5	24
TC-12B	149+80	51.5	17
TC-13	85+80	51.4	26
TC-14	427+90	41.5	28

We reviewed groundwater level data for nearby wells available at the California Department of Water Resources website (http://www.water.ca.gov/waterdatalibrary/) and using the Sustainable Groundwater Management Act (SGMA) data viewer (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels). Based on this information, the depth to groundwater across the site typically ranges from 20 to 30 feet, although it occasionally is measured above 20 feet or below 30 feet. Relatively shallow perched water may occur within the near-surface soils during the winter and spring months, and adjacent to the existing canals and streams.

Groundwater and perched water levels can fluctuate due to changes in precipitation, creek levels, canal levels, irrigation, pumping of wells, and other factors.

3.4.3 Existing Pavement Sections

We drilled 30 of the 43 borings in the paved roadway.

- Along Olivehurst Ave, the pavement section consisted of about 6 to 9 inches of AC over 0 to 6 inches of AB.
- Along Mary Ave, the pavement section consisted of about 1 to 6½ inches of Asphalt Concrete (AC) over 0 to 3 inches of Aggregate Base (AB).
- Along McGowan Ave west of Highway 70, the pavement section consisted of about 6 inches of AC over 15 inches of AB.
- Along McGowan Ave east of Highway 70, the pavement section consisted of about 3 to 6 inches of AC over 3 to 6 inches of AB.
- Along Rancho Rd, the pavement section consisted of about 2½ to 9 inches of AC over 9 to 16 inches of AB (Boring P-16 had approximately 32 inches of AB).
- Along Forty Mile Rd, the pavement section generally consisted of about 6 to 7 inches of AC over 10 to 14 inches of AB (boring log TC-12A indicates 3 inches of AC over 4 inches of AB).

Table 3.1 includes approximate pavement section thickness encountered in each boring.

3.5 Preliminary Design Considerations – Sewer and Gravity Force Main

3.5.1 Alignment Ground Suitability

The ground conditions along the proposed pipeline alignment will be suitable for the planned improvements when constructed in accordance with the project plans, industry standards, and our geotechnical recommendations.

3.5.2 Geologic Hazards

- Faulting—The potential for surface rupture or creep due to faulting at the site is very low. The Fault Activity Map of California[2] and the Geologic Map of the Sacramento Quadrangle[3] does not identify Historic or Holocene age faults (displacement within the last 11,700 years) within or immediately adjacent to the site. The site does not lie within or adjacent to an Alquist–Priolo Earthquake Fault Zone[4].
- Ground Shaking—For the Maximum Considered Earthquake, a peak horizontal ground acceleration (PGA) of approximately 0.21g could be expected.
- Liquefaction—Our investigation shows a soil profile that consists of stiff to hard clays and medium dense to dense silty and clayey sands that are not liquefiable. Therefore, the potential for damaging liquefaction at the site is very low.
- Landslides and Slope Stability—Due to the relatively low topographic relief and existing slope gradients we do not expect landslides or natural slope failure.

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[2] Jennings, Charles W., and Bryant, William A., 2010 Fault Activity Map of California: California Geological Survey, Geologic Data Map No. 6.

[3] Saucedo, G.J. and Wagner, D.L., et al, 1992, Geologic map of the Chico quadrangle, California, 1: 250,000: California Division of Mines and Geology, Regional Geologic Map 7A, scale 1: 250,000.

[4] Bryant, W.A., and Hart, E.W., 2007 (Interim Revision), Fault-Rupture Hazard Zones in California: California Department of Conservation, Division of Mines and Geology, Special Publication 42.

- Seismically Induced Settlement—During a seismic event, ground shaking can cause densification of granular soil that can result in settlement of the ground surface. Considering the cohesive soils and medium dense to very dense sandy soils observed in the borings, we consider the potential for significant seismically induced settlement to be very low.

3.5.3 Seismic Design

Based on the mapped geology and our subsurface exploration, most of the preliminary pipeline alignment is underlain by stiff soil and a Site Class "D" (California Building Code, 2019).

Table 3.3 presents the California Building Code[5] (CBC) design parameters for the alignment. These values are based on Blackburn's review of design parameters at the approximate midpoint of the pipeline alignment.

Table 3.3: 2019 CBC Seismic Design Parameters (Site Class D)	
S_s – MCE_R ground motion (0.2 second period)	0.496 g
S_1 – MCE_R ground motion (1.0 second period)	0.241 g
F_a – Site Coefficient	1.403
F_v – Site Coefficient	2.12[1]
S_{MS} – Adjusted MCE* Spectral Response Acceleration Parameter	0.696 g
S_{M1} – Adjusted MCE* Spectral Response Acceleration Parameter	0.511 g[1]
S_{DS} – Design Spectral Acceleration Parameter	0.464 g
S_{D1} – Design Spectral Acceleration Parameter	0.341 g[1]
Seismic Design Category	D[1]
**T_L – Long Period Transition Period	12 sec
PGA	0.21

* Maximum Considered Earthquake
** Figure 22-14, ASCE 7-16
1 – We assume that the seismic response coefficient, Cs, is determined by ASCE 7-16 Eq. (12.8-2) for values of T ≤ 1.5Ts and taken as equal to 1.5 times the value computed in accordance with either ASCE 7-16 Eq. (12.8-3) for TL ≥T > 1.5Ts or Eq. (12.8-4) for T > TL. Contact Blackburn to re-evaluate the above parameters if this assumption is not valid.

If the proposed design does not meet the exception noted above (note 1) a site-specific response analysis will be required for final design.

3.5.4 Soil Excavatability and Trench Stability

We anticipate that the site soil will be excavatable with a medium to large size excavator (such as a CAT 320 or similar).

[5] California Building Code, 2016, California Code of Regulations, Title 24, Part 2 (Volume 2); published by International Conference of Building Officials and the California Building Standards Commission (CBSC).

Open excavations 5 feet or deeper will require sloping and/or shoring in accordance with Section 8.4 of the Yuba County Standard Specifications and Cal OSHA requirements. For planning and preliminary design, anticipate sloping/shoring requirements within the soil along the alignment for Type A soil. Excavations near waterway crossings or where perched groundwater/seepage or a sand layer is encountered will require shoring/sloping requirements for a Type C soil (shoring or sloping at a gradient of 1.5:1).

The contractor is responsible for the safety of all temporary excavations and must provide trench sloping and shoring in accordance with current Cal OSHA requirements based on exposed soil and groundwater/seepage conditions. The contractor is also responsible for the protection of existing facilities and improvements. The Contractor must retain an engineer to evaluate the impact of construction traffic vibrations, actual soil conditions exposed in the open excavations, seepage and/or groundwater conditions, surcharges adjacent to excavations, proximity of excavations to existing structures, and other factors that may promote excavation wall instability or cause excavation related damage to existing facilities and improvements and adjust excavation sloping/shoring methods accordingly.

3.5.5 Trench Dewatering

We did not encounter groundwater in our pipeline borings at anticipated trench depths. We anticipate that groundwater/seepage could be encountered at/near trenchless crossings or perched at shallower depths along the project alignment. Section 3.4.2 shows the depth of groundwater encountered in our borings. Groundwater levels may be higher during the late fall through late spring months, resulting from higher water levels in creeks and precipitation infiltrating the shallow surficial soil and ponding above the hard clay layers. Similarly, landscape irrigation along the project alignment could infiltrate and pond above the hard clay layer.

Sump pumps should be adequate to dewater excavations if groundwater/seepage is encountered. during excavation. The contractor is solely responsible for design and performance of dewatering systems.

We strongly recommend scheduling the project excavations and backfill during the summer through early fall months to reduce potential groundwater/seepage impacts.

Dewatering needs may differ near creak crossings. Refer to Jacobs' trenchless crossing design for dewatering recommendations for trenches near creek crossings.

3.5.6 Trench Backfill and Compaction

3.5.6.1 Pipe Bedding and Pipe Zone Material

Support pipe on a minimum of 4-inches of granular bedding and in accordance with the pipe manufacturer's recommendations. Although we do not anticipate soft, unsuitable pipe subgrade at any particular location, it can occur where shallow perched groundwater conditions or sandy soils are encountered. If unsuitable subgrade conditions exist, notify the project engineer and Blackburn for review and mitigation recommendations. Typical mitigation, to achieve a stable and non-yielding subgrade suitable for pipe placement and backfilling, may include replacement of unsuitable subgrade with ¾-inch minus crushed rock (minimum of 6 inches), enclosed in geotextile filtration fabric such as Mirafi 140N (or equivalent). A granular pipe zone material may also be used.

Native soils will contain a significant amount of fines (passing #200 sieve) and will not be suitable for bedding or pipe zone backfill. For pipe zone backfill material (which extends a minimum 12 inches above the top of pipe), Yuba County, Department of Public Works, Standard Plans and Specifications specifies the following:

1. ¾-inch crushed rock or clean sand compacted to 95% or
2. 2 sack slurry

Use a modulus of soil reaction (E') of:

- 2,000 psi for granular pipe zone backfill outlined above (or another approved granular material) if compacted to >85% relative compaction (ASTM D 1557) or 4,000 psi at >90%.
- 3,000 psi for native soils that consist of stiff to hard clays.

3.5.6.2 Trench Backfill

Yuba County Department of Public Works Trench Details show backfill within existing roadways is to be ¾-inch Class 2 AB compacted to 95% relative compaction (based on ASTM 1557) unless recommended by an engineer and approved by the County. Intermediate trench backfill above the pipe zone material may consist of native excavated soil provided the following recommendations are followed. Fill should be free of debris and concentrations of vegetation.

If import fill is required for trench backfill, it should be graded and have material properties as follows:

- 100% passing the 1-inch sieve
- 75% to 100% passing the #4 sieve
- Minimum 12% passing the #200 sieve
- Plasticity Index not greater than 20
- Free of debris and concentrations of vegetation.

Use ¾-inch Class 2 AB in the upper 12-inches of the trench within roadways.

3.5.6.3 Trench Backfill Compaction

It is important to achieve compaction of Pipe Bedding and Pipe Zone materials at the pipe haunches and spring line; compaction below the pipe spring line will be a difficult task for the contractor. Follow the pipe manufacturer's requirements for initial backfill to avoid damage to the pipe. To facilitate compaction in the pipe zone area (top of bedding up to 12 inches above pipe), use a trench width that provides a minimum clearance of 12 inches between the pipe and trench wall. We recommend a compaction demonstration section to test placement and compaction means and methods for each material type that will be used.

Moisture condition trench backfill above the Pipe Zone material to within 2% of optimum moisture content. Compact pipe backfill:

- To a minimum 92% relative compaction (based on ASTM 1557) below depths of 10 feet.

- To a maximum of 90% relative compaction (based on ASTM 1557) above depths of 10 feet
- In roadways, compact upper 12-inches of AB subgrade to 95% relative compaction (based on ASTM 1557).

To protect the pipe, use a maximum loose lift thickness of 12 inches for the first lift of fill placed above the top of the pipe. Use a maximum loose lift thickness of 8 inches for subsequent lifts. . Jetting is not acceptable for compaction.

Test all trench backfill (bedding, pipe zone backfill, trench zone, etc.) at vertical increments of not more than 1 foot and at final grade or pavement subgrade. For horizontal testing frequency consider a frequency of at least one test for every 200 linear feet of pipe (both sides of pipe in pipe zone). Complete at least one compaction curve (Proctor) for each material type, source location (for import), and as changes in native materials occur. Material changes include a change in material designation based on the Unified Soil Classification System. Testing frequency can be adjusted based on contractor performance, ease of compaction, and material variability.

Soil excavated during pipe installation can have moisture contents well over optimum, especially during the winter and spring months or if perched water is encountered. In this case, it will be necessary to dry back the soil to within 2% of optimum moisture content prior to use as backfill.

3.5.6.4 Trench Backfill Settlement

The magnitude of potential trench backfill settlement will be largely dependent on the degree and uniformity of compaction; therefore, it is important that backfill materials and compaction are checked at frequent intervals to limit potential settlement.

3.5.7 Pipeline Thrust Blocks

We expect thrust blocks to be installed at depths greater than 10 feet. For design of thrust blocks, use a lateral bearing of 200 psf per foot of depth below the surface, up to a maximum of 3,000 psf.

3.5.8 Soil Corrosivity

Our sulfate and chloride content tests indicate that Type II or V Portland cement can be used for concrete mix design. Our pH and resistivity tests generally indicate that the onsite soil exhibits a corrosive to extremely corrosive potential to metal pipes. We are not corrosion consultants and cannot evaluate the potential corrosion impacts to metallic elements embedded in, or in contact with, the ground. A corrosion consultant should provide specific corrosion protection recommendations for buried metallic elements used at the site. Table 3.4 presents the soil corrosivity test results.

Table 3.4: Soil Corrosivity Test Results

Sample No.	Depth (ft.)	pH	Minimum Resistivity (ohm-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
P-2-3C	16-16.5	6.02	2,040	4.1	15.4
P-4-4C	14.5-15	6.03	3,220	0.2	6.7
P-7-3B	10-10.5	6.33	1,420	5.0	9.1
P-8-3B	10.5-11	6.24	1,150	19.8	3.1
P-11-3B	10.5-11	7.09	1,230	40.7	17.4
P-16-3C	15.5-16	7.26	1,630	7.5	2.2
P-18-4B	14-14.5	7.25	910	31.5	10.9
P-24-2B	5.5-6	7.18	1,020	40.6	1.3
P-28-1C	3-3.5	6.58	1,070	30.0	2.5
P-32-3B	10.5-11	7.33	1,630	8.0	1.5

4 TRENCHLESS PIPELINE CROSSINGS

4.1 Site Location and Description

The sewer and water pipelines described in Sections 1.3 and 3.1 will use trenchless technologies to cross various waterways and Caltrans freeways. The final size, depths, and trenchless methods have not been determined at this time. Table 4.1 summarizes the location of each trenchless Caltrans crossing and Table 4.2 summarizes the location of each waterway crossing.

Table 4.1: Caltrans Crossing Locations

Pipeline(s)	Freeway Crossed	Upstream Road	Downstream Road
Water & Sewer	Hwy 70	McGowan Pkwy	McGowan Pkwy
Sewer	Hwy 65	Rancho Rd	Olive Ave
Sewer	Hwy 65	Rossler Rd	Shimer Rd

The Highway 70 grade at the McGowan Pkwy crossing and the Highway 65 grade at the Rancho Rd to Olive Ave crossing are approximately 15 to 20 feet lower than the adjacent roadway grades. At the Highway 65 Rossler Rd to Shimer Rd crossing, the Highway 65 grade is at a similar elevation to the surrounding area.

Table 4.2: Waterway Crossing Locations			
Pipeline(s)	**Waterway Crossed**	**Alignment Road**	**Approximate station of waterway**
Water & Sewer	Reeds Creek	Rancho Rd	322+00
Water & Sewer	Reeds Creek	Rancho Rd	330+00
Water & Sewer	Hutchinson Creek	Rancho Rd	350+00
Water & Sewer	Kimball Creek	Rancho Rd	401+00
Water & Sewer	Culvert	Rancho Rd	428+00
Water	Unnamed creek	Morrison Rd	879+50
Water & Sewer	Culvert	McGowan Pkwy	83+50
Water & Sewer	Kimball Creek	McGowan Pkwy	149+00

The depths of the waterways vary from crossing to crossing. Near the waterway crossings, the roadway is generally lined with trees, bushes and other vegetation.

4.2 Geology

4.2.1 Geology

Tables 4.3 and 4.4 show the mapped geologic formation and USDA soil type within each proposed trenchless crossing area.

4.3 Field Work and Laboratory Testing

4.3.1 Exploratory Borings

To characterize the site subsurface conditions, Blackburn drilled, logged and sampled 17 borings near proposed sending and receiving shaft locations. Jacobs reviewed and approved of the boring locations. Our subcontractor, Taber Drilling, drilled the borings to depths ranging from ± 40 to 50 feet below existing site grades. Appendix B1 shows the proposed site improvements and approximate boring locations. We include the borings logs of borings drilled as of November 10, 2020 in Appendix B2.

Taber drilled the borings using 4-inch diameter solid-stem auger. Soil samples were obtained by Taber at various intervals using a 3.0-inch O.D. Modified California (MC) sampler (equipped with 2.4-inch diameter steel liners) or 2–inch O.D. Standard Penetration (SPT) sampler. Samples were driven with an automatic hammer, weighing 140-pounds and falling approximately 30-inches per blow. We also collected bulk samples at various depths within the borings. Blackburn's project engineers/geologist Daniel Contreras, Luke Morrell, and Sophie Stuart logged the borings and retained samples for laboratory testing.

4.3.2 Laboratory Testing

Jacobs assigned laboratory tests for trenchless crossing borings. We performed the following laboratory tests on representative soil samples from the exploratory borings as requested:

- Sieve analysis and Plasticity index
- Unconfined compressive strength tests.

Appendix B3 presents the laboratory test results (as of November 10, 2020).

4.4 Subsurface Findings

4.4.1 General Subsurface Soil Conditions

Table 4.3 and 4.4 summarize subsurface soil conditions at the trenchless crossing alignments (based on borings drilled as of November 10th, 2020).

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Table 4.3: Subsurface Soil Conditions at Caltrans Trenchless Crossings

Crossing	Boring ID	Boring Depth (ft)	Approximate Boring Station	Approximate Existing Pavement		Approximate Depth to GW (ft)	Mapped Geologic Unit*	USDA Soil Type*	General Subsurface Soil Conditions**
				AC (in)	AB (in)				
McGowan Pkwy under Hwy 70	TC-1A	-	planned future boring	-	-	-	Riverbank Formation	214, 217	-
	TC-1C	-	planned future boring	-	-	-			
Olive Ave to Rancho Rd under Hwy 65	TC-2AA	51.5	19+60	6	NA	29	Basin Deposits	134, 214	Very stiff to hard lean clay and sandy lean clay.
	TC-2C	51.5	300+10	2.5	12	27.5			Hard silt and lean clay in upper 27 ft., underlain by 11 ft. of dense silty sand. Hard lean clay and sandy silt to depth of 50 ft.
Rossler Rd to Shimer Rd under Hwy 65	TC-4A	-	planned future boring	-	-	-	Riverbank Formation	214	-
	TC-4B	-	planned future boring	-	-	-			

*Refer to Section 2.1 for description of geologic formation and USDA mapped soil type.

**Depths are approximate

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Crossing	Boring ID	Boring Depth (ft)	Approximate Boring Station	Approximate Existing Pavement AC (in)	Approximate Existing Pavement AB (in)	Approximate Depth to GW (ft)	Mapped Geologic Unit*	USDA Soil Type*	General Subsurface Soil Conditions**
Rancho Rd under Reeds Creek	TC-7A	51.5	321+30	9	12	23	Modesto Formation	214	Stiff to hard lean clay and lean clay with sand within the upper 15 ft., underlain by hard silt to sandy silt and lean clay to depth of 26 to 29 ft. Medium dense to very dense sand and clayey sand to maximum depth explored.
	TC-7B	51.5	323+30	8.5	16	15		142	
	TC-8A	51.5	329+60	9	9	14	Modesto Formation and Riverbank Formation	142, 214	Very stiff to hard lean clay and lean clay with sand within the upper 14 ft., underlain by approximately 10 (TC-8A) to 20 ft (TC-8B) of thickly bedded medium dense to dense sand with varying amounts of fines with thick interbeds of stiff to hard sandy lean clay. stiff to hard lean clay in TC-8A from approximately 24 to 38 ft deep. Both borings indicate dense clean sand to maximum depth explored.
	TC-8B	51.5	331+10	8	16	15			
Rancho Rd under Hutchins on Creek	TC-9A	51.5	349+70	8	16	25	Modesto Formation	142	Stiff to hard lean clay to sandy lean clay within the upper 30 ft. (layer of medium dense clayey sand from approximately 10.5 to 14 ft.) underlain by approximately 5 ft. of medium dense silty sand. Lean clay to sandy lean clay to maximum depth explored.

Table 4.4: Subsurface Soil Conditions

Table 4.4: Subsurface Soil Conditions									
Crossing	Boring ID	Boring Depth (ft)	Approximate Boring Station	Approximate Existing Pavement AC (in)	Approximate Existing Pavement AB (in)	Approximate Depth to GW (ft)	Mapped Geologic Unit*	USDA Soil Type*	General Subsurface Soil Conditions**
	TC-9B	51.5	351+20	6	12	25			Stiff to hard lean clay, silty clay, and sandy lean clay within the upper 29 ft. (layer of medium dense clayey sand from approximately 23 to 25.5 ft.) underlain by 5 ft. of medium dense silty sand and very stiff silt. Very stiff sandy lean clay and loose to medium dense clayey sand to maximum depth explored.
Rancho Rd under Kimball Creek	TC-10A	51.5	400+00	7	10	24	Riverbank Formation	214	Very stiff to hard lean clay and sandy lean clay within the upper 9 ft. underlain by 5 ft. of medium dense clayey sand. Very stiff sandy silt from approximately 15 to 19 ft. above 7 feet of medium dense sand and sand with silt underlain by 3 ft. of very stiff sandy silt. Medium dense to dense sand and silty sand from 29 ft. deep to maximum depth explored.
	TC-10B	51.5	402+60	NA	NA	24			Stiff to hard lean clay within the upper 24 ft. (layer of very dense gravel with clay and sand from approximately 14 to 17 ft.) underlain by approximately 5 ft. of medium dense silty sand. Stiff to hard lean clay and sandy lean clay from 29 to 38 ft. deep underlain by dense sand and silty sand to maximum depth explored.

Table 4.4: Subsurface Soil Conditions									
Crossing	Boring ID	Boring Depth (ft)	Approximate Boring Station	Approximate Existing Pavement		Approximate Depth to GW (ft)	Mapped Geologic Unit*	USDA Soil Type*	General Subsurface Soil Conditions**
				AC (in)	AB (in)				
Rancho Rd culvert	TC-14	41.5	427+90	8	12	28	Riverbank Formation	214	Hard lean clay to lean clay with sand in upper 13 ft., underlain by medium dense to very dense sand, silty sand, and clayey sand to depth of 38 ft. (layer of very dense clayey gravel from 24 ft. to 29 ft.). Stiff lean clay below 38 ft depth to maximum depth explored.
40 Mile Rd culvert	TC-13	51.4	85+80	6.5	12	26	Basin Deposits	131, 214	Stiff to hard lean clay and silt within the upper 35 ft. underlain by 11 ft. of hard sandy silt and dense silty sand. Very stiff silt from approximately 46 to 50 ft. deep underlain by very dense sand with silt.
40 Mile Rd under Kimball Creek	TC-12A	51.5	147+50	3	4	24	Basin Deposits underlain by Riverbank Formation	142, 214	Stiff to very stiff lean clay and silt with sand within the upper 15 ft. underlain by approximately 15 ft. of medium dense clayey sand and sand with silt. Hard silt from 30 ft. to 40 ft. underlain by very dense sand with silt to maximum depth explored.
	TC-12B	51.5	149+80	7	12	17			Hard lean clay and silt with sand within the upper 33 ft. (layer of medium dense clayey sand from 22 to 25.5 ft.) underlain by dense to very dense silty sand and sand to maximum depth explored (lens of very stiff sandy silt at approximately 40 ft. deep).

*Refer to Section 2.1 for description of geologic formation and USDA mapped soil type.

**Depths are approximate

4.4.2 Groundwater

We generally observed groundwater at depths of 23 to 29 feet below the ground surface in our borings drilled August through September 2020. In three (3) borings near Reeds Creek on Rancho Road, we observed groundwater at depths of 14 to 15 feet. We encountered groundwater 17 feet below ground surface in our boring on Forty Mile Road just north of Kimball Creek.

Table 4.5 lists the borings where we encountered groundwater and depth to groundwater.

Table 4.5: Groundwater Summary		
Boring	**Approximate Station**	**Approximate Depth to Water (ft.)**
TC-2AA	19+60	29
TC-2C	300+10	27.5
TC-7A	321+30	23
TC-7B	323+30	15
TC-8A	329+60	14
TC-8B	331+10	15
TC-9A	349+70	25
TC-9B	351+20	25
TC-10A	400+00	24
TC-10B	402+60	24
TC-12A	147+50	24
TC-12B	149+80	17
TC-13	85+80	26
TC-14	427+90	28

We reviewed groundwater level data for nearby wells available at the California Department of Water Resources website (http://www.water.ca.gov/waterdatalibrary/) and using the Sustainable Groundwater Management Act (SGMA) data viewer (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels). Based on this information, the depth to groundwater at the site typically ranges from 20 to 30 feet, although it occasionally is measured above 20 feet. Relatively shallow perched water may occur within the near-surface soils during the winter and spring months, and adjacent to the existing canals and streams.

Groundwater and perched water levels can fluctuate due to changes in precipitation, creek and canal levels, irrigation, pumping of wells, and other factors.

4.4.3 Existing Pavement Sections

Table 4.6 shows approximate pavement conditions encountered in borings for the trenchless crossings.

Table 4.6: Pavement Conditions			
Boring	**Approximate Station**	**Approximate AC Thickness (in)**	**Approximate AB Thickness (in)**
TC-2AA	19+60	6	NA
TC-2C	300+10	2.5	12
TC-7A	321+30	9	12
TC-7B	323+30	8.5	16
TC-8A	329+60	9	9
TC-8B	331+10	8	16
TC-9A	349+70	8	16
TC-9B	351+20	6	12
TC-10A	400+00	7	10
TC-10B	402+60	NA	NA
TC-12A	147+50	3	4
TC-12B	149+80	7	12
TC-13	85+80	6.5	12
TC-14	427+90	8	12

5 PUMP STATIONS & LIFT STATIONS

5.1 Site Location and Description

Final pump station and lift station locations and wet well depths were not determined at the time of this report. Table 5.1 presents proposed lift and pump station locations based on available information from the design team.

Table 5.1: Lift/Pump Station Locations			
Lift/Pump Station	**Street**	**Nearest Cross Street of Creek**	**Approximate Station**
LS 1	Olivehurst Ave	11th Ave	*
PS 26	Mary Ave	McGowan Pkwy	139+10
PS 2	McGowan Pkwy	Dan Ave	226+30
PS 21	Rancho Rd	Ostrom Rd Or Shimer Rd	368+50 or 355+50
LS 22	Rancho Rd	Kimball Creek	404+60
LS 23	Rancho Rd	Virginia Rd	462+00
LS 24	Forty Mile Rd	Morrison Rd	102+90
PS 25	Forty Mile Rd	Kimball Creek	154+90

*Stationing not available at time of this report.

The preliminary locations are generally flat and covered in grassy vegetation. Photos 9 through 12 represent typical proposed pump/lift station locations.

Photo 9: Pump/Lift Stations

Looking northwest at proposed Lift Station #1 site on corner of Olivehurst Ave and 7th Ave.

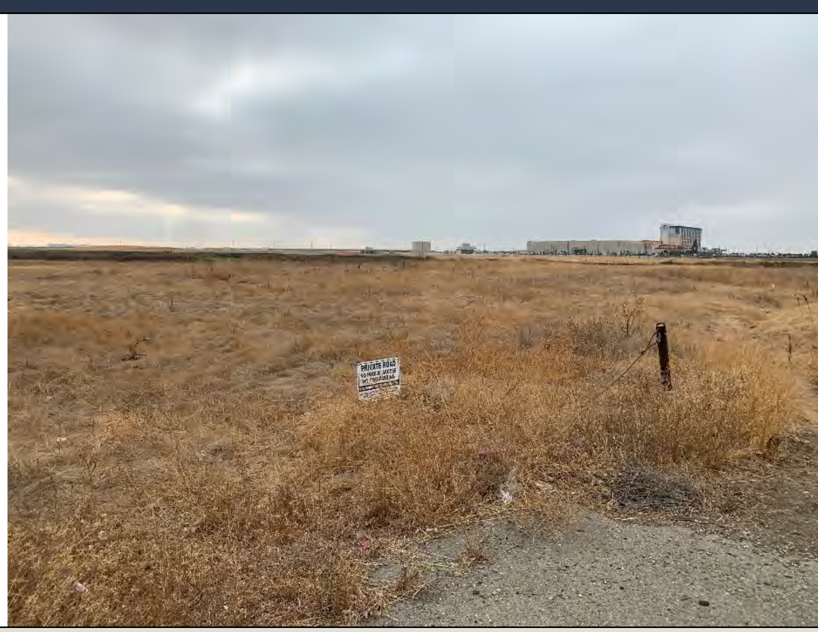
Photo 10: Pump/Lift Stations

Looking west at proposed Pump Station #26 site on corner of Mary Ave and McGowan Pkwy.

Photo 11: Pump/Lift Stations

Looking south at proposed Lift Station #23 site on Rancho Rd near Virginia Rd.

Photo 12: Pump/Lift Stations



Looking southeast at proposed Pump Station #25 site on Forty Mile Rd near Kimball Creek. Hard Rock Hotel and Casino can be seen in the background.

5.2 Geology

Table 5.2 shows the geologic formation and USDA soil type mapped within each proposed lift/pump station location.

5.3 Field Work and Laboratory Testing

Field work or laboratory testing for pump or lift stations is ongoing at the time of this report. Blackburn will complete drilling borings and laboratory testing at each pump/lift station once the locations have been confirmed. The following subsurface sections are based on the exploratory borings Blackburn drilled, logged, and sampled for the pipeline and trenchless crossing preliminary design.

5.4 Subsurface Findings

5.4.1 General Subsurface Soil Conditions

Table 5.2 shows subsurface conditions in the borings drilled (as of November 10th, 2020) closest to the planned pump station/lift station location.

Table 5.2: Mapped Geology					
Lift/Pump Station	**Approximate Station**	**Geologic Formation***	**USDA Soil Type***	**Nearest borings ****	**General Subsurface Soil Conditions*****
LS 1	****	Riverbank Formation	217	OS-1	Very stiff to hard lean clay and sandy lean clay within the upper 9 ft., underlain by approximately 6 ft of very dense clayey sand over very stiff lean clay. Hard sandy silt greater than 20 ft. below ground surface.
PS 26	139+10	Riverbank Formation	217	P-3, P-4	Hard lean clay to sandy lean clay within the upper 7 to 10 ft. underlain by medium stiff to very stiff lean clay and lean clay with sand to approximately 18 ft. deep. Medium dense clayey sand to maximum depth explored.
PS 2	226+30	Riverbank Formation or Holocene Alluvium	198	P-5	Very stiff to hard lean clay, sandy lean clay and silt.
PS 21	368+50 or 355+50	Riverbank Formation	214	TC-9B	Stiff to hard lean clay, silty clay, and sandy lean clay within the upper 29 ft. (layer of medium dense clayey sand from approximately 23 to 25.5 ft.) underlain by 5 ft. of medium dense silty sand and very stiff silt. Very stiff sandy lean clay and loose to medium dense clayey sand to maximum depth explored.

Table 5.2: Mapped Geology					
Lift/Pump Station	Approximate Station	Geologic Formation*	USDA Soil Type*	Nearest borings **	General Subsurface Soil Conditions***
				P-10	Hard lean clay and lean clay with sand within the upper 9 ft. underlain by dense to very dense clayey sand and silty sand.
LS 22	404+60	Riverbank Formation	214	TC-10B	Stiff to hard lean clay within the upper 24 ft. (layer of very dense gravel with clay and sand from approximately 14 to 17 ft.) underlain by approximately 5 ft. of medium dense silty sand. Stiff to hard lean clay and sandy lean clay from 29 to 38 ft. deep underlain by dense sand and silty sand to maximum depth explored.
				P-13	Hard lean clay to sandy lean clay within the upper 15 ft. underlain by medium dense sand with silt.
LS 23	462+00	Riverbank Formation	131	P-15, P-16	Stiff to hard lean clay within the upper 5 ft, underlain by 5 to 10 ft of medium dense clayey sand and hard sandy clay over hard lean clay and silt.
LS 24	102+90	Riverbank Formation	214	P-26, P-27	Very stiff to hard lean clay, lean clay with sand, silt with sand, and sandy silt within the upper 20 ft. (Very dense poorly-graded sand with silt below 18 ft. in Boring P-26)
PS 25	154+90	Riverbank Formation	214	TC-12B	Hard lean clay and silt with sand within the upper 33 ft. (layer of medium dense clayey sand from 22 to 25.5 ft.) underlain by dense to very dense silty sand and sand to maximum depth explored (lens of very stiff sandy silt at approximately 40 ft. deep).

*Refer to Section 2.1 for description of geologic formation and USDA mapped soil type.
**Nearest boring drilled by Blackburn as of Nov. 10, 2020
***Depths are approximate
****Stationing not available at time of this report.

5.4.2 Groundwater

We generally observed groundwater at depths of 24 to 29 feet below ground surface in the borings drilled nearest the proposed pump/lift station locations in August through September 2020. In boring TC-12B (near proposed Pump Station #25) we measured groundwater at a depth of 17 feet below ground surface.

We reviewed groundwater level data for nearby wells available at the California Department of Water Resources website (http://www.water.ca.gov/waterdatalibrary/) and using the Sustainable Groundwater Management Act (SGMA) data viewer (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels). Based on this information, the depth to groundwater at the site typically ranges from 20 to 30 feet, although it occasionally is measured above 20 feet. Relatively shallow perched water may occur within the near-surface soils during the winter and spring months, and adjacent to the existing canals and streams.

Groundwater and perched water levels can fluctuate due to changes in precipitation, creek and canal levels, irrigation, pumping of wells, and other factors.

Table 5.3 lists groundwater depth in the 2 borings nearest to each pump station in which the driller encountered groundwater.

Table 5.3 Groundwater Summary

Lift/Pump Station Proposed Location	Approximate Station	Nearest Borings	Approximate Distance from Lift/Pump Station (yd)	Approximate Depth to Water (ft.)**
LS 1	***	TC-2AA	2,230	29
		B8*	2,640	20.7
PS 26	139+10	B8*	1,380	20.7
		TC-2AA	1,620	29
PS 2	226+30	TC-2AA	870	29
		TC-2C	1,030	27.5
PS 21	368+50 or 355+50	TC-9B	Pump station location not determined at time of this report	25
		TC-10A		24
LS 22	404+60	TC-10B	30	24
		TC-10A	110	24
LS 23	462+00	TC-6A	1,500	NA
		TC-10B	1,960	24
LS 24	102+90	TC-13	540	26
		TC-12A	1,520	24
PS 25	154+90	TC-12B	160	17
		TC-12A	250	24

*Drilled in 2004 for CH2M HILL WWTP Expansion and Upgrade Project Schematic Design – Preliminary Geotechnical Exploration Report
** Depth to groundwater measured from ground surface at boring location. Elevation of ground surface at pump/lift station may differ from elevation of ground surface at boring location.
***Stationing not available at time of this report.

5.5 Preliminary Design Considerations – Pump/Lift Stations

The final locations of the pump/lift stations have not been determined. Our subsurface investigation and laboratory testing will be completed once Jacobs determines the final locations and obtains the Rights-of-Entry. Based on nearby borings completed for the pipeline and trenchless crossings, we anticipate the soil conditions within the proposed pump/lift station sites will be suitable for the planned facilities when constructed in accordance with the project plans, industry standards, and our final geotechnical recommendations. The recommendations below are for preliminary design only and will need to be finalized after we complete the site-specific borings, laboratory tests, and further analysis.

5.5.1 Geologic Hazards

- Faulting—The potential for surface rupture or creep due to faulting at the site is very low. The Fault Activity Map of California[6] and the Geologic Map of the Sacramento Quadrangle[7] does not identify Historic or Holocene age faults (displacement within the last 11,700 years) within or immediately adjacent to the site. The site does not lie within or adjacent to an Alquist–Priolo Earthquake Fault Zone[8].
- Ground Shaking—For the Maximum Considered Earthquake, a peak horizontal ground acceleration (PGA) of approximately 0.21g could be expected.
- Liquefaction—Our investigation shows a soil profile that consists of stiff to hard clays and medium dense to dense silty and clayey sands that are not liquefiable. Therefore, the potential for damaging liquefaction at the site is very low.
- Landslides and Slope Stability—Due to the relatively low topographic relief and existing slope gradients, we do not expect landslides or natural slope failure.
- Seismically Induced Settlement—During a seismic event, ground shaking can cause densification of granular soil that can result in settlement of the ground surface. Considering the cohesive soils and medium dense soils observed in the borings, we consider the potential for significant seismically induced settlement to be very low.

5.5.2 Seismic Design

Based on the mapped geology and our boring data, use a Site Class “D” (stiff soil). Table 5.4 presents the 2019 *California Building Code* (Chapter 16) and ASCE 7-16 seismic design parameters for the site.

[6] Jennings, Charles W., and Bryant, William A., 2010 Fault Activity Map of California: California Geological Survey, Geologic Data Map No. 6.
[7] Saucedo, G.J. and Wagner, D.L., et al, 1992, Geologic map of the Chico quadrangle, California, 1: 250,000: California Division of Mines and Geology, Regional Geologic Map 7A, scale 1: 250,000.
[8] Bryant, W.A., and Hart, E.W., 2007 (Interim Revision), Fault-Rupture Hazard Zones in California: California Department of Conservation, Division of Mines and Geology, Special Publication 42.

Table 5.4: 2019 CBC Seismic Design Parameters (Site Class D)	
S_s – MCE_R ground motion (0.2 second period)	0.496 g
S_1 – MCE_R ground motion (1.0 second period)	0.241 g
F_a – Site Coefficient	1.403
F_v – Site Coefficient	2.12[1]
S_{MS} – Adjusted MCE* Spectral Response Acceleration Parameter	0.696 g
S_{M1} – Adjusted MCE* Spectral Response Acceleration Parameter	0.511 g[1]
S_{DS} – Design Spectral Acceleration Parameter	0.464 g
S_{D1} – Design Spectral Acceleration Parameter	0.341 g[1]
Seismic Design Category	D[1]
**T_L – Long Period Transition Period	12 sec
PGA	0.21

* Maximum Considered Earthquake
** Figure 22-14, ASCE 7-16
1 – We assume that the seismic response coefficient, Cs, is determined by ASCE 7-16 Eq. (12.8-2) for values of T ≤ 1.5Ts and taken as equal to 1.5 times the value computed in accordance with either ASCE 7-16 Eq. (12.8-3) for TL ≥T > 1.5Ts or Eq. (12.8-4) for T > TL. Contact Blackburn to re-evaluate the above parameters if this assumption is not valid.

If the proposed design does not meet the exception noted above (note 1) a site-specific response analysis will be required for final design.

5.5.3 General Grading Recommendations

5.5.3.1 Excavation Conditions

Based on the soil conditions and drilling performance for nearby explorations, excavation is likely possible with conventional equipment (common earthmoving equipment and large backhoe/excavator). The fine-grained and hard soil conditions can create slow excavation conditions.

5.5.3.2 Site Clearing

Prior to excavation or making any cuts and fills, remove existing underground utilities, foundations, vegetation (root balls and roots), debris, and other underground features in accordance with this Geotechnical Report. Remove loose and disturbed soil caused by the removal(s) and widen the excavation/depression so it is accessible to compaction equipment. Remove strippings from the site or use as landscape soil in designated areas.

5.5.3.3 Original Ground and Subgrade Preparation

After clearing, process and compact the exposed soil in at-grade, cut, and fill areas as follows:

- Scarify the exposed soil to a depth of approximately 8 inches.
- Moisture condition subgrade to within 3% of the optimum moisture content.
- Compact the subgrade soil to a minimum 90% relative compaction based on ASTM D1557

Where fill is placed on sloping ground, blade back slopes horizontally during placement of embankment fill to create a stepped (or benched) fill surface (such that a uniform, sloping fill surface is avoided). Benching must remove loose surficial soils and result in stepped benches, generally one to two feet in height and depth into the existing slope. The lower bench should be sloped a minimum of 2% into the slope. Where benching will interfere with existing structures, utilities, or vegetation, Blackburn can review modifications on a case-by-case basis.

5.5.3.4 General Fill Placement and Compaction

General Fill (not structure backfill) may consist of on-site soil. Fill should be free of debris and concentrations of vegetation.

If import fill is required, it should be graded and have material properties as follows:

- 100% passing the 1-inch sieve
- 75% to 100% passing the #4 sieve
- Minimum 12% passing the #200 sieve
- Plasticity Index not greater than 20
- Free of debris and concentrations of vegetation.
- Approval from Blackburn prior to placement

Place fill in maximum 8-inch thick loose lifts, moisture condition 1% to 2% above optimum, and compact to a minimum of 90% relative compaction based on ASTM D 1557 test procedure. Compact fill using a sheepsfoot or padded drum type roller.

Construct fill slopes no steeper than 2(H):1(V). To achieve adequate compaction on the face of fill slopes, over-build the slopes and then cut back to the design grade. Track-walking is not an adequate method to compact the face of slopes.

5.5.4 Dewatering

Dewatering may be required for installations greater than approximately 20 feet deep. Significant groundwater inflow may occur at the pump stations, particularly those located near water ways during winter and spring months.

Dewatering can consist of:

- Deep sumps within the excavation. Considering the presence of fine-grained soils and relatively flat lying bedding, sumps within the excavation are not likely to provide good drawdown.
- Well points. Well points will likely work better to cut off flow into the excavation and drawdown the water level over a larger area.

To facilitate work at the base of the excavation, groundwater should be drawn down at least 3 feet below the planned bottom of excavation. The need for dewatering can be reduced by planning excavations during the lowest anticipated seasonal water levels (expected during the late summer and fall months.

5.5.5 Temporary Excavations

Temporary excavations will require sloping and/or shoring in accordance with Cal OSHA requirements. Based on our subsurface exploration and laboratory testing, preliminary excavation and shoring design may be based on Type A soil to planned excavation depth that may be sloped at 3/4(H):1(V).

Where groundwater is present or cohesionless/uncemented granular soils are encountered, Type C soil conditions will apply and a 1.5(H):1(V) slope gradient is required.

The Contractor must retain an engineer to evaluate the impact of existing structures, traffic vibrations, actual soil conditions exposed in the open trenches, and other factors that may promote trench wall instability and adjust trench sloping/shoring accordingly. Surcharge loads such as trench spoils, equipment, etc. should not be placed adjacent to an open excavation (within a distance of ½ the height of the trench). ***The above is guideline information only.*** The contractor is responsible for the safety of all excavations and should provide appropriate excavation sloping and shoring in accordance with current Cal OSHA requirements and observe conditions observed during construction for necessary modification and safety.

5.5.6 Foundations

5.5.6.1 Below-Grade Foundations

5.5.6.1.1 <u>Bearing Capacity</u>

The pump/lift stations are below-grade structures and the net pressure exerted upon the subsurface will be similar to or less than the current soil pressure at the bottom of the pump station wet wells. Excavation for below-grade structures reduces the net pressure by removing soil that acts as a “preload” to the underlying soils, thus “unloading” the bearing materials before “loading” by placement of the structure.

We understand that below grade structures will use mat type foundations for support. For structures at depths greater than 15 feet:

- Use a maximum net contact pressure for mat foundation of 3,000 psf.
- Use a Modulus of Subgrade Reaction, k_s, equal to 25 pci.
- We expect settlement of mat foundations is expected to be less than 1 inch with differential settlement less than ½-inch across the pump station structure.
- Clean footing excavations of debris and loose soil prior to placing concrete.
- Blackburn must observe all footing excavations prior to reinforcement placement to verify competent bearing materials.
- For subgrade uniformity, Caltrans Class 2 aggregate baserock as underlayment (this is not geotechnically necessary provided a firm uniform subgrade is obtained). If an aggregate underlayment is used, place a minimum thickness of 6-inches and compact to a minimum of 95% relative compaction (per ASTM D 1557 test method).
- Crushed rock underlayment may also be used (and can benefit excavation dewatering). Underlay the crushed rock with a geotextile filter fabric (i.e., Mirafi 140N) and compact the rock with at least 6 passes of a static roller.

If isolated spread footings or piers are required for column support, Blackburn can provide additional recommendations when the planned design and approximate loading is available.

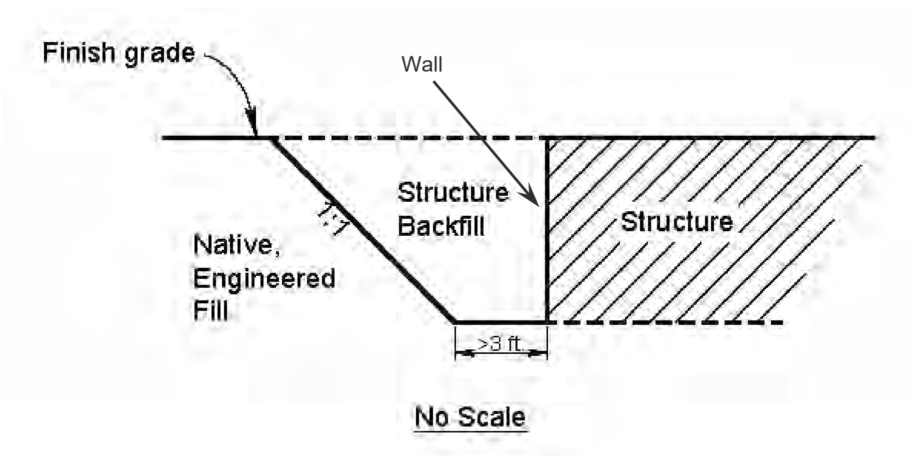
5.5.6.1.2 Structure Backfill

Native material encountered in our borings for the pipeline and trenchless crossings primarily consist of fine-grained soils and are not suitable for structure backfill.

Use the specifications in Table 5.5 for imported structure backfill for all below-grade structures:

Table 5.5: Import Structure Backfill Requirements			
Gradation		Test Procedures	
Sieve Size	Percent Passing	ASTM	Caltrans
1 inch	100	D6913	202
¾ inch	70-100	D6913	202
No. 4	50-100	D6913	202
No. 200	12-40	D6913	202
Plasticity			
Plasticity Index	<12	D4318	204

As shown below, the zone of placement for structure backfill should extend up from the base of the wall at a slope of 1(H):1(V) and at least 3 feet behind the wall.



- Moisture condition structure backfill to within 2% of optimum and place in maximum 8-inch thick, horizontal, loose lifts.
- Compact structure backfill to a minimum 92% relative compaction based on the ASTM D 1557 test method.

To minimize the residual lateral earth pressures on structure walls, restrict compaction equipment behind the walls (by load and distance from wall) so that wall design values are not exceeded. We recommend compaction within a horizontal distance equal to one-half of the wall height (to a maximum distance of 5 feet), be completed with hand-operated equipment (i.e., jumping jack).

To minimize the potential for significant settlement around deep walls, controlled low strength material (CLSM) can be used to backfill to the surface or to a manageable depth (e.g., 10 feet below grade).

5.5.6.1.3 Lateral Earth Pressures

The pump/lift stations are below grade structures that will act as restrained retaining structures. Walls will retain compacted select native soils and/or imported soils meeting the requirement for structure backfill. For evaluation of lateral earth pressures, use the backfill equivalent fluid weights (EFW) for level ground conditions shown below in Table 5.6.

Table 5.6: LATERAL EARTH PRESSURES

Condition	Equivalent Fluid Weight (pcf)	Seismic Equivalent Fluid Weight (pcf)
At-Rest	85	6
Passive	150	140*

*Total passive EFW for passive condition

The above pressures assume structure backfill placed against the structure wall in accordance with our recommendations, a saturated (total) unit weight of approximately 135 pounds per cubic foot (pcf) and a minimum internal angle of friction of 32 degrees. Notify Blackburn if these assumptions are not valid so that we may assess the situation and provide additional recommendations, if necessary. Backfill with CLSM is an acceptable alternative.

For seismic loading, add the Seismic EFW to the at-rest EFW and apply the total force as a uniform load on the wall with a resultant located at 0.5H where H is the backfill height. We estimated the EFWs for seismic loading using the Mononobe-Okabe equation and a horizontal seismic acceleration coefficient, k_h, of approximately ½ the expected PGA (0.22). This k_h value assumes that the walls displace at least 1-inch during the design seismic event.

Surface loads (footings, storage, vehicle traffic) applied near the wall will increase the lateral pressure on the wall. A uniform surface load of 240 psf to 300 psf is often used to approximate construction traffic loading on walls. In general, if surface loads are closer to the edge of the retaining wall than three-fourths of the retained height, increase the design wall pressure by 0.5q over the area of the retaining wall. In this expression, q is the surface surcharge load in psf. This is a conservative procedure and lower design pressures may be applicable upon evaluation of individual surface loads and setback distances.

5.5.6.1.4 Buoyancy Resistance

Based on nearby borings we estimate a groundwater depth of approximately 20 feet, as discussed in Section 5.4.2. In undrained conditions, structures below a depth of approximately 20 feet, may be subjected to an uplift load (buoyancy). The uplift force will be resisted by the weight of the structure and the weight of the backfill overlying foundation extensions (if any).

If Jacobs designs foundation extensions to resist buoyancy forces, calculate the resistance against uplift due to the weight of the soil. Use a backfill total unit weight of 130 pcf above groundwater and 67 pcf below groundwater, with a soil wedge extending vertically up from foundation extensions

5.5.6.1.5 Lateral Resistance

Lateral resistance for retaining structures can be achieved through friction and passive earth pressures acting on the foundation. For design, use a coefficient of friction of 0.40 (below or above groundwater) at the base of the concrete footing and a passive earth pressure of 150 psf per foot of embedment depth. Limit passive earth pressures to a maximum of 3,000 psf (additional passive pressure can be evaluated for specific locations if necessary). Do not include the upper 1-foot of soil in passive resistance calculations. Where passive pressure or friction alone is used against sliding, use a minimum factor of safety of 1.5 for lateral stability (1.1 if seismic loading is included). Where both passive pressure and friction are used to resist sliding, use a minimum factor of safety of 2.0.

5.5.6.2 Minor Structures

Provided that the recommendations in this report are followed, we anticipate minor structures (such as valve vaults, etc.) may be founded on concrete mat or strip footings, or a compacted granular base (minimum of 6 inches of Class 2 baserock) if appropriate.

- Embed the foundations a minimum of 18 inches below the lowest adjacent prepared subgrade into firm native soil or compacted fill/backfill.
- Footings must be a minimum of 12 inches wide and sized not to exceed an allowable bearing capacity of 2,000 psf. The allowable bearing capacity may be increased by one-third if seismic and/or wind loads are included.
- If additional bearing capacity is required for specific minor structures, we can review and provide recommendations on a case-by-case basis.
- To resist lateral movement, use a coefficient of friction of 0.40 at the base of the foundation and an ultimate passive earth pressure of 150 psf (undrained condition) per foot of embedment depth up to a maximum of 2,000 psf. Ignore the upper one-foot of footing depth (below the lowest adjacent soil grade) in determination of the passive pressure. Both frictional resistance and passive earth pressure can be combined for lateral resistance; when combined, increase the safety factor against sliding from a minimum of 1.5 to 2.0.

5.5.7 Soil Corrosivity

Our sulfate and chloride content tests on pipeline samples indicate that Type II or V Portland cement can be used for concrete mix design. Our resistivity tests generally indicate that the onsite soils may exhibit corrosive to extremely corrosive conditions for metal pipes. We are not corrosion consultants and cannot evaluate the potential corrosion impacts to metallic elements embedded in or in contact with the ground. A corrosion consultant should provide specific corrosion protection recommendations for buried metallic elements used at the site.

6 WWTP IMPROVEMENTS

6.1 Site Location and Description

The proposed WWTP expansion will be constructed at the existing WWTP on Mary Ave in Olivehurst. The proposed secondary clarifier location is generally level and covered in gravel. The site for the proposed equalization basin is generally flat but depressed approximately 3 to 4 feet below the WWTP ground surface and is covered in seasonal grass and weeds. Photos 9 and 10 represent site conditions at the time of our October 19, 2020 site visit.

Photo 13: Secondary Clarifier

Looking northwest at proposed secondary clarifier location. Existing secondary clarifier can be seen on the left in the background.

Photo 14: Equalization Basin

Looking south across the proposed equalization basin. Existing slope along east side of basin can be seen in background.

6.2 Project Description

The proposed WWTP improvements consist of an additional secondary clarifier, a 30.7 Acre-ft concrete-lined equalization basin, a 4.37 Acre-ft Stormwater Detention Basin, and a 16-inch-diameter force main.

6.3 Previous Studies

Geotechnical conclusions and recommendations for the proposed secondary clarifier presented in this report are primarily based on the CH2M HILL WWTP Expansion and Upgrade Project Schematic Design – Preliminary Geotechnical Exploration Report, February 2004 (CH2M Report).

6.4 Geology

We reviewed geology maps and the United States Department of Agriculture's (USDA) Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) to infer likely subsurface conditions at the site. The "Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierra Foothills, California" (Helley and Harwood, 1985) generally maps Upper Member, Riverbank Formation under the site. Refer to Section 2.1 for a description of the Riverbank Formation.

The web soil survey indicates that the site is underlain by San Joaquin loam (214). The survey states this unit has the following relevant properties from 0 to 25 inches deep: Silt (ML), Silty Clay (CL-ML) and Clay (CL) with fines content ranging from 50 to 70 percent.

6.5 Field Work and Laboratory Testing

6.5.1 Exploratory Test Pits

Blackburn excavated, logged, and sampled 5 test pits to characterize the site subsurface conditions at the equalization basin site. Our subcontractor, Burke Construction, excavated the test pits to a depth of 8 feet below existing site grades. Appendix D1 shows the proposed site improvements and approximate test pit locations. The test pit logs are included in Appendix D2. Burke Construction excavated the test pits using a CAT 420 backhoe equipped with a 2-foot wide bucket. Blackburn's project engineer, Luke Morrell, logged the test pits, collected samples from various depths and retained samples for laboratory testing.

Blackburn drilled an exploratory boring for the clarifier but lab has not been completed at this time, so no recommendations in this report are based on conditions in Blackburn's boring.

6.5.2 Laboratory Testing

We have not completed laboratory tests on the samples collected from the equalization basin site.

6.6 Subsurface Findings

6.6.1 General Subsurface Soil Conditions

We generally encountered hard lean clay to sandy lean clay in the test pits, excavated October 19, 2020. In the southeast portion of the equalization basin (TP-5), we encountered dense clayey sand below a depth of approximately 2.5 feet.

The CH2M Report (2004) indicates that the subsurface soils in boring B8 near the proposed secondary clarifier location consist of:

- Approximately 3 feet of sandy clay over a lean clay with sand hardpan layer to approximately 8 feet below ground surface.
- Sandy clays and clayey sands from depths of about 8 to 23 feet,
- Sandy gravel from depths of 23 to 30 feet.
- Sandy clay and clayey sand to the maximum depth explored (41.5 ft).

6.6.2 Groundwater

We did not encounter groundwater in our test pits excavated October 19, 2020.

According to the CH2M Report (2004) and associated boring logs, perched groundwater was encountered in the sandy clay above the hardpan layer and groundwater was measured 20.7 feet below the ground surface near the proposed secondary clarifier location. The logs indicate that the groundwater elevation ranges from 29.8 to 33.3 feet across the WWTP site (CH2M Report does not specify datum used).

We reviewed groundwater level data for nearby wells available at the California Department of Water Resources website (http://www.water.ca.gov/waterdatalibrary/) and using the Sustainable Groundwater Management Act (SGMA) data viewer (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels). Based on this information, the groundwater elevation at the site typically ranges from 25 to 40 feet above mean sea level (NAVD88). Relatively shallow perched water may occur within the near-surface soils during the winter and spring months, and adjacent to the existing canals and streams.

Groundwater and perched water levels can fluctuate due to changes in precipitation, canal levels, irrigation, pumping of wells, and other factors.

6.7 Preliminary Design Considerations – WWTP Improvements

At the time of this report, basin design was not finalized. Blackburn will provide updated recommendations in the design-level geotechnical report based on final basin design.

6.7.1 Facility Ground Suitability

The soil conditions at the site are suitable for the planned facilities when constructed in accordance with the project plans, industry standards, and our geotechnical recommendations. Some of the more significant site limitations include the presence of clay soils that will not be suitable for structure backfill, and relatively shallow groundwater that may require dewatering for some structure installations.

6.7.2 Geologic Hazards

- Faulting—The potential for surface rupture or creep due to faulting at the site is very low. The Fault Activity Map of California[9] and the Geologic Map of the Sacramento Quadrangle[10] does not identify Historic or Holocene age faults (displacement within the last 11,700 years) within or immediately adjacent to the site. The site does not lie within or adjacent to an Alquist–Priolo Earthquake Fault Zone[11].
- Ground Shaking— For the Maximum Considered Earthquake, a peak horizontal ground acceleration (PGA) of approximately 0.22g could be expected.
- Liquefaction—Our investigation shows a soil profile that consists of stiff to hard clays and medium dense to dense silty and clayey sands that are not liquefiable. Therefore, the potential for damaging liquefaction at the site is very low.
- Landslides and Slope Stability—Due to the relatively low topographic relief we do not expect landslides or natural slope failure.
- Seismically Induced Settlement—During a seismic event, ground shaking can cause densification of granular soil that can result in settlement of the ground surface. Considering the cohesive soils and medium dense soils observed in the borings, we consider the potential for significant seismically induced settlement to be very low.

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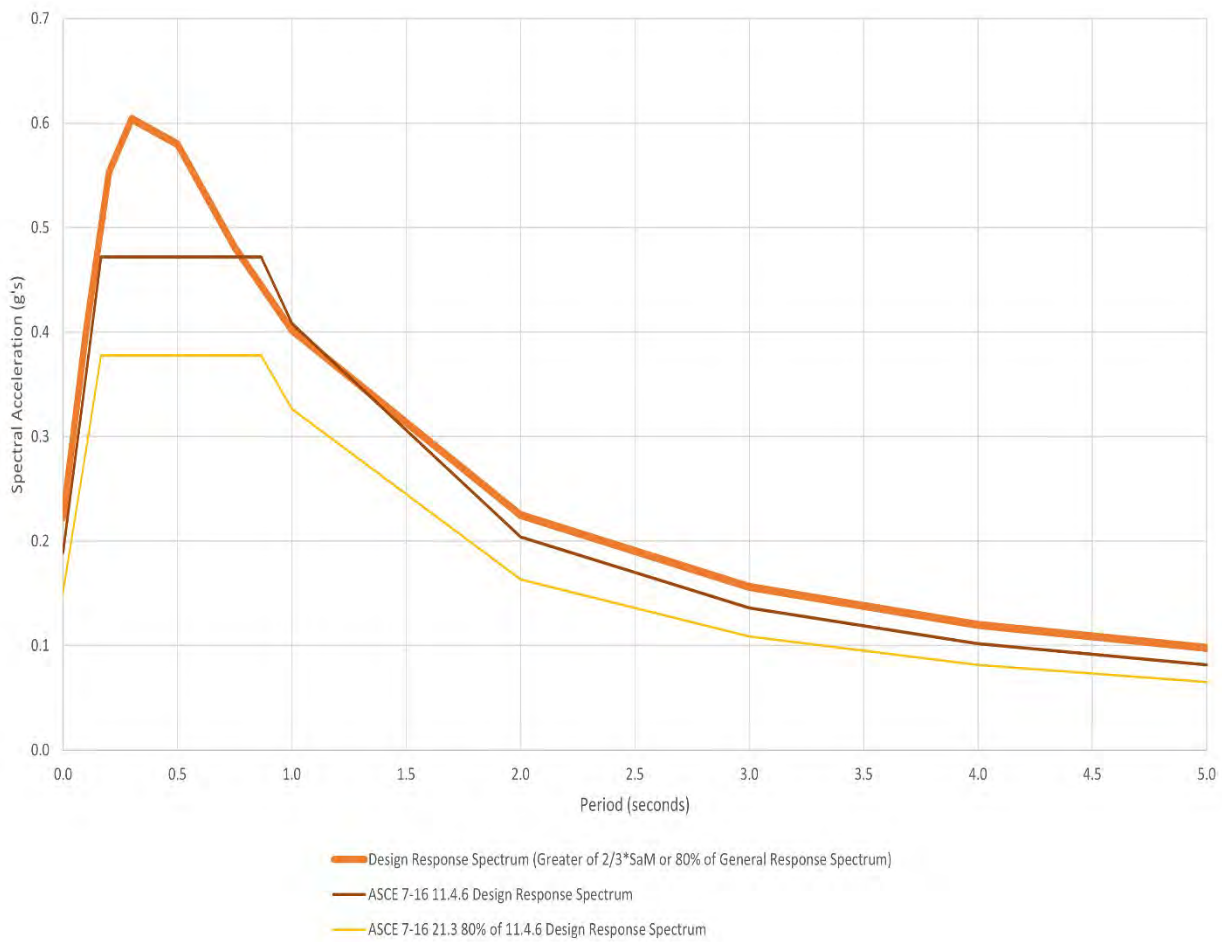
[9] Jennings, Charles W., and Bryant, William A., 2010 Fault Activity Map of California: California Geological Survey, Geologic Data Map No. 6.
[10] Saucedo, G.J. and Wagner, D.L., et al, 1992, Geologic map of the Chico quadrangle, California, 1: 250,000: California Division of Mines and Geology, Regional Geologic Map 7A, scale 1: 250,000
[11] Bryant, W.A., and Hart, E.W., 2007 (Interim Revision), Fault-Rupture Hazard Zones in California: California Department of Conservation, Division of Mines and Geology, Special Publication 42.

6.7.3 Seismic Design

We assumed, based in part on our boring data, an average shear wave velocity, V_{S30}, of 850 ft/sec that corresponds to a site class "D" (Section 2.3). Per ASCE 7-16 a site-specific analysis is required for a site class "D" site unless one of the exceptions noted in ASCE7-16, Section 11.4.8, is used. We understand that for this project the exception will not be used. Therefore, we performed a site-specific analysis per ASCE 7-16, Chapter 21. We analyzed probabilistic and minimum code values to develop a site-specific spectra for 5% damping. A deterministic analysis is not required because the largest spectral response acceleration of the probabilistic ground motion response calculated in accordance with ASCE 7-16 21.2.1 is less than 1.2 F_a. The recommended spectra are presented in Graph 2 and digitized spectral values in Table 2. Appendix D4 presents details of our site specific response analysis.



Graph : Site-Specific Design Spectra

Use the S_{MS}, S_{M1}, S_{DS}, and S_{D1} values in Table 3. We calculated the values in accordance with ASCE 7-16, Section 21.4 and 21.5.

Table C-3: Comparison of Recommended and ASCE 7-16 Section 11.4.6 Spectra			
Period	Recommended Design Response Spectrum	ASCE 7-16 11.4.6 Response Spectrum	80% of ASCE 7-16 11.4.6 Response Spectrum
0	0.223	0.189	0.151
0.1	0.400	0.359	0.288
0.166	0.507	0.472	0.378
0.2	0.553	0.472	0.378
0.3	0.604	0.472	0.378
0.5	0.580	0.472	0.378
0.75	0.481	0.472	0.378
0.865	0.440	0.472	0.378
1.0	0.402	0.408	0.327
2.0	0.225	0.204	0.163
3.0	0.156	0.136	0.109
4.0	0.120	0.102	0.082
5.0	0.098	0.082	0.065

Table C-4: Design Spectral Acceleration Values and Peak Ground Acceleration	
Parameter	Acceleration Value (g's)
S_{MS}	0.815[1]
S_{M1}	0.735[2]
S_{DS}	0.544[3]
S_{D1}	0.490[4]
PGA_M	0.317[5]

[1]S_{MS} 1.5 times the S_{DS} value in Table C-4
[2]S_{M1} 1.5 times the S_{D1} value in Table C-4
[3]S_{DS} 90% of the maximum spectral acceleration from the site-specific spectrum (0.399)
[4]S_{D1} Maximum value of the product of TS_a (time multiplied by spectral acceleration value) for periods of 1 to 2 seconds for sites with V_{S30} of greater than 1,200 ft/s)
[5]The site-specific MCE_G peak ground acceleration (PGA_M) is the lesser of the probabilistic or deterministic mean peak ground acceleration.

6.7.4 General Grading Recommendations

6.7.4.1 Excavation Conditions

Based on the soil conditions and drilling performance, excavation is possible with conventional equipment (common earthmoving equipment and large backhoe/excavator). The fine-grained and hard soil conditions can create slow excavation conditions and is not suitable for structure backfill.

6.7.4.2 Site Clearing

Prior to trenching or making any cuts and fills, remove existing underground utilities, foundations, vegetation (root balls and roots), debris, and other underground features in accordance with this Geotechnical Report. Remove loose and disturbed soil caused by the removal(s) and widen the excavation/depression so it is accessible to compaction equipment. Remove strippings from the site or use as landscape soil in designated areas.

6.7.4.3 Original Ground and Subgrade Preparation

Process and compact the exposed soil in at-grade, cut, and fill areas as follows:

- Scarify the exposed soil to a depth of approximately 8 inches.
- Moisture condition subgrade to within 3% of the optimum moisture content.
- Compact the subgrade soil to a minimum 90% relative compaction based on ASTM D1557.

Where fill will be placed on or against slopes with a gradient of 5(H):1(V) or steeper, fill must be benched into the slope. Benching must remove loose surficial soils and result in stepped benches, generally one to two feet in height and depth into the existing slope. Where benching will interfere with existing structures, utilities, or vegetation, Blackburn can review modifications on a case-by-case basis.

For fills that are 5 feet or higher and placed on or against a slope with a gradient of 5:1 or steeper, provide a key at the toe of the fill slope. The key must be a minimum of 10 feet wide, one foot deep, sloped a minimum of 2% into the slope, and extend 2 feet beyond the fill toe. Where restricted access will not allow for a toe-bench 10 feet wide, the bench can be reduced to a minimum width of 6 feet provided the fill slope is less than 10 feet in height and the contractor can show that compaction equipment can achieve the specified compaction for the full width of the bench.

6.7.4.4 General Fill Placement and Compaction

General fill (**not trench or structure backfill**) may consist of on-site soil provided it contains no rocks larger than 4 inches in maximum dimension. Fill should be free of debris and concentrations of vegetation.

If import for general fill is required, it must be free of debris and meet the following requirements:

Table 6.4: General Backfill Import Requirements			
Gradation		**Test Procedures**	
Sieve Size	**Percent Passing**	**ASTM**	**Caltrans**
1 inch	100	D6913	202
No. 4	75-100	D6913	202
No. 200	12-100	D6913	202
Plasticity Index			
Less than 20		D4318	

- Approved by Blackburn prior to site delivery.

Place and compact fill as follows:

- Place fill in maximum 8-inch-thick loose lifts,
- Moisture condition the soil within 3% of optimum
- Compact the soil to a minimum 90% relative compaction based on ASTM D1557.

Test all fill at vertical increments of not more than 1 foot and at final grade or pavement subgrade. For horizontal testing frequency, use the following minimums:

- One test for every 100 square feet around structures
- One test for every 500 square feet for structure pads

Complete at least one compaction curve (Proctor) for each material type, source location (for import), and as changes in native materials occur. Material changes include a change in material designation based on the Unified Soil Classification System.

6.7.4.5 Fill Slopes

Construct fill slopes no steeper than 2(H):1(V). To achieve adequate compaction on the face of fill slopes, over-build the slopes and then cut back to the design grade. Track-walking is not an adequate method to compact the face of slopes.

6.7.5 Dewatering

Dewatering may be required for installations greater than approximately 15 feet deep (see Section 6.6.2). Significant groundwater inflow should be anticipated at the deeper excavations for the clarifier.

Dewatering can consist of:

- Deep sumps within the excavation. Considering the presence of fine-grained soils and relatively flat lying bedding, sumps within the excavation are not likely to provide good drawdown.
- Well points. Well points will likely work better to cut off flow into the excavation and drawdown the water level over a larger area.

To facilitate work at the base of the excavation, groundwater should be drawn down at least 3 feet below the planned bottom of excavation. The need for dewatering can be reduced by planning excavations during the lowest anticipated seasonal water levels (expected during the late summer and fall months).

6.7.6 Temporary Excavations

Temporary excavations will require sloping and/or shoring in accordance with Cal OSHA requirements. Based on previous subsurface explorations by CH2M Hill, preliminary excavation and shoring design may be based on Type A soil to planned excavation depth. For Type A soil conditions, temporary excavations may be sloped at ¾(H):1(V).

Where groundwater is present or cohesionless/uncemented granular soils are encountered, Type C soil conditions will apply and a 1.5(H):1(V) slope gradient is required.

The Contractor must retain an engineer to evaluate the impact of existing structures, traffic vibrations, actual soil conditions exposed in the open trenches, and other factors that may promote trench wall instability and adjust trench sloping/shoring accordingly. Surcharge loads such as trench spoils, equipment, etc. should not be placed adjacent to an open excavation (within a distance of ½ the height of the trench). ***The above is guideline information only.*** The contractor is responsible for the safety of all excavations and should provide appropriate excavation sloping and shoring in accordance with current Cal OSHA requirements and observe conditions observed during construction for necessary modification and safety.

6.7.7 Foundations

6.7.7.1 At-Grade Shallow Foundations

If the designers and contractors follow our grading and construction recommendations below, foundations for at grade structures can be supported on shallow strip footings and isolated spread footings. We expect footings for at-grade structures to be founded on compacted fill and/or firm native soils.

- Embed continuous strip and isolated footings a minimum of 18 inches into the lowest adjacent prepared subgrade.
- Both strip and isolated footings must be a minimum of 18 inches wide. Size strip and isolated footings not to exceed an allowable bearing capacity of 2,000 pounds per square foot (dead load plus live load). The allowable bearing capacity may be increased by one-third if seismic and/or wind loads are included.
- Total settlement is expected to be less than ¾-inch and differential settlement less than ½-inch over a length of 50 feet.
- To resist lateral movement, use a coefficient of friction of 0.40 psf at the base of the foundation and a passive earth pressure of 200 psf per foot of embedment depth up to a maximum of 2,000 psf. Ignore the upper one-foot of footing depth (below the lowest adjacent soil grade) in determination of the passive pressure. Both frictional resistance and passive earth pressure can be combined for lateral resistance; when combined, increase the safety factor against sliding from a minimum of 1.5 to 2.0.
- Concrete slabs with crushed rock underlayment may be designed using a Modulus of Subgrade Reaction, k_s, of 25 pounds per cubic inch (pci) in cut or fill locations where engineered fill is placed as recommended in this report.
- Clean footing excavations of debris and loose soil prior to placing concrete.
- Blackburn must observe all footing excavations prior to reinforcement placement to verify competent bearing materials.
- Slope the ground surface away from foundations at a minimum of 2 percent for a distance of at least 5 feet.

6.7.7.2 Below-Grade Foundations

6.7.7.2.1 <u>Bearing Capacity</u>

The planned clarifier is a below-grade structure and the net pressure exerted upon the subsurface will be similar to or less than the existing soil pressure at the bottom of the clarifier. Excavation for below-grade structures reduces the net pressure by removing soil that acts as a "preload" to the underlying soils, thus "unloading" the bearing materials before "loading" by placement of the structure.

Below grade structures will use mat type foundations for support. For structures at depths greater than 20 feet:

- Use a maximum net contact pressure of 3,000 psf.
- Use a Modulus of Subgrade Reaction, k_s, equal to 25 pci.
- We expect settlement of mat foundations is expected to be less than 1 inch with differential settlement less than ½-inch over a distance of approximately 100 feet.
- Clean footing excavations of debris and loose soil prior to placing concrete.
- Blackburn must observe all footing excavations prior to reinforcement placement to verify competent bearing materials.
- For ground preparation and subgrade uniformity, Class 2 aggregate baserock can be used as underlayment (this is not geotechnically necessary provided a firm uniform subgrade is obtained). If an aggregate underlayment is used, place a minimum thickness of 6-inches and compact to a minimum of 95% relative compaction (per ASTM D 1557 test method).
- Crushed rock underlayment may also be used (and can benefit excavation dewatering). Envelope the crushed rock with a geotextile filter fabric (ie. Mirafi 140N) and compact the rock with a static roller.

Blackburn can provide additional recommendations when the planned design and approximate loading is available if isolated spread footings or piers are required for column support.

6.7.7.2.2 Structure Backfill

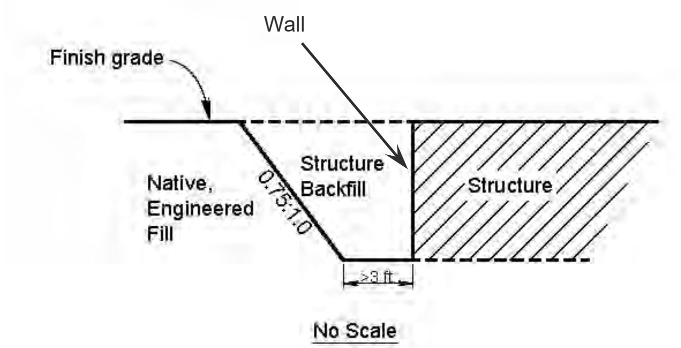
Native soils in approximately the upper 23± feet consist of lean clay which will not be suitable for structure backfill.

Blackburn must approve import structure backfill prior to delivery. Use the specifications in Table 6.5 for import structure backfill for all below-grade structures:

Table 5.5: Import Structure Backfill Requirements

Gradation		Test Procedures	
Sieve Size	**Percent Passing**	**ASTM**	**Caltrans**
1 inch	100	D6913	202
¾ inch	70-100	D6913	202
No. 4	50-100	D6913	202
No. 200	12-40	D6913	202
Plasticity			
Plasticity Index	<12	D4318	204

As shown below, the zone of placement for structure backfill should extend up from the base of the wall at a slope of 0.75(H):1(V) and at least 3 feet behind the wall. Native, engineered fill may be placed beyond the structure backfill zone.



- Moisture condition backfill to within 2% of optimum and place in maximum 8-inch thick, horizontal, loose lifts.
- Compact backfill to a minimum 92% relative compaction based on the ASTM D 1557 test method.

To minimize the residual lateral earth pressures on structure walls, compaction equipment used behind the walls must be restricted (by load and distance from wall) so that wall design values are not exceeded. We recommend compaction within a horizontal distance equal to one-half of the wall height (to a maximum distance of 5 feet), be completed with hand-operated equipment (i.e., jumping jack). To minimize the potential for significant settlement around deep walls, controlled low strength material (CLSM) can be used to backfill to the surface or to a manageable depth (e.g., 10 feet below grade).

6.7.7.2.3 Lateral Earth Pressures

The below grade structure will act as retaining structure. Walls will retain compacted select imported soils meeting the requirement for structure backfill. For evaluation of lateral earth pressures, use the backfill equivalent fluid weights (EFW) for level ground conditions shown below in Table 5.6.

Table 6.6: LATERAL EARTH PRESSURES		
Condition	**Equivalent Fluid Weight (pcf)**	**Seismic Equivalent Fluid Weight (pcf)**
At-Rest	85	6
Passive	150	140*

*Total passive EFW for passive condition

The above pressures assume structure backfill placed against the structure wall in accordance with our recommendations, a saturated (total) unit weight of approximately 135 pounds per cubic foot (pcf) and a minimum internal angle of friction of 32 degrees. Notify Blackburn if these assumptions are not valid so that we may assess the situation and provide additional recommendations, if necessary. Backfill with CLSM is an acceptable alternative.

For seismic loading, add the Seismic EFW to the at-rest or active EFW and apply the total force as a uniform load on the wall with a resultant located at 0.5H where H is the backfill height. We estimated the EFWs for seismic loading using the Mononobe-Okabe equation and a horizontal seismic acceleration coefficient, k_h, of approximately ½ the expected PGA. This k_h value assumes that the walls displace at least 1-inch during the design seismic event.

Surface loads (footings, storage, vehicle traffic) applied near the wall will increase the lateral pressure on the wall. A uniform surface load of 200 psf to 300 psf is often used to approximate construction traffic loading on walls. In general, if surface loads are closer to the edge of the retaining wall than three-fourths of the retained height, increase the design wall pressure by 0.5q over the area of the retaining wall. In this expression, q is the surface surcharge load in psf. This is a conservative procedure and lower design pressures may be applicable upon evaluation of individual surface loads and setback distances.

For drained conditions, provide adequate drainage to avoid build-up of hydrostatic pressures. Positive drainage for retaining walls should consist of a vertical layer of permeable material, such as a graded sand and gravel (graded to meet Caltrans Standard Specifications for Class 1, Type A Permeable Material), pea gravel, or crushed rock, at least 6 inches thick, positioned between the retaining wall and the backfill.
If pea gravel or crushed rock is used, place a nonwoven filter fabric between it and the backfill to prevent the drain from becoming clogged. A synthetic drainage fabric, such as Enkadrain (Colbond Geosynthetics Co.), Miradrain (TC Mirafi) or an equivalent, may be substituted for the permeable layer. Use care during installation to assure that the filter part of the material faces the backfill. Remove collected water by installing weep holes along the bottom of the wall or by a perforated drainage pipe along the bottom of the permeable material or drainage fabric continuously sloped towards suitable drainage facilities (i.e., gravity drain or sump pump).

6.7.7.2.4 Buoyancy Resistance

As discussed in Section 6.6.2, groundwater may occur at depths as shallow as 15 feet bgs. In undrained conditions, below grade structures may be subjected to an uplift load (buoyancy). The uplift force will be resisted by the weight of the structure and the weight of the backfill overlying foundation extensions (if any).

If foundation extensions are used to resist buoyant forces, calculate the resistance against uplift due to the weight of the soil. Use a backfill unit weight of 130 pcf above groundwater and 73 pcf below groundwater, with a soil wedge extending vertically up from foundation extensions.

6.7.7.2.5 Lateral Resistance

Lateral resistance for retaining structures can be achieved through friction and passive earth pressures acting on the foundation. For design, use a coefficient of friction of 0.40 (below or above groundwater) at the base of the concrete footing and an ultimate passive earth pressure of 200 psf per foot of embedment depth. Limit passive earth pressures to a maximum of 2,000 psf (additional passive pressure can be evaluated for specific locations if necessary). Decrease the passive pressure to 75 psf per foot of depth when below design groundwater levels. Do not include the upper 1-foot of soil in passive resistance calculations. Where passive pressure or friction alone is used against sliding, use a minimum factor of safety of 1.5 for lateral stability (1.1 if seismic loading is included). Where both passive pressure and friction are used to resist sliding, use a minimum factor of safety of 2.0.

6.7.7.3 Minor Structures

Provided that the recommendations in this report are followed, minor structures (such as valve or blow-off vaults, access ways, etc.) may be founded on concrete mat or strip footings, or a compacted granular base (minimum of 6 inches of Class 2 baserock) if appropriate.

- Embed the foundations a minimum of 18 inches below the lowest adjacent prepared subgrade into firm native soil or compacted fill/backfill.
- Footings must be a minimum of 12 inches wide and sized not to exceed an allowable bearing capacity of 2,000 psf. The allowable bearing capacity may be increased by one-third if seismic and/or wind loads are included.
- Concrete slabs with crushed rock underlayment may be designed using a Modulus of Subgrade Reaction, k_s, of 25 pci on structural fill placed as recommended in this report.
- If additional bearing capacity is required for specific minor structures, we can review and provide recommendations on a case-by-case basis.
- To resist lateral movement, use a coefficient of friction of 0.40 at the base of the foundation and a passive earth pressure of 200 psf per foot of embedment depth up to a maximum of 2,000 psf. Ignore the upper one-foot of footing depth (below the lowest adjacent soil grade) in determination of the passive pressure. Both frictional resistance and passive earth pressure can be combined for lateral resistance; when combined, increase the safety factor against sliding from a minimum of 1.5 to 2.0.

If necessary for evaluation of lateral loading on shallow vaults, use an At-Rest equivalent fluid weight of 65 pcf for the drained condition and 95 pcf for undrained. The drained condition assumes groundwater does not accumulate; the undrained condition would be applied below an assumed groundwater level.

We based these values on foundations bearing on native soil and native soil backfill compacted against vault walls.

6.7.8 Soil Corrosivity

We have not completed our subsurface explorations or laboratory testing for the proposed structures. Based on data from pipeline borings for similar materials (lean clays) we expect clay soils to be corrosive to extremely corrosive conditions to metal pipes. We are not corrosion consultants and cannot evaluate the potential corrosion impacts to metallic elements embedded in or in contact with the ground. A corrosion consultant should provide specific corrosion protection recommendations for buried metallic elements used at the site.

6.7.9 Concrete Slabs on Grade

6.7.9.1 Slab Underlayment

For minor structures, concrete slabs-on-grade may be used provided the contractor(s) prepares the structure pads in accordance with our grading recommendations and any addenda by Blackburn. Use a minimum slab thickness of 4 inches. Underlay the concrete slabs with a minimum of 4 inches of washed, crushed, and compacted rock to provide uniform support. Concrete reinforcement, doweling, curing, joint spacing, and mix design should conform to ACI guidelines. The above recommendations are not for slabs subject to equipment or forklift loads. Moderately expansive clay potentially underlay the site. To mitigate potential expansive soil, consider a slab thickness of 6-inches with 8-inches of crushed rock.

6.7.10 Trench Backfill and Compaction

6.7.10.1 Pipe Bedding and Pipe Zone Material

Support pipe on a minimum of 4 inches of granular bedding and in accordance with the pipe manufacturer's recommendations. Although we do not anticipate soft, unsuitable pipe subgrade at any particular location, it can occur with shallow groundwater conditions and sandy soils. Notify the project engineer and Blackburn for review and mitigation recommendations if encountered. To achieve a stable and non-yielding subgrade suitable for pipe placement and backfilling, typical mitigation may include:

- Replacement of unsuitable subgrade with ¾-inch minus crushed rock (minimum of 6 inches)
- Enclose rock in geotextile filtration fabric such as Mirafi 140N (or equivalent).

A granular pipe zone material may be used. Native soils will contain a significant amount of fines (passing #200 sieve) and will **not** be suitable for bedding or pipe zone backfill. For pipe bedding and initial backfill material (which extends to 1 foot above the top of pipe) use material that meet the specification in Table 6.7.

Table 6.7: Pipe Bedding and Initial Backfill Requirements			
Gradation		**Test Procedures**	
Sieve Size	**Percent Passing**	**ASTM**	**Caltrans**
1 inch	100	D6913	202
¾ inch	90-100	D6913	202
No. 4	35-60	D6913	202
No. 30	10-30	D6913	202
No. 200	2-5	D6913	202
Sand Equivalent			
Minimum 25		D2974	

Blackburn considers the following materials to be suitable as alternative pipe zone (bedding) backfill material:

- Controlled Low Strength Material (CLSM)
- Controlled Density Fill (CDF)

6.7.10.2 Trench Backfill

Trench backfill above the Pipe Zone material may consist of excavated soils. Fill should be free of debris and concentrations of vegetation or clay soils and meet the specifications in Table 6.8.

Table 6.8: Intermediate Trench Backfill Requirements			
Gradation		**Test Procedures**	
Sieve Size	**Percent Passing**	**ASTM**	**Caltrans**
3 inch	100	D6913	202
No. 200	20-70	D6913	202
Organic Content			
Less than 3%		D2974	
Expansion Index			
Less than 20		D4829	

If import fill is required for trench backfill, it should be graded and have material properties as follows:

- 100% passing the 1-inch sieve
- 75% to 100% passing the #4 sieve
- Minimum 12% passing the #200 sieve
- Plasticity Index not greater than 20
- Free of debris and concentrations of vegetation.

Use ¾-inch Class 2 AB in the upper 12-inches of the trench within roadways.

6.7.10.3 Trench Backfill Compaction

Follow the pipe manufacturer's requirements for initial backfill to avoid damage to the pipe. To facilitate compaction in the pipe zone area (top of bedding up to 12 inches above pipe), use a trench width that provides a minimum clearance of 12 inches between the pipe and trench wall.

- Moisture condition trench backfill to within 2% of optimum moisture content and compact to a minimum 92% relative compaction (based on ASTM 1557) below 10 feet and 90% relative compaction (based on ASTM 1557) above 10 feet.
- Use a maximum compacted lift thickness of 8 inches unless field performance testing can demonstrate adequate compaction of thicker lifts.
- Jetting is not acceptable for compaction.

Test all trench backfill (bedding, pipe zone backfill, trench zone, etc.):

- At vertical increments of not more than 1 foot and at final grade or pavement subgrade.
- At horizontal testing frequencies of at least one test for every 200 linear feet of pipe (both sides of pipe in pipe zone).
- Complete at least one compaction curve (Proctor) for each material type, source location (for import), and as changes in native materials occur. Material changes include a change in material designation based on the Unified Soil Classification System.
- Testing frequency can be adjusted based on contractor performance, ease of compaction, and material variability.

Soil excavated during pipe installation can have moisture contents well over optimum, especially during the winter and spring months or if perched water is encountered. In this case, it will be necessary to dry back the soil to within 2% of optimum moisture content prior to use as backfill.

It is important to achieve compaction of pipe zone materials at the pipe haunches and spring line; compaction below the pipe spring line will be a difficult task for the contractor. We recommend a compaction demonstration section to test placement and compaction means and methods for each material type that will be used.

6.7.11 Equalization Basin Concrete Lining

Concrete pavement is proposed to line the Equalization Basin. Prepare the subgrade as discussed in Section 6.7.4.2 and 6.7.4.3. We understand the pavement will not be subject to regular wheel loads.

Design concrete pavement in accordance with American Concrete Institute (ACI) Guide for the Design and Construction of Concrete Parking Lots (ACI 330R-08).

- Use a modulus of subgrade reaction of 100 pci.
- Use a minimum of 6 -inches of concrete over 8 inches of Class 2 AB.
- Concrete reinforcement, doweling, curing, joint spacing, and mix design should conform to ACI guidelines.

Aggregate base (AB) should conform to Caltrans Class 2 requirements. Moisture condition and compact AB to a minimum 95% relative compaction based on ASTM D1557. Prior to placing concrete, the aggregate base should be stable under the weight of a loaded water truck. Mitigate unstable areas as recommended by Blackburn.

Concrete pavement must meet the following requirements:

- Minimum 28-day compressive strength of 3,500 psi.
- Joint spacing will be determined by the structural engineer in accordance with ACI 350-06.

The Civil Engineer should design the final joint types/spacing and appropriate concrete mix design.

7 WATER TANK AND BOOSTER STATION

7.1 Site Location and Description

The OPUD South Yuba Sewer Infrastructure Project includes a 1 MG steel storage tank, water well, booster station, and on-site piping. Appendix E1 shows the proposed improvement location.

The proposed water tank and booster station will be constructed in a vacant lot northeast of the existing Casino water tank. Based on aerial photographs the lot appears to be free of vegetation and graded level.

7.2 Previous Studies

To prepare this section of the report, Blackburn reviewed Geocon Consultants, Inc.'s "Geotechnical Investigation – Enterprise Rancheria Casino, October 2014" (Geocon Investigation) and limited explorations from our pipeline exploration for the OPUD project. We will perform site-specific subsurface explorations, laboratory testing, and analysis to provide final design recommendations for the water tank and booster station.

7.3 Geology

We reviewed geology maps and the United States Department of Agriculture's (USDA) Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm). The "Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierra Foothills, California" (Helley and Harwood, 1985) shows the site underlain by the Upper Member, Riverbank Formation that consists of unconsolidated, but compact, dark brown to red, alluvium composed of gravel, sand, silt, and clay.

The web soil survey indicates that the site is underlain by San Joaquin loam (214). The survey states this unit has the following relevant properties from 0 to 25 inches deep: Silt (ML), Silty Clay (CL-ML) and Clay (CL) with fines content ranging from 50 to 70 percent.

7.4 Subsurface Findings

7.4.1 General Subsurface Soil Conditions

In Blackburn boring TC-12A, drilled on September 9, 2020 approximately 2,000 feet from the proposed tank site, we generally encountered stiff to very stiff lean clay and silt with sand within the upper 15 feet underlain by approximately 15 feet of medium dense clayey sand and sand with silt. Hard silt from 30 feet to 40 feet underlain by very dense sand with silt to maximum depth explored (51.5 feet).

The Geocon Investigation (2014) indicates that the subsurface soils across the Casino site consist of:

- Approximately 2.5 to 4 feet of moderately to highly expansive clay (the upper 1 to 1.5 feet of which is loose due to disturbance by agricultural operations), underlain by
- Very stiff to hard clays and silts with varying sand contents and sands with varying fines contents to the maximum depth explored (41.5 feet).
- Some zones of cementation encountered throughout the subsurface soil profile.

7.4.2 Groundwater

In our borings TC-12A and TC-12B, drilled September 9, 2020, we measured groundwater at depths of 24 and 17 feet (respectively) below ground surface.

Geocon's Investigation for the casino drilled only one boring deeper than 27 feet. That boring log (Boring B1) indicates groundwater at 29 ft below ground surface.

We reviewed groundwater level data for nearby wells available at the California Department of Water Resources website (http://www.water.ca.gov/waterdatalibrary/) and using the Sustainable Groundwater Management Act (SGMA) data viewer (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels). Based on this information, the depth to groundwater at the site typically ranges from 20 to 30 feet, although it occasionally is measured above 20 feet. Relatively shallow perched water may occur within the near-surface soils during the winter and spring months, and adjacent to the existing canals and streams.

Groundwater and perched water levels can fluctuate due to changes in precipitation, canal and creek levels, irrigation, pumping of wells, and other factors.

7.5 Preliminary Design Considerations – Water Tank and Booster Station

7.5.1 Facility Ground Suitability

The site will be suitable for the planned facilities when constructed in accordance with the project plans, industry standards, and our geotechnical recommendations.

7.5.2 Geologic Hazards

- Faulting—The potential for surface rupture or creep due to faulting at the site is very low. The Fault Activity Map of California[12] and the Geologic Map of the Sacramento Quadrangle[13] does not identify Historic or Holocene age faults (displacement within the last 11,700 years) within or immediately adjacent to the site. The site does not lie within or adjacent to an Alquist–Priolo Earthquake Fault Zone[14].
- Ground Shaking— For the Maximum Considered Earthquake, a peak horizontal ground acceleration (PGA) of approximately 0.21g could be expected.
- Liquefaction—Our investigation shows a soil profile that consists of stiff to hard clays and medium dense to dense sands ad silty and clayey sands that are not liquefiable. Therefore, the potential for damaging liquefaction at the site is very low.
- Landslides and Slope Stability—Due to the relatively low topographic relief we do not expect landslides or natural slope failure.
- Seismically Induced Settlement—During a seismic event, ground shaking can cause densification of granular soil that can result in settlement of the ground surface. Considering the cohesive soils and medium dense to dense soils observed in the borings, we consider the potential for significant seismically induced settlement to be very low.

7.5.3 Seismic Design

Based on the mapped geology and nearby boring data, use a Site Class “D” (stiff soil). Table 7.1 presents the 2019 *California Building Code* (Chapter 16) and ASCE 7-16 seismic design parameters for the site.

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[12] Jennings, Charles W., and Bryant, William A., 2010 Fault Activity Map of California: California Geological Survey, Geologic Data Map No. 6.
[13] Saucedo, G.J. and Wagner, D.L., et al, 1992, Geologic map of the Chico quadrangle, California, 1: 250,000: California Division of Mines and Geology, Regional Geologic Map 7A, scale 1: 250,000
[14] Bryant, W.A., and Hart, E.W., 2007 (Interim Revision), Fault-Rupture Hazard Zones in California: California Department of Conservation, Division of Mines and Geology, Special Publication 42.

Table 7.1: 2019 CBC Seismic Design Parameters (Site Class D)	
S_s – MCE_R ground motion (0.2 second period)	0.495 g
S_1 – MCE_R ground motion (1.0 second period)	0.24 g
F_a – Site Coefficient	1.404
F_v – Site Coefficient	2.11[1]
S_{MS} – Adjusted MCE* Spectral Response Acceleration Parameter	0.695 g
S_{M1} – Adjusted MCE* Spectral Response Acceleration Parameter	0.509 g[1]
S_{DS} – Design Spectral Acceleration Parameter	0.464 g
S_{D1} – Design Spectral Acceleration Parameter	0.339 g[1]
Seismic Design Category	C[1]
**T_L – Long Period Transition Period	12 sec
PGA	0.213

* Maximum Considered Earthquake
** Figure 22-14, ASCE 7-16
1 – We assume that the seismic response coefficient, Cs, is determined by ASCE 7-16 Eq. (12.8-2) for values of T ≤ 1.5Ts and taken as equal to 1.5 times the value computed in accordance with either ASCE 7-16 Eq. (12.8-3) for TL ≥T > 1.5Ts or Eq. (12.8-4) for T > TL. Contact Blackburn to re-evaluate the above parameters if this assumption is not valid.

If the proposed design does not meet the exception noted above (note 1) a site-specific response analysis will be required for final design.

7.5.4 General Grading Recommendations

7.5.4.1 Excavation Conditions

Based on the soil conditions and drilling performance, excavation is possible with conventional equipment (common earthmoving equipment and large backhoe/excavator). The fine-grained and hard soil conditions can create slow excavation conditions and is not suitable for structure backfill.

7.5.4.2 Site Clearing

Prior to making any cuts and fills, remove existing underground utilities, foundations, vegetation (root balls and roots), debris, and other underground features in accordance with this Geotechnical Report. Remove loose and disturbed soil caused by the removal(s) and widen the excavation/depression so it is accessible to compaction equipment. Remove strippings from the site or use as landscape soil in designated areas.

7.5.4.3 Original Ground and Subgrade Preparation

The site has historically been covered by agricultural fields. To avoid loose disturbed soils and adverse settlement, overexcavate the tank footprint and 5 feet beyond to a depth of 3 feet below existing grade. After overexcavation, compact the exposed soil at the bottom of the excavation as follows:

- Scarify the exposed soil to a depth of approximately 8 inches.

- Moisture condition subgrade to within 3% of the optimum moisture content.
- Compact the subgrade soil to a minimum 90% relative compaction based on ASTM D1557.
- Backfill the excavation with General Fill as recommended below.

7.5.4.4 General Fill Placement and Compaction

General fill (**not trench or structure backfill**) may consist of on-site soil provided it contains no rocks larger than 3 inches in maximum dimension. Fill should be free of debris and concentrations of vegetation.

If import for general fill is required, it must be free of debris and meet the following requirements:

Table 7.2: General Backfill Import Requirements			
Gradation		**Test Procedures**	
Sieve Size	**Percent Passing**	**ASTM**	**Caltrans**
1 inch	100	D6913	202
No. 4	75-100	D6913	202
No. 200	12-100	D6913	202
Plasticity Index			
Less than 20		D4318	

- Approved by Blackburn prior to site delivery.

Place and compact general fill as follows:

- Place fill in maximum 8-inch-thick loose lifts,
- Moisture condition the soil within 3% of optimum
- Compact the soil to a minimum 90% relative compaction based on ASTM D1557.

Test all fill at vertical increments of not more than 1 foot and at final grade or pavement subgrade. For horizontal testing frequency, use the following minimums:

- One test for every 100 square feet around structures
- One test for every 500 square feet for structure pads

Complete at least one compaction curve (Proctor) for each material type, source location (for import), and as changes in native materials occur. Material changes include a change in material designation based on the Unified Soil Classification System.

7.5.5 Dewatering

We do not expect deep excavations for the water tank construction. Dewatering may be required for installations greater than approximately 15 feet deep (see Section 7.4.2).
Dewatering can consist of:

- Deep sumps within the excavation. Considering the presence of fine-grained soils and relatively flat lying bedding, sumps within the excavation are not likely to provide good drawdown.
- Well points. Well points will likely work better to cut off flow into the excavation and drawdown the water level over a larger area.

To facilitate work at the base of the excavation, groundwater should be drawn down at least 3 feet below the planned bottom of excavation. The need for dewatering can be reduced by planning excavations during the lowest anticipated seasonal water levels (expected during the late summer and fall months).

7.5.6 Temporary Excavations

Temporary excavations will require sloping and/or shoring in accordance with Cal OSHA requirements. Based on our subsurface explorations for other portions of the Project, preliminary excavation and shoring design may be based on Type A soil to planned excavation depth. For Type A soil conditions, temporary excavations may be sloped at ¾(H):1(V).

Where groundwater is present or cohesionless/uncemented granular soils are encountered, Type C soil conditions will apply and a 1.5(H):1(V) slope gradient is required.

The Contractor must retain an engineer to evaluate the impact of existing structures, traffic vibrations, actual soil conditions exposed in the open trenches, and other factors that may promote trench wall instability and adjust trench sloping/shoring accordingly. Surcharge loads such as trench spoils, equipment, etc. should not be placed adjacent to an open excavation (within a distance of ½ the height of the trench). ***The above is guideline information only.*** The contractor is responsible for the safety of all excavations and should provide appropriate excavation sloping and shoring in accordance with current Cal OSHA requirements and observe conditions observed during construction for necessary modification and safety.

7.5.7 Foundations

7.5.7.1 Shallow Foundations

We expect the tank foundation to consist of a perimeter (ring) footing, with a compacted baserock interior.

- Embed the footing a minimum of 18 inches into the lowest adjacent prepared subgrade.
- Footings must be a minimum of 18 inches wide.
- Size footings not to exceed an allowable bearing capacity of 3,000 pounds per square foot (dead load plus live load). The allowable bearing capacity may be increased by one-third if seismic and/or wind loads are included.
- Clean footing excavations of debris and loose soil prior to placing concrete.
- Blackburn must observe all footing excavations prior to reinforcement placement to verify competent bearing materials.
- Slope the ground surface away from foundations at a minimum of 2 percent for a distance of at least 5 feet.

- To resist lateral movement, use a coefficient of friction of 0.35 psf at the base of the foundation and a passive earth pressure of 200 psf per foot of embedment depth up to a maximum of 3,000 psf. Ignore the upper one-foot of footing depth (below the lowest adjacent soil grade) in determination of the passive pressure. Both frictional resistance and passive earth pressure can be combined for lateral resistance; when combined, increase the safety factor against sliding from a minimum of 1.5 to 2.0.
- Based on typical Riverbank soils we anticipate total settlement to be less than 1-2 inches and differential settlement less than ½-inch over a length of 50 feet. We anticipate approximately half of the total settlement will occur during loading of the foundations and half will occur when the tank is filled.

7.5.7.2 Minor Structures

Provided that the recommendations in this report are followed, minor structures may be founded on concrete mat or strip footings, or a compacted granular base (minimum of 6 inches of Class 2 baserock) if appropriate.

- Embed the foundations a minimum of 18 inches below the lowest adjacent prepared subgrade into firm native soil or compacted fill/backfill.
- Footings must be a minimum of 12 inches wide and sized not to exceed an allowable bearing capacity of 2,000 psf. The allowable bearing capacity may be increased by one-third if seismic and/or wind loads are included.
- Concrete slabs with crushed rock underlayment may be designed using a Modulus of Subgrade Reaction, k_s, of 25 pounds per cubic inch (pci) in cut or fill locations where engineered fill is placed as recommended in this report.
- If additional bearing capacity is required for specific minor structures, we can review and provide recommendations on a case-by-case basis.
- To resist lateral movement, use a coefficient of friction of 0.40 at the base of the foundation and a passive earth pressure of 200 psf per foot of embedment depth up to a maximum of 2,000 psf. Ignore the upper one-foot of footing depth (below the lowest adjacent soil grade) in determination of the passive pressure. Both frictional resistance and passive earth pressure can be combined for lateral resistance; when combined, increase the safety factor against sliding from a minimum of 1.5 to 2.0.

If necessary for evaluation of lateral loading on shallow vaults, use an At-Rest equivalent fluid weight of 65 pcf for the drained condition and 95 pcf for undrained. The drained condition assumes groundwater does not accumulate; the undrained condition would be applied below an assumed groundwater level.

We based these values on foundations bearing on native soil and native soil backfill compacted against vault walls.

7.5.8 Soil Corrosivity

We have not completed our subsurface explorations or laboratory testing for the proposed structures. Based on data from pipeline borings for similar materials (lean clays) we expect clay soils to be corrosive to extremely corrosive conditions to metal pipes. We are not corrosion consultants and cannot evaluate the potential corrosion impacts to metallic elements embedded in or in contact with the ground. A corrosion consultant should provide specific corrosion protection recommendations for buried metallic elements used at the site.

7.5.9 Concrete Slabs on Grade

7.5.9.1 Slab Underlayment

For minor structures, concrete slabs-on-grade may be used provided the contractor(s) prepares the structure pads in accordance with our grading recommendations and any addenda by Blackburn. Use a minimum slab thickness of 4 inches. Underlay the concrete slabs with a minimum of 4 inches of washed, crushed, and compacted rock to provide uniform support. Concrete reinforcement, doweling, curing, joint spacing, and mix design should conform to ACI guidelines. The above recommendations are not for slabs subject to equipment or forklift loads. Moderately expansive clay potentially underlay the site. To mitigate potential expansive soil, consider a slab thickness of 6 -inches with 8-inches of crushed rock.

7.5.10 Trench Backfill and Compaction

7.5.10.1 Pipe Bedding and Pipe Zone Material

Support pipe on a minimum of 4 inches of granular bedding and in accordance with the pipe manufacturer's recommendations. Although we do not anticipate soft, unsuitable pipe subgrade at any particular location, it can occur with shallow groundwater conditions and sandy soils. Notify the project engineer and Blackburn for review and mitigation recommendations if encountered. To achieve a stable and non-yielding subgrade suitable for pipe placement and backfilling, typical mitigation may include:

- Replacement of unsuitable subgrade with ¾-inch minus crushed rock (minimum of 6 inches)
- Enclose rock in geotextile filtration fabric such as Mirafi 140N (or equivalent).

A granular pipe zone material may be used. Native soils will contain a significant amount of fines (passing #200 sieve) and will **not** be suitable for bedding or pipe zone backfill. For pipe bedding and initial backfill material (which extends to 1 foot above the top of pipe) use material that meet the specification in Table 7.3.

Table 7.3: Pipe Bedding and Initial Backfill Requirements			
Gradation		Test Procedures	
Sieve Size	Percent Passing	ASTM	Caltrans
1 inch	100	D6913	202
¾ inch	90-100	D6913	202
No. 4	35-60	D6913	202
No. 30	10-30	D6913	202
No. 200	2-5	D6913	202
Sand Equivalent			
Minimum 25		D2974	

Blackburn considers the following materials to be suitable as alternative pipe zone (bedding) backfill material:

- Controlled Low Strength Material (CLSM)
- Controlled Density Fill (CDF)

7.5.10.2 Trench Backfill

Trench backfill about the Pipe Zone material may consist of excavated soils. Fill should be free of debris and concentrations of vegetation or clay soils and meet the specifications in Table 7.4.

Table 7.4: Intermediate Trench Backfill Requirements			
Gradation		Test Procedures	
Sieve Size	Percent Passing	ASTM	Caltrans
3 inch	100	D6913	202
No. 200	20-70	D6913	202
Organic Content			
Less than 3%		D2974	
Expansion Index			
Less than 20		D4829	

If import fill is required for trench backfill, it should be graded and have material properties as follows:

- 100% passing the 1-inch sieve
- 75% to 100% passing the #4 sieve
- Minimum 12% passing the #200 sieve
- Plasticity Index not greater than 20
- Free of debris and concentrations of vegetation.

Use ¾-inch Class 2 AB in the upper 12-inches of the trench within roadways.

7.5.10.3 Trench Backfill Compaction

Follow the pipe manufacturer’s requirements for initial backfill to avoid damage to the pipe. To facilitate compaction in the pipe zone area (top of bedding up to 12 inches above pipe), use a trench width that provides a minimum clearance of 12 inches between the pipe and trench wall.

- Moisture condition trench backfill to within 2% of optimum moisture content and compact to a minimum 92% relative compaction (based on ASTM 1557) below 10 feet and 90% relative compaction (based on ASTM 1557) above 10 feet.
- Use a maximum compacted lift thickness of 8 inches unless field performance testing can demonstrate adequate compaction of thicker lifts.
- Jetting is not acceptable for compaction.

Test all trench backfill (bedding, pipe zone backfill, trench zone, etc.):

- At vertical increments of not more than 1 foot and at final grade or pavement subgrade.

- At horizontal testing frequencies of at least one test for every 200 linear feet of pipe (both sides of pipe in pipe zone).
- Complete at least one compaction curve (Proctor) for each material type, source location (for import), and as changes in native materials occur. Material changes include a change in material designation based on the Unified Soil Classification System.
- Testing frequency can be adjusted based on contractor performance, ease of compaction, and material variability.

Soil excavated during pipe installation can have moisture contents well over optimum, especially during the winter and spring months or if perched water is encountered. In this case, it will be necessary to dry back the soil to within 2% of optimum moisture content prior to use as backfill.

It is important to achieve compaction of pipe zone materials at the pipe haunches and spring line; compaction below the pipe spring line will be a difficult task for the contractor. We recommend a compaction demonstration section to test placement and compaction means and methods for each material type that will be used.

8 RISK MANAGEMENT

This report provides preliminary design considerations only. Blackburn has not completed the field work, lab testing, and analysis necessary to provide final design recommendations. Blackburn could not complete the necessary work because alignments were not finalized and rights of entry to properties were not obtained in time for Blackburn to plan, coordinate, and execute field investigations at the locations of proposed improvements.

Blackburn will submit a final report after all field work, lab testing, and analysis has been completed.

Our experience and that of our profession clearly indicates that the risks of costly design, construction, and maintenance problems can be significantly lowered by retaining the geotechnical engineer of record to provide additional services during design and construction. For this project, retain Blackburn to:

- Review and provide comments on the civil plans and specifications prior to construction.
- Attend a preconstruction meeting with the owner, general contractor, earthwork contractor, underground contractor and other parties associated with the management, oversite and process of demolition and earthwork prior to site clearing, grubbing and demolition of existing structures to review geotechnical recommendations, testing requirements and project schedule.
- Observe removal of underground utilities, foundations, vegetation (root balls and roots) and other underground features in accordance with the project plans, specifications and this Geotechnical Report including loose soil generated from the removal.
- Monitor construction to check and document our report assumptions. At a minimum, Blackburn should monitor grading, overexcavation and recompaction of building pad areas, trench backfill, pavement subgrade and aggregate base compaction, and footing excavations.
- Update this report as design changes occur, 2 years or more lapse between this report and construction, and/or site conditions have changed.

If we are not retained to perform the above applicable services, we are not responsible for any other party's interpretation of our report, and subsequent addendums, letters, and discussions.

9 LIMITATIONS

Blackburn performed services in accordance with generally accepted geotechnical engineering principles and practices currently used in this area. This report is for preliminary design only and shall not be used for final design. Where referenced, we used ASTM or Caltrans standards as a general (not strict) *guideline* only. We do not warranty our services.

Blackburn based this report on the current site conditions. We assumed the soil and ground water conditions encountered in our borings are representative of the subsurface conditions across the site. Actual conditions between these locations could be different.

Blackburn completed a Phase 1 Initial Site Assessment for the project. Refer to Blackburn's report dated October 15, 2020 for our evaluation of on-site hazardous material.

Appendices A2, B2, and D2 present our exploratory boring logs and test pit logs. The lines designating the interface between soil types are approximate. The transition between soil types may be abrupt or gradual. Our recommendations are based on the final logs, which represent our interpretation of the field logs, laboratory test results and general knowledge of the site and geological conditions.

Refer to Appendix G (Important Information about This Geotechnical Engineering Report, Geoprofessional Business Association, 2019) for additional limitations regarding this report.

Modern design and construction is complex, with many regulatory sources/restrictions, involved parties, construction alternatives, etc. It is common to experience changes and delays. The owner should set aside a reasonable contingency fund based on complexities and cost estimates to cover changes and delays.

UPDATED DRAFT PRELIMINARY GEOTECHNICAL BASIS OF DESIGN REPORT

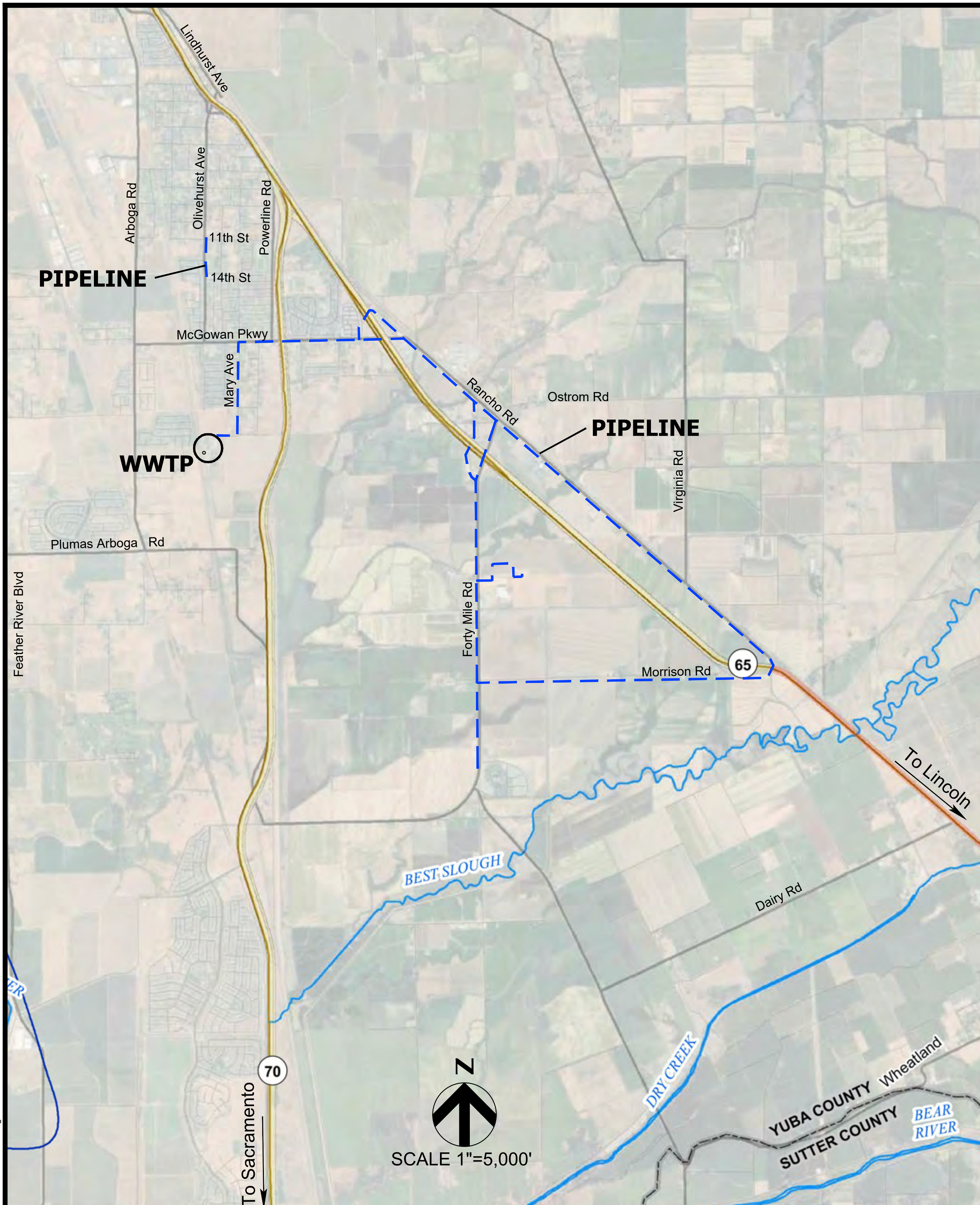
Olivehurst Public Utilities District

South Yuba Sewer and Water Infrastructure Project

Olivehurst, CA

FIGURES

Vicinity Map
Overall Project Map
Regional Geologic Map
USDA Soil Map
Regional Fault Map



4/30/2021 3842.x Fig1 OPUD South Yuba Sewer.dwg

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VICINITY MAP

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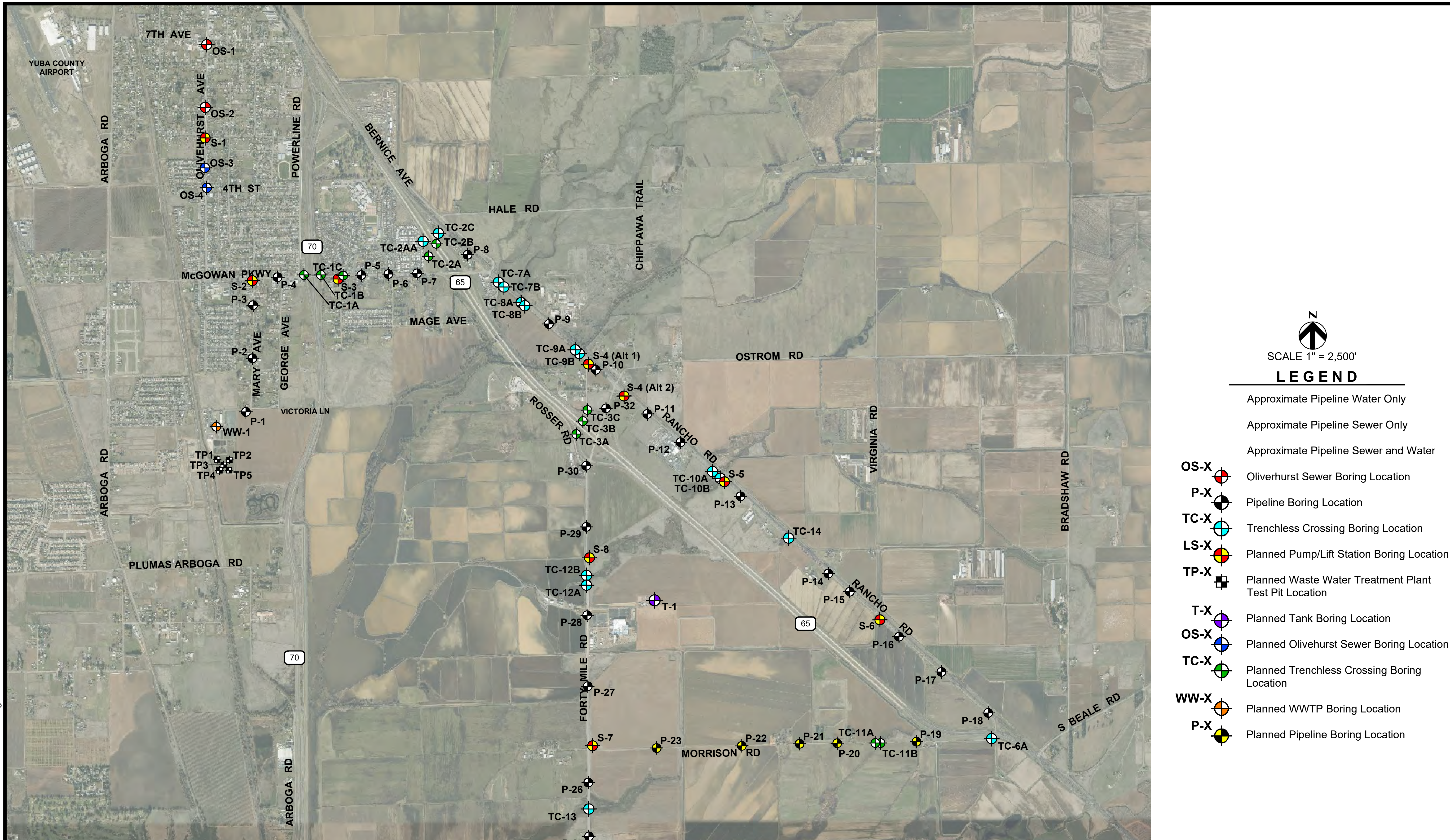
Figure 1



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OVERALL PROJECT MAP

OPUD Yuba County Sewer and Water Infrastructure Project
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Figure 2

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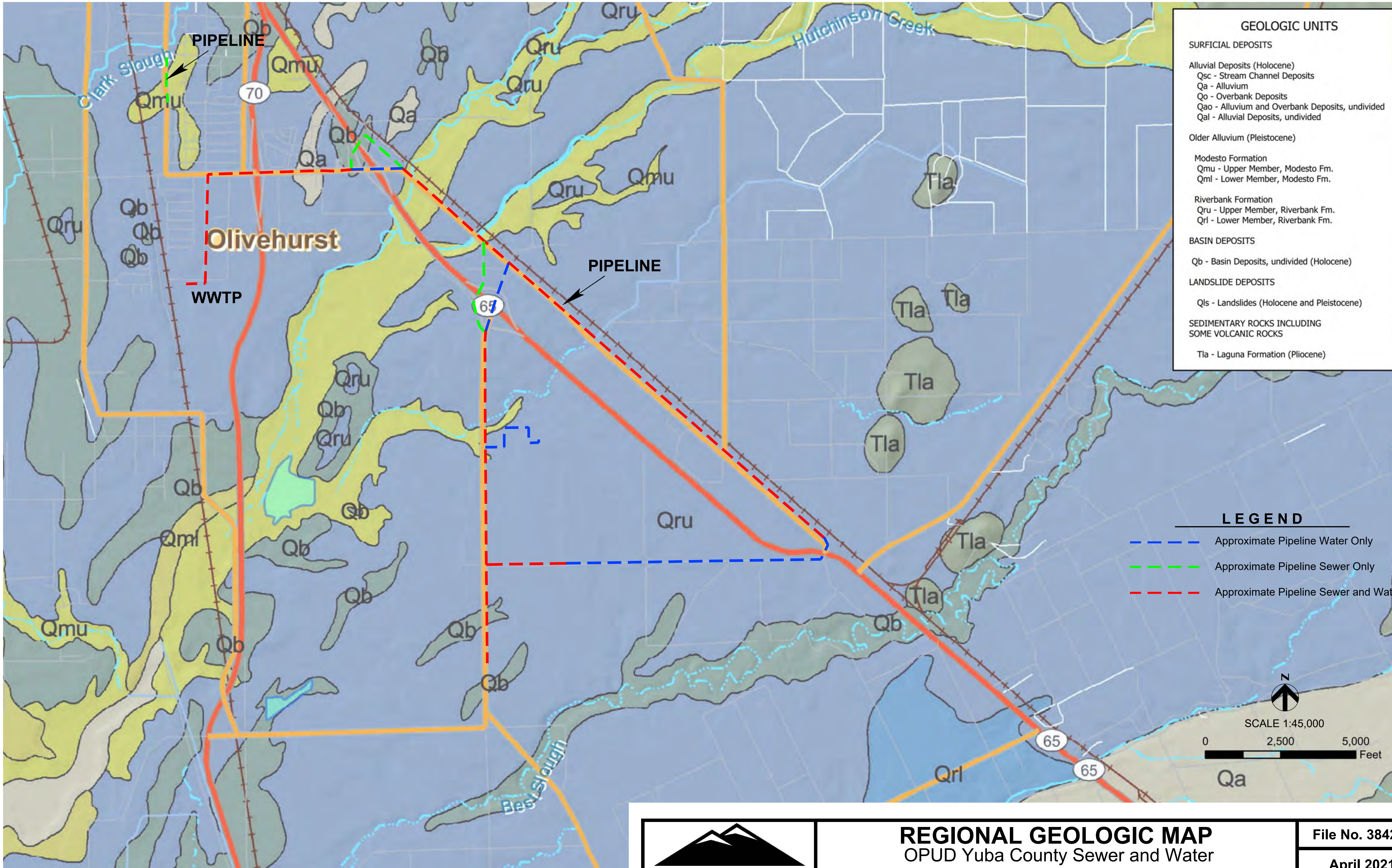

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REGIONAL GEOLOGIC MAP
OPUD Yuba County Sewer and Water
Infrastructure Project
Olivehurst, California

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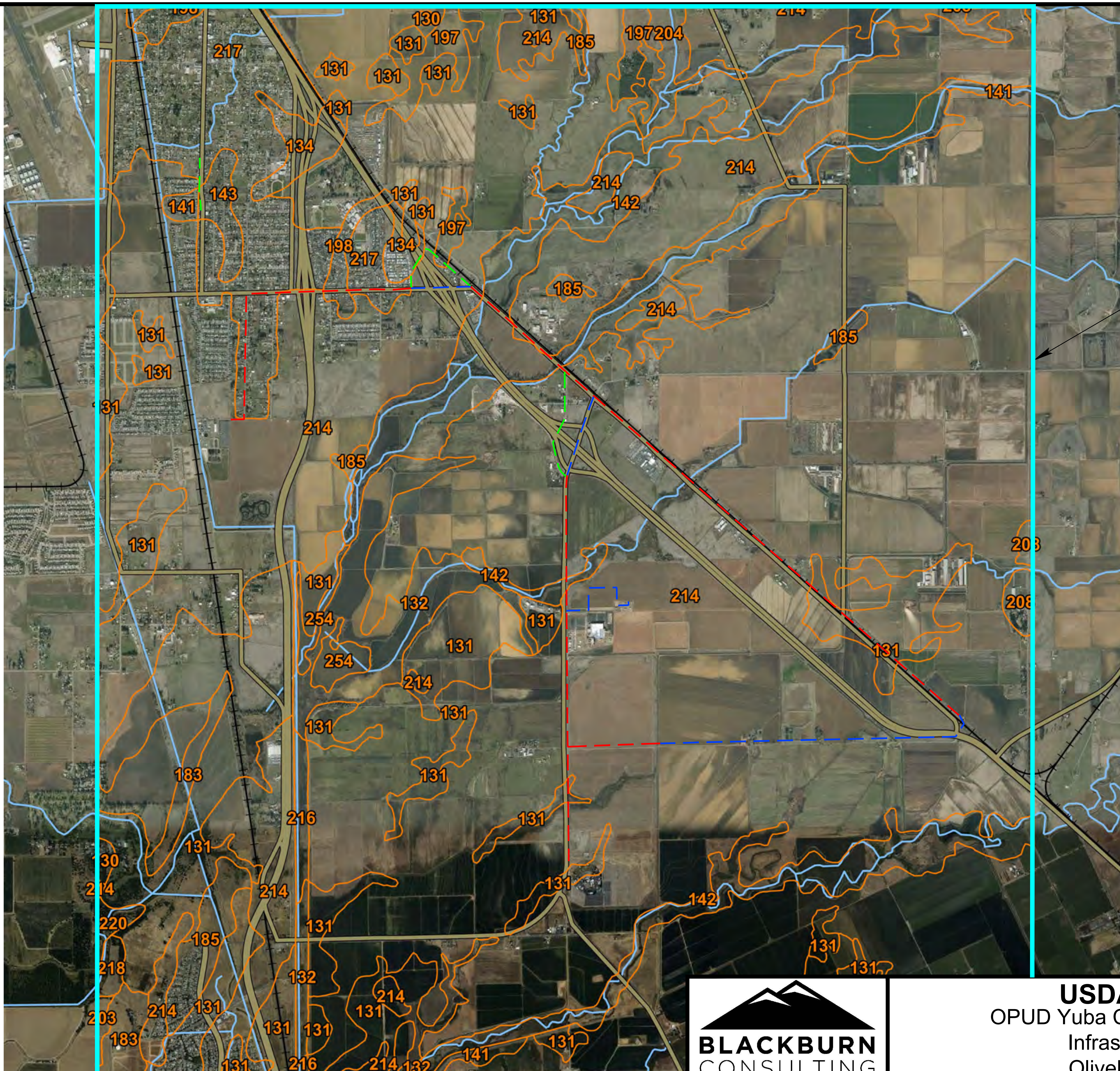
Figure 3



Area of Interest

N

SCALE 1" = 3,000'

LEGEND

- Approximate Pipeline Water Only
- Approximate Pipeline Sewer Only
- Approximate Pipeline Sewer and Water

Map Unit Symbol	Unit Name
131	Hollenbeck Silty Clay Loam
134	Hollenbeck-Urban Land Complex
141	Conejo Loam
142	Conejo Loam
143	Conejo-Urban Land Complex
185	Kimball Loam
197	Oakdale Sandy Loam
198	Oakdale - Urban Land Complex
208	Redding Gravelly Loam
214	San Joaquin Loam
217	San Joaquin - Urban Land Complex
254	Water

Source: USDA Web Soil Map - Yuba County, California, 1:45,000, printed 10/27/2020.

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USDA SOIL MAP

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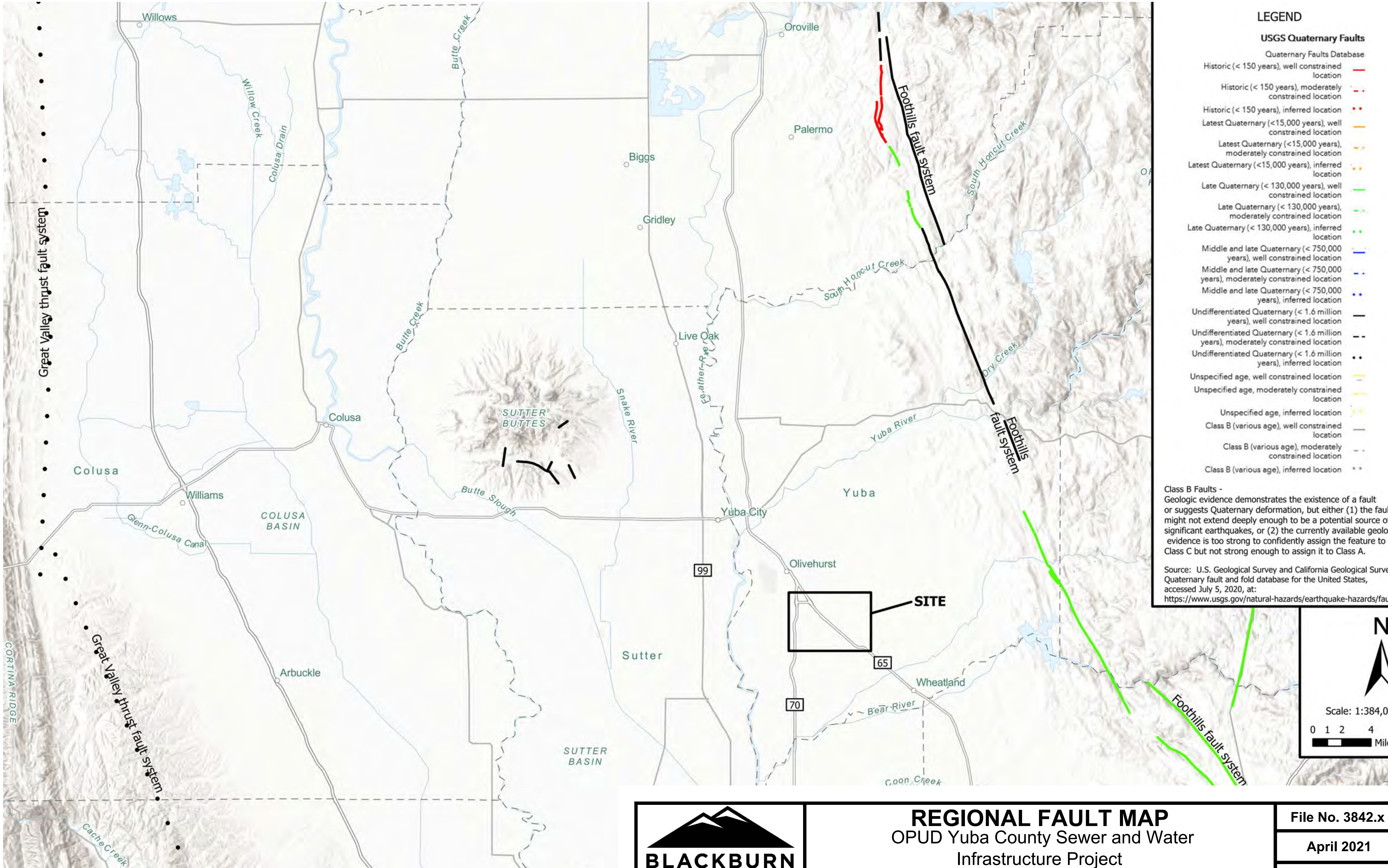
Figure 4

4/30/2021 3842.x Fig4 OPUD South Yuba Sewer.dwg



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REGIONAL FAULT MAP

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Olivehurst, California

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Figure 5

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UPDATED DRAFT PRELIMINARY GEOTECHNICAL BASIS OF DESIGN REPORT

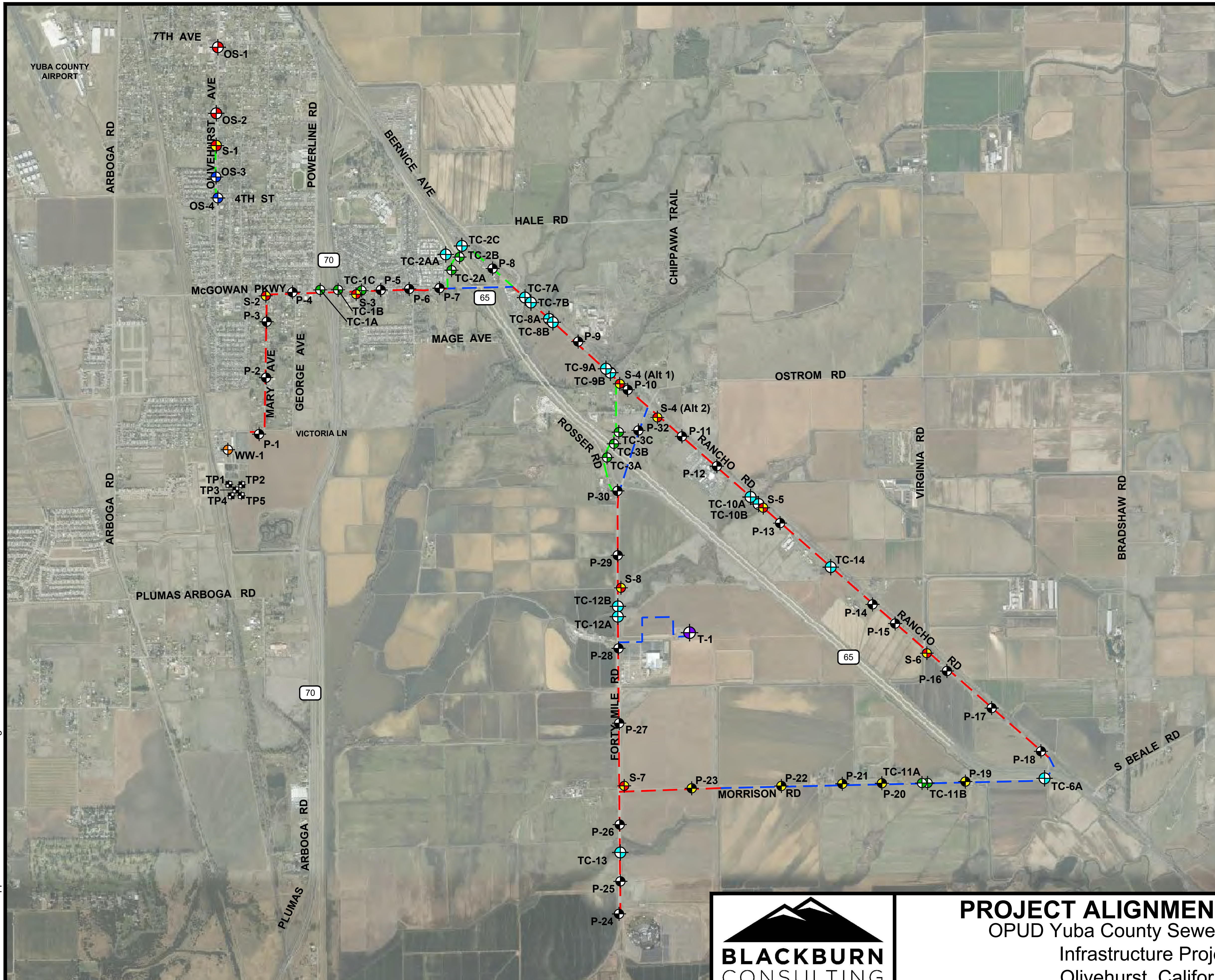
Olivehurst Public Utilities District

South Yuba Sewer and Water Infrastructure Project

Olivehurst, CA

APPENDIX A: Sewer and Water Pipelines

A1: Site Plan
A2: Boring and Test Pit Logs Legend
Boring and Test Pit Logs
A3: Laboratory Test Results



N

SCALE 1" = 2,500'

LEGEND

- Approximate Pipeline Water Only
- Approximate Pipeline Sewer Only
- Approximate Pipeline Sewer and Water
- OS-X Oliverhurst Sewer Boring Location
- P-X Pipeline Boring Location
- TC-X Trenchless Crossing Boring Location
- LS-X Planned Pump/Lift Station Boring Location
- TP-X Planned Waste Water Treatment Plant Test Pit Location
- T-X Planned Tank Boring Location
- OS-X Planned Olivehurst Sewer Boring Location
- TC-X Planned Trenchless Crossing Boring Location
- WW-X Planned WWTP Boring Location
- P-X Planned Pipeline Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

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PROJECT ALIGNMENT LEGEND

OPUD Yuba County Sewer and Water Infrastructure Project

Olivehurst, California

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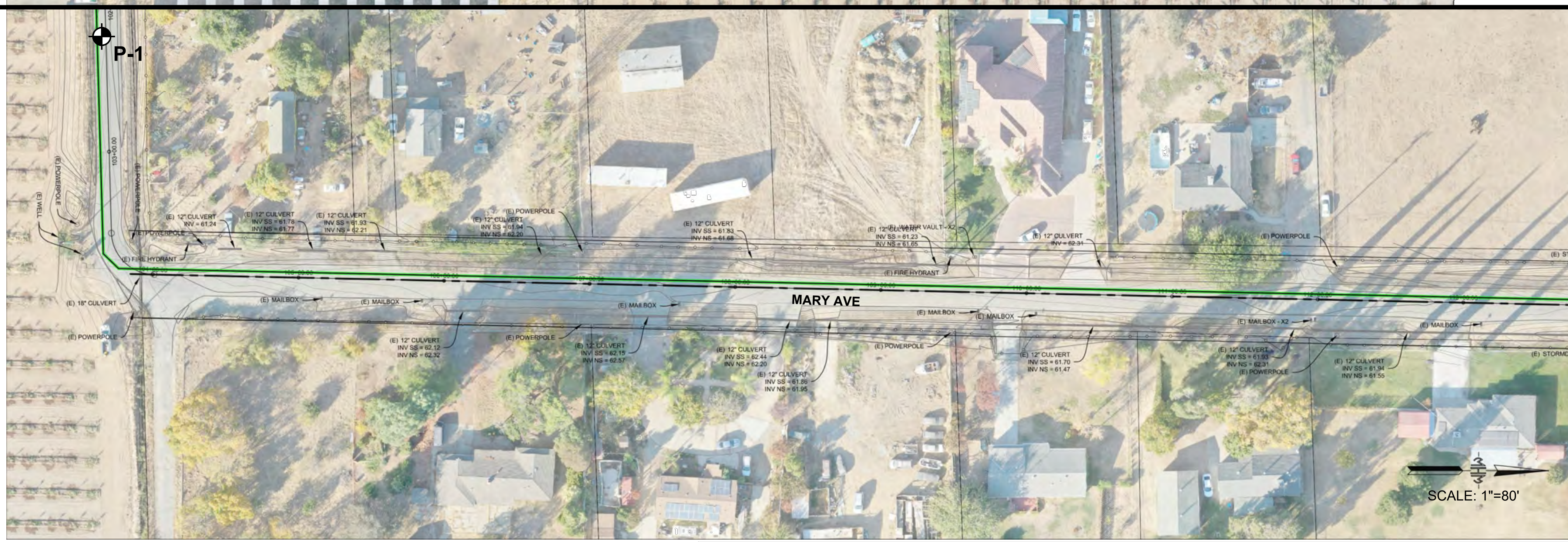

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PIPELINE ALIGNMENT PLAN

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Appendix A1b	

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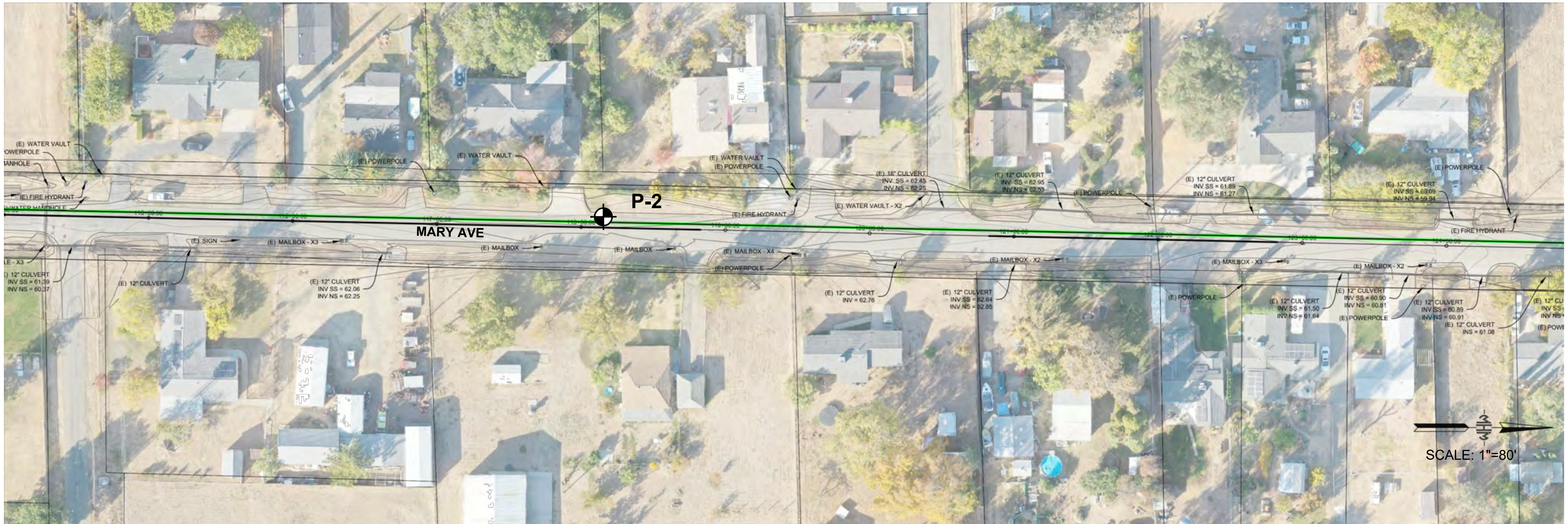

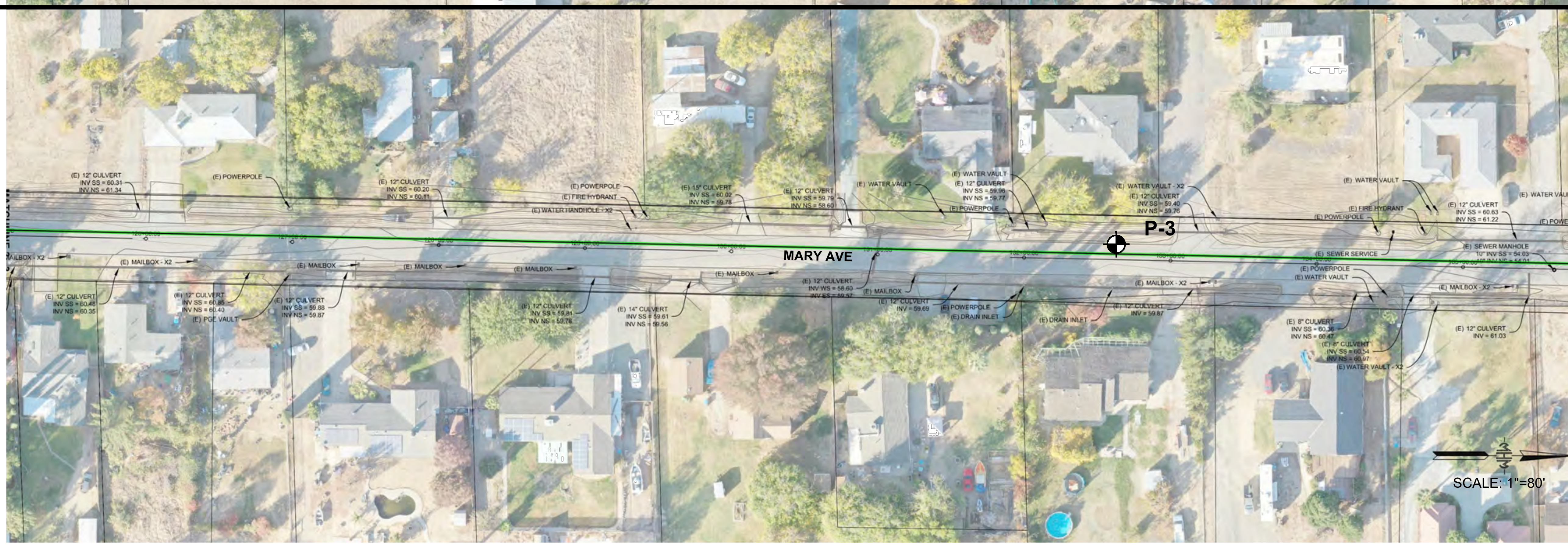

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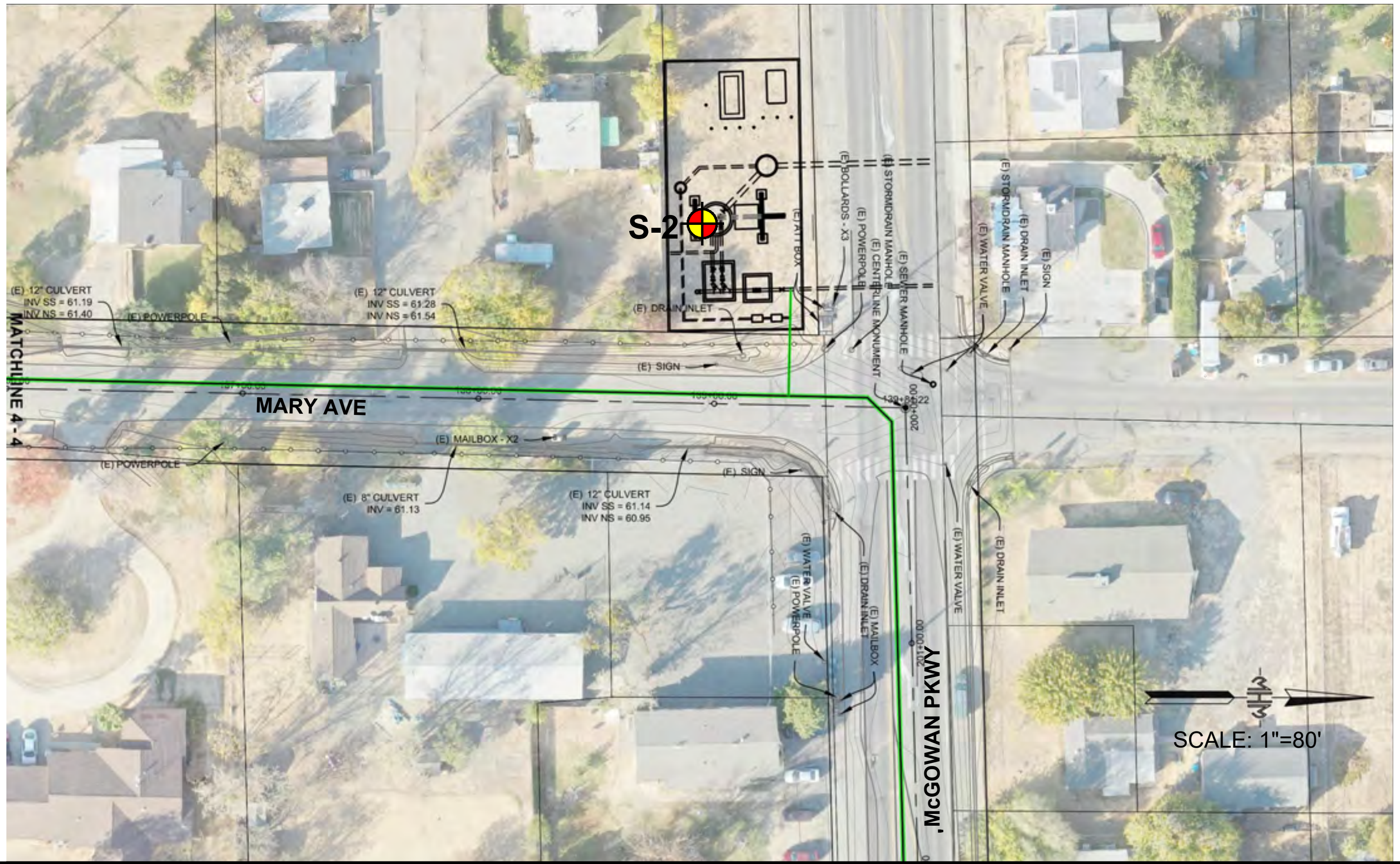

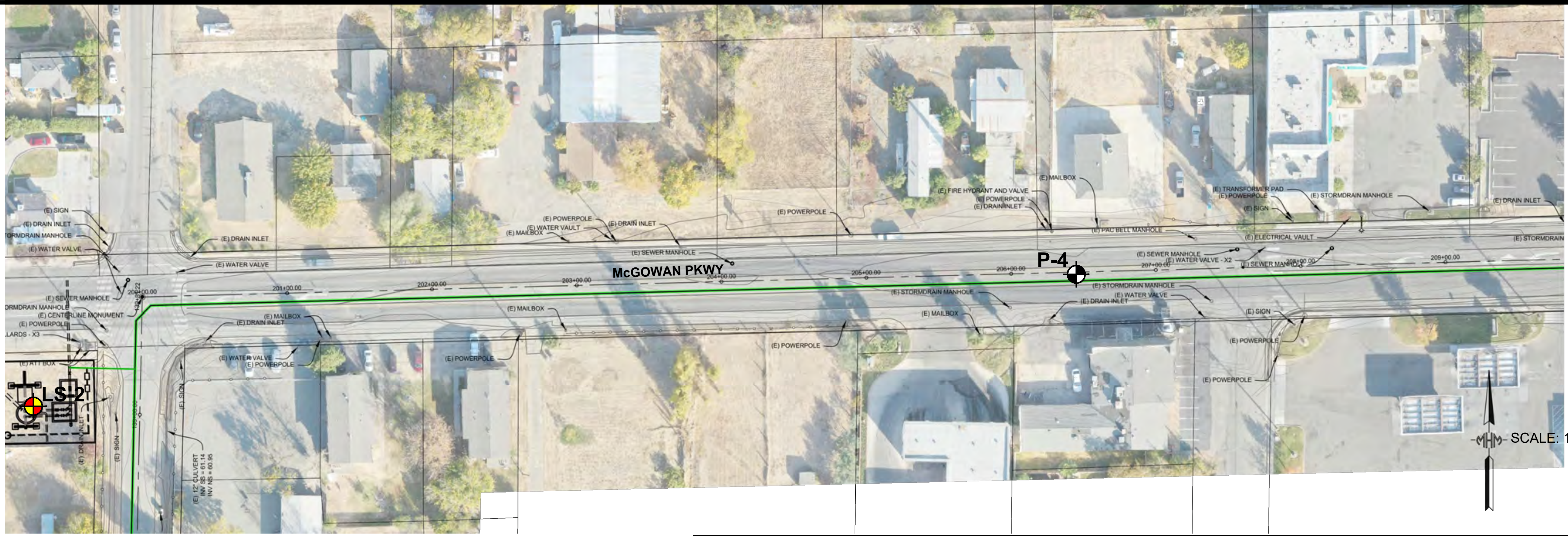

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Appendix A1d

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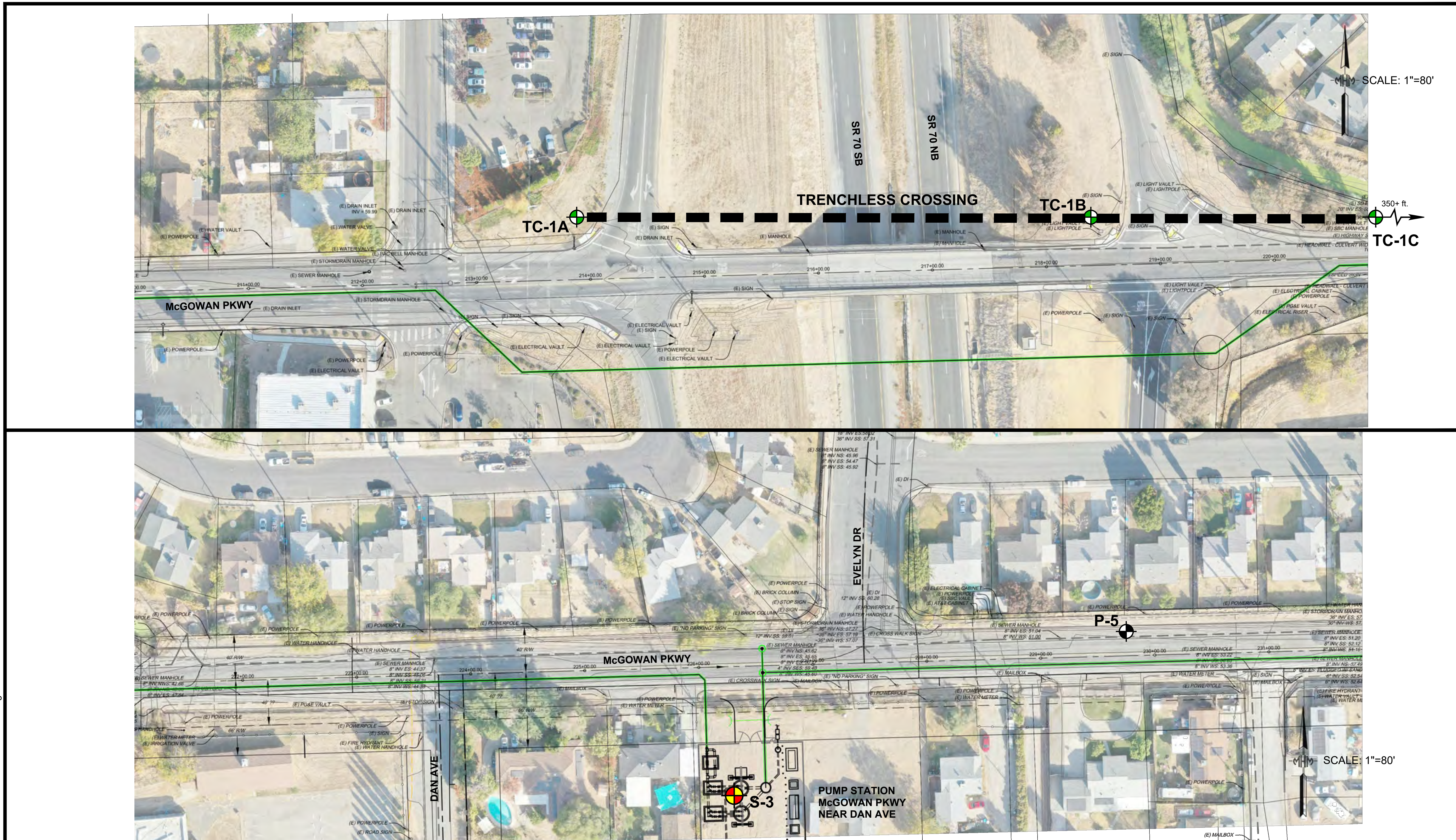

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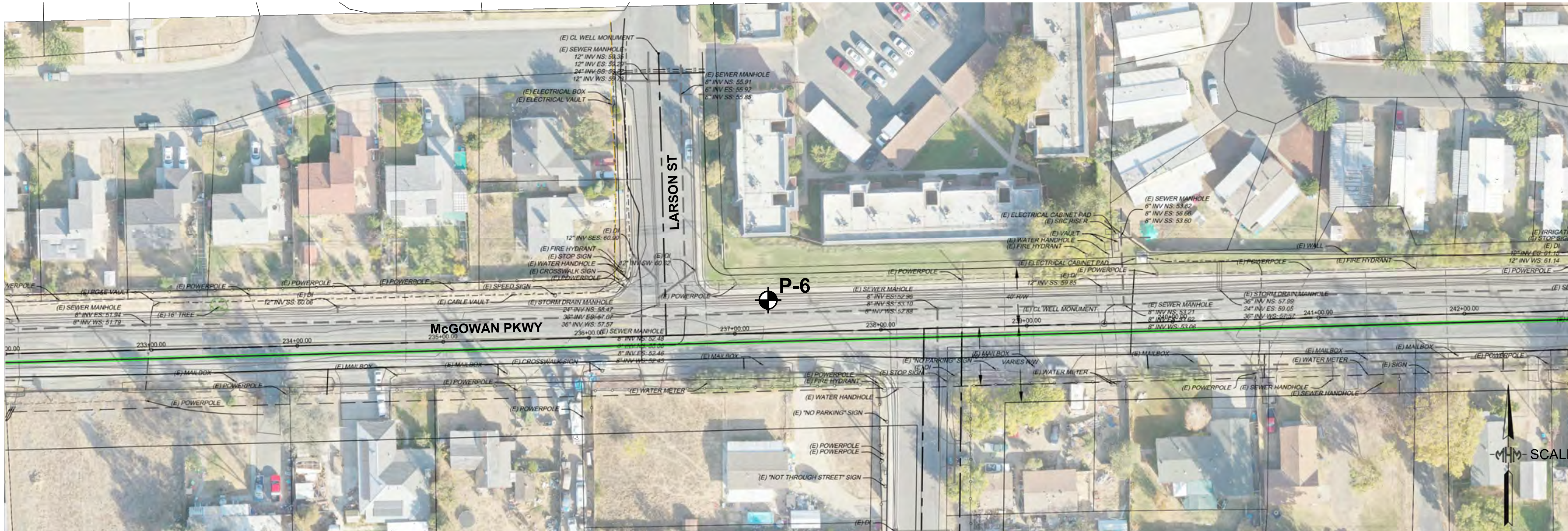

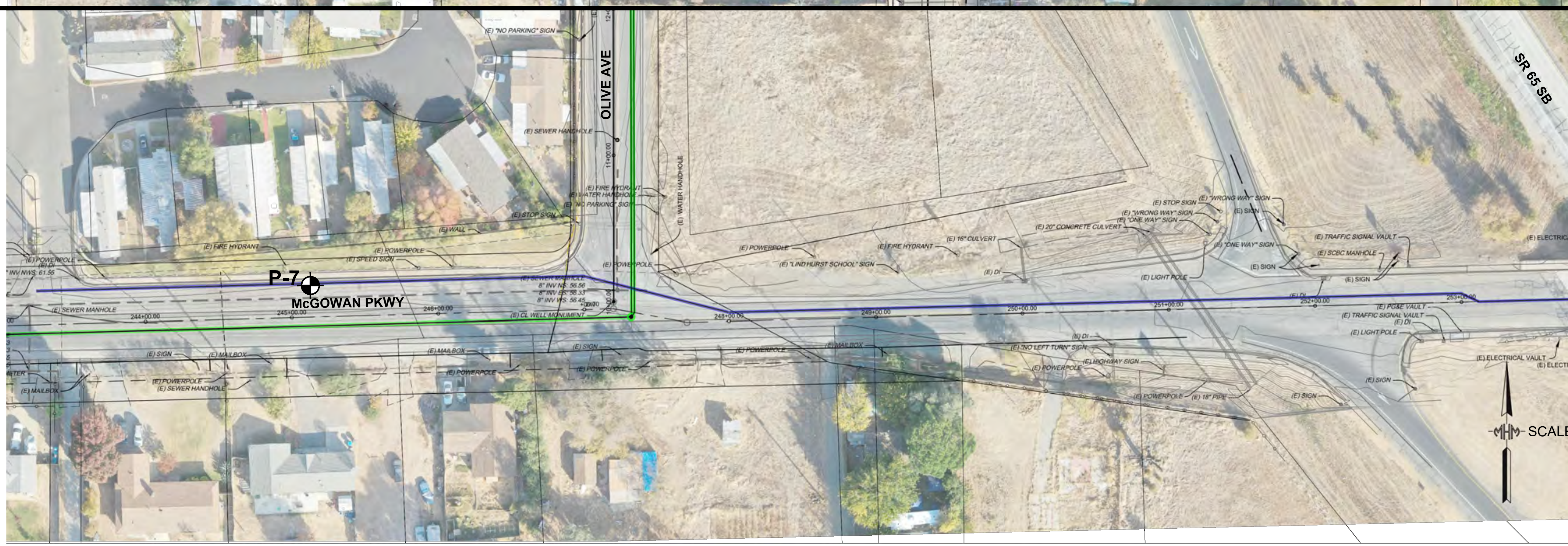

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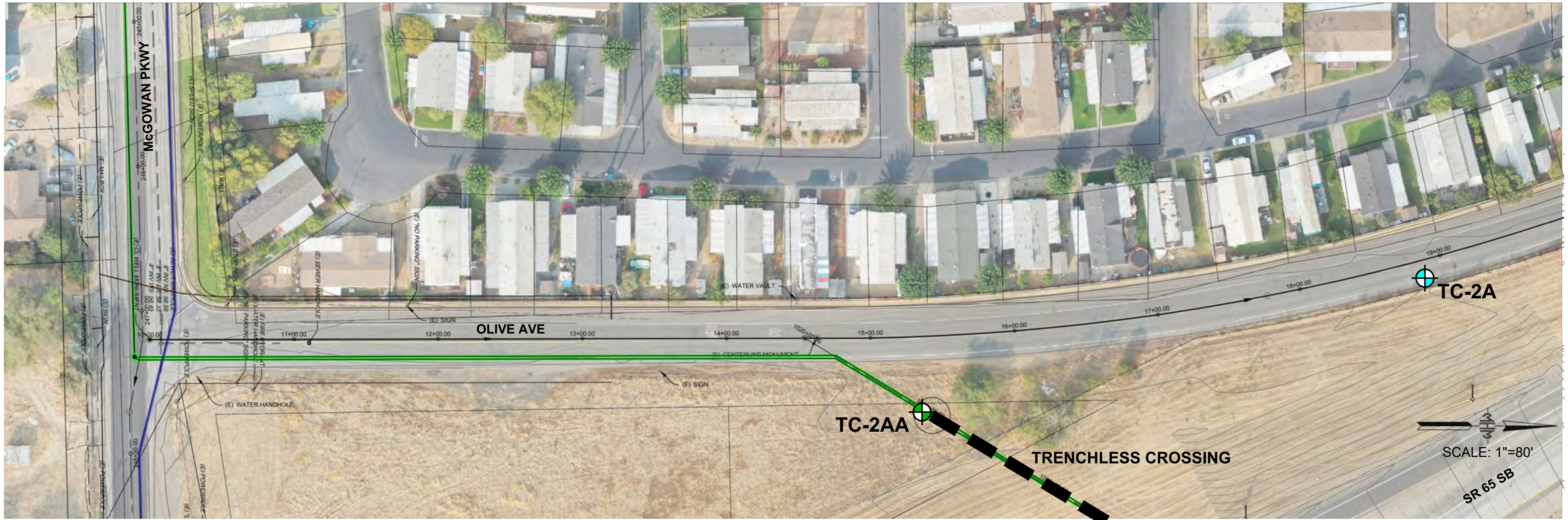

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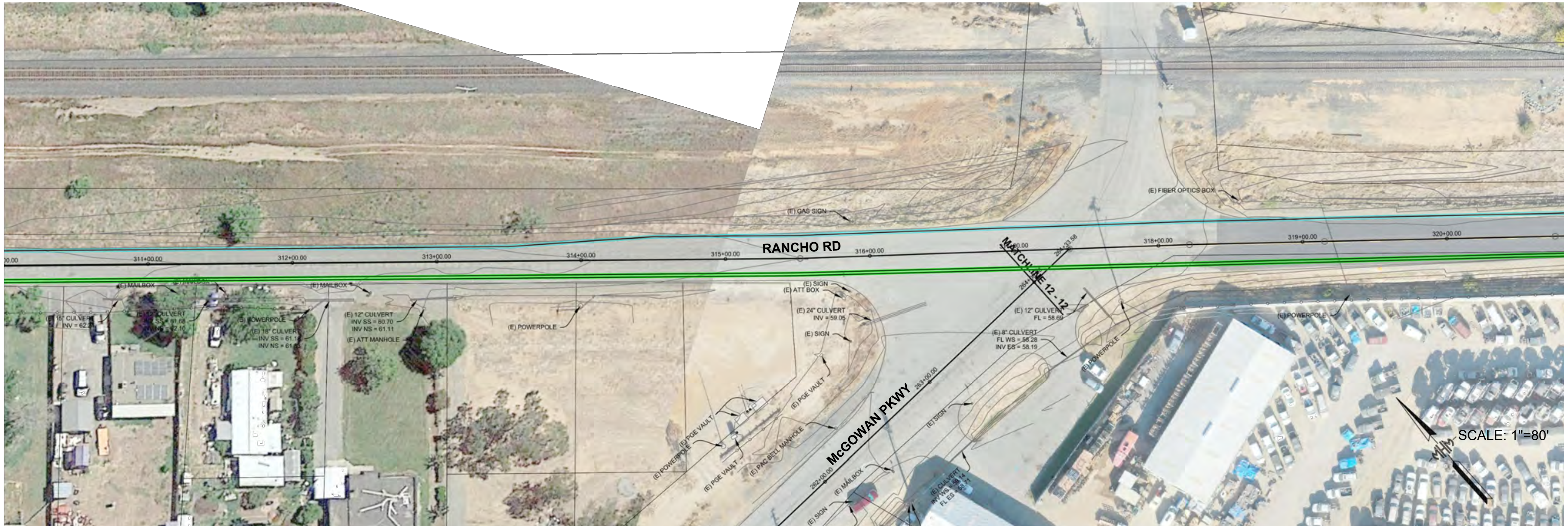

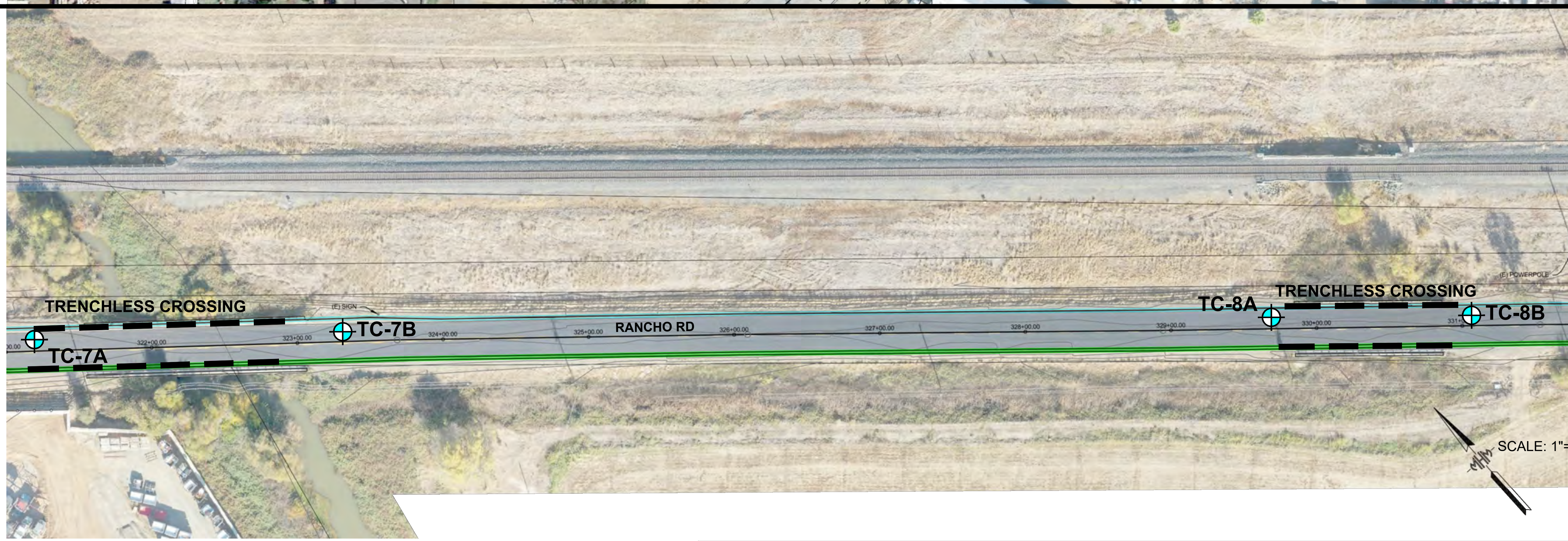

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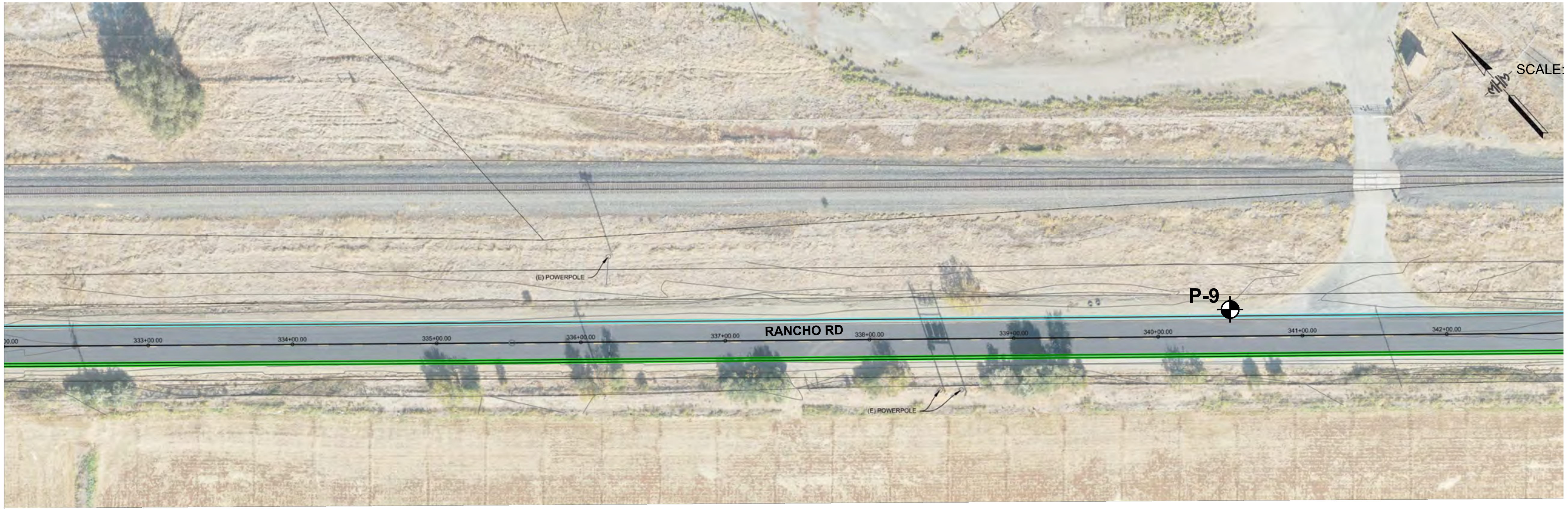

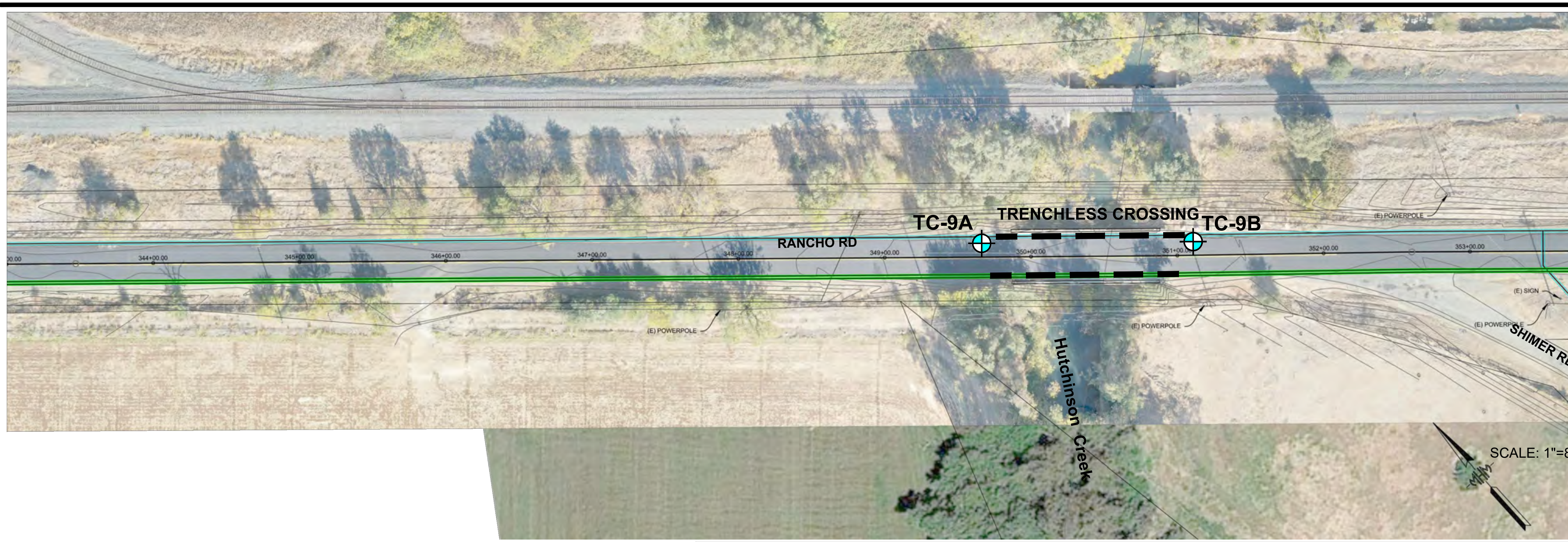

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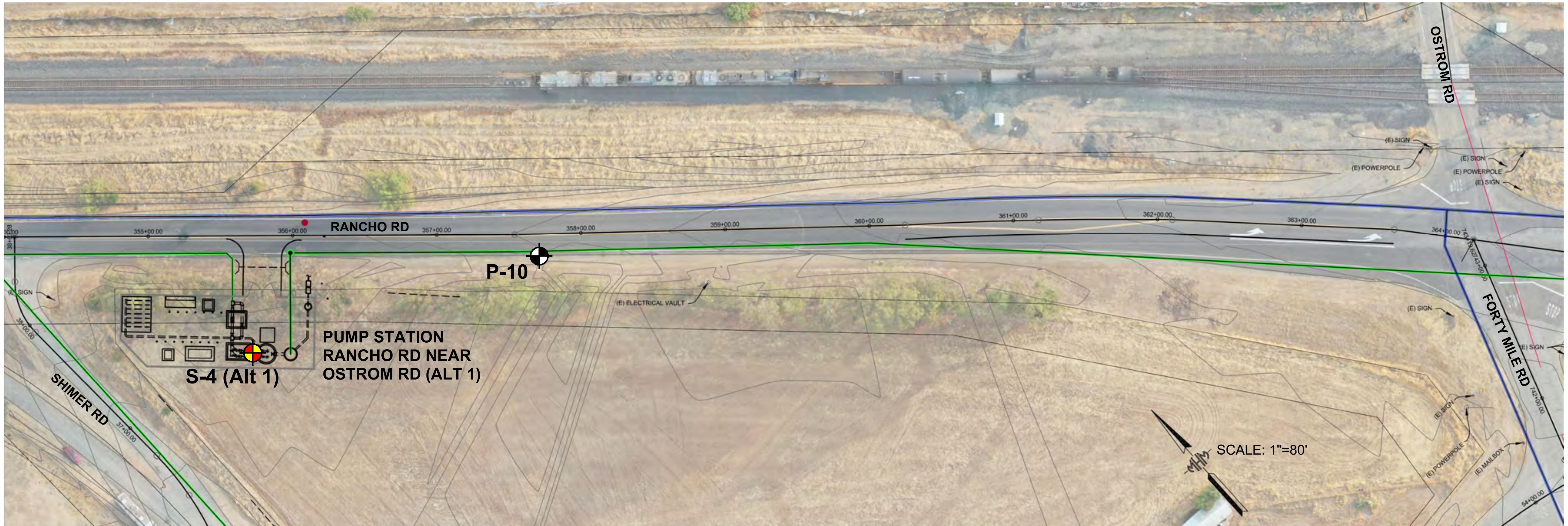

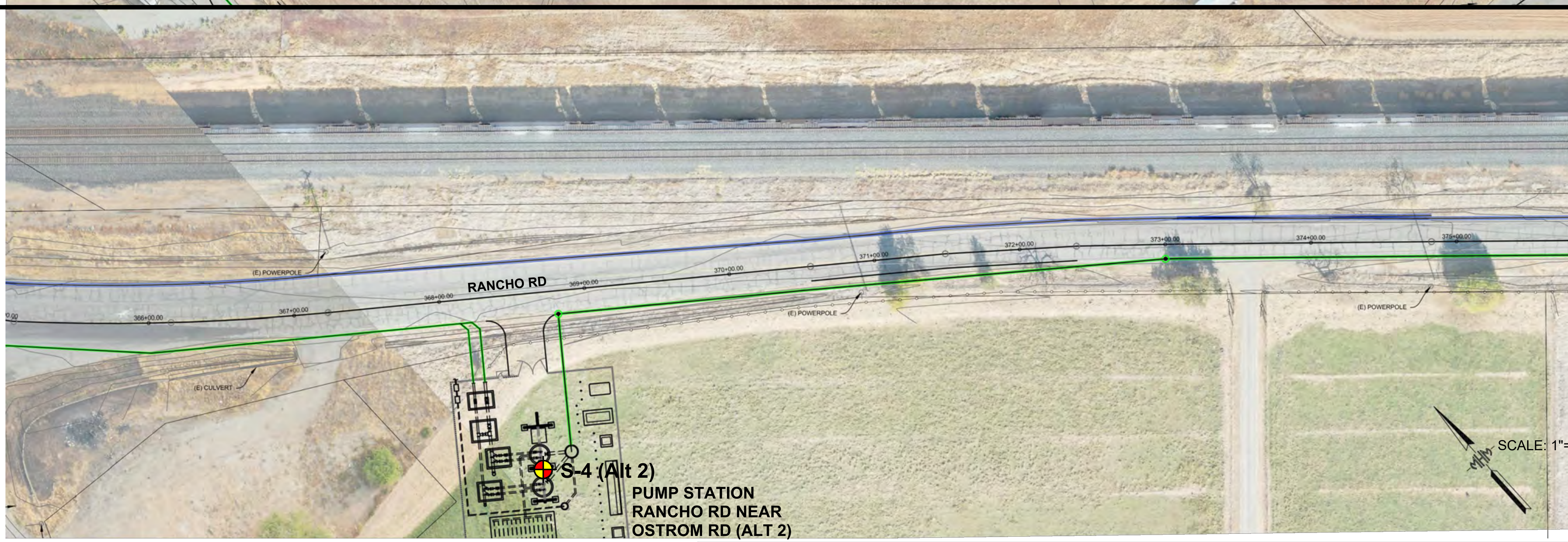

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Appendix A1k

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Appendix A1n

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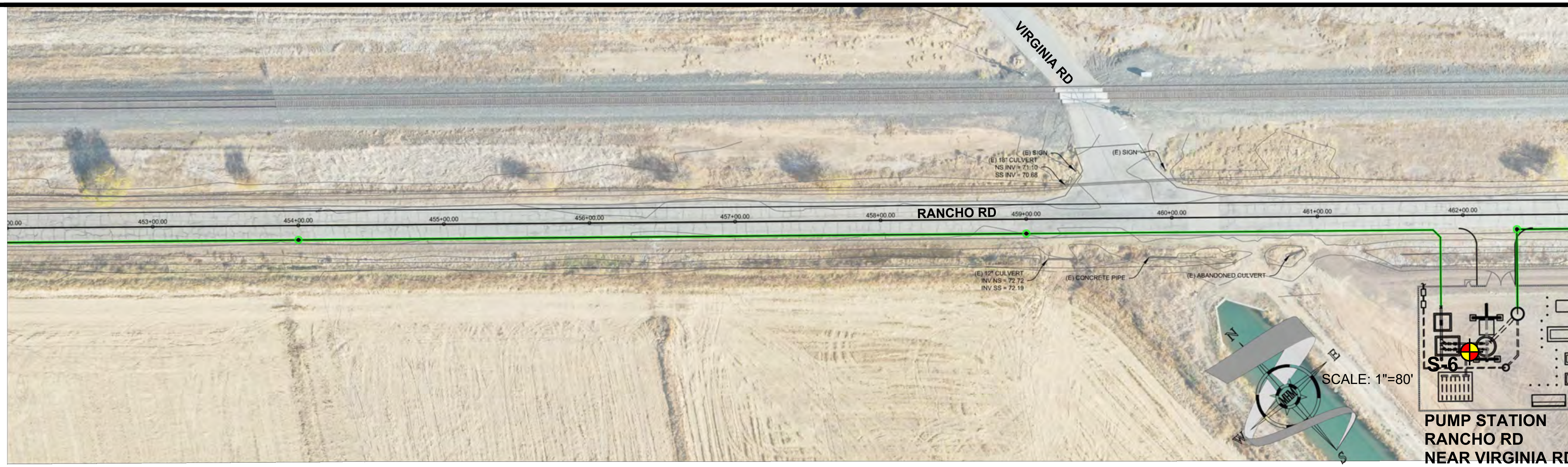

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PIPELINE ALIGNMENT PLAN

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April 2021

Appendix A1o

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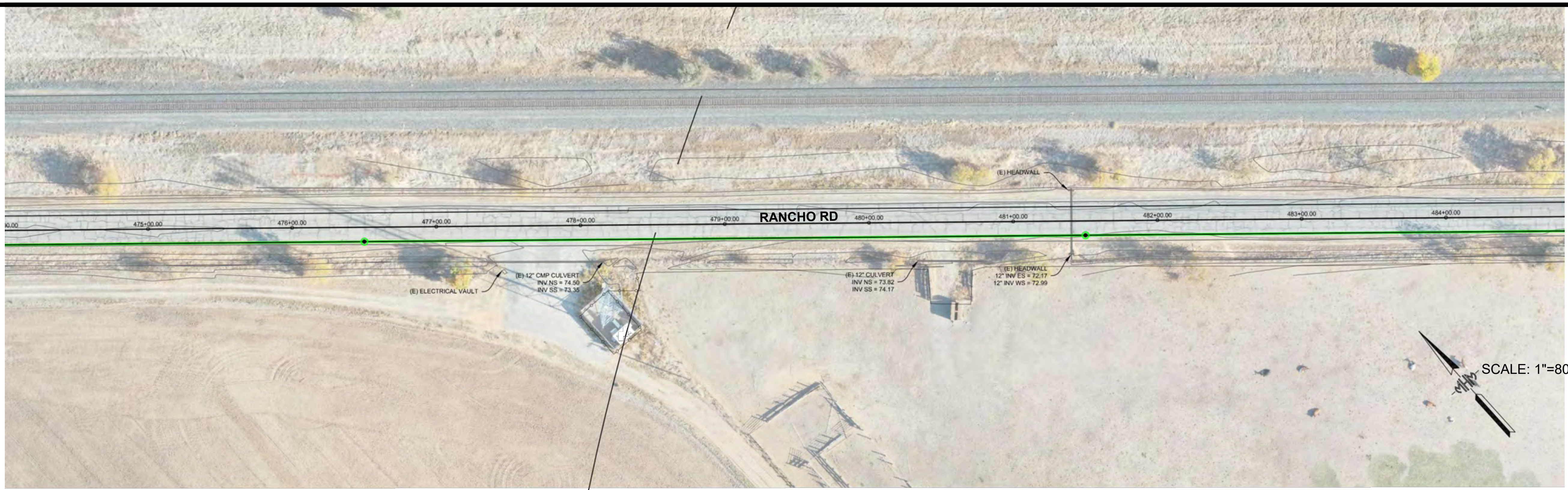

P-17

NO PLAN FOR
STA. 485 - to
end of Rancho Rd

4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg

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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
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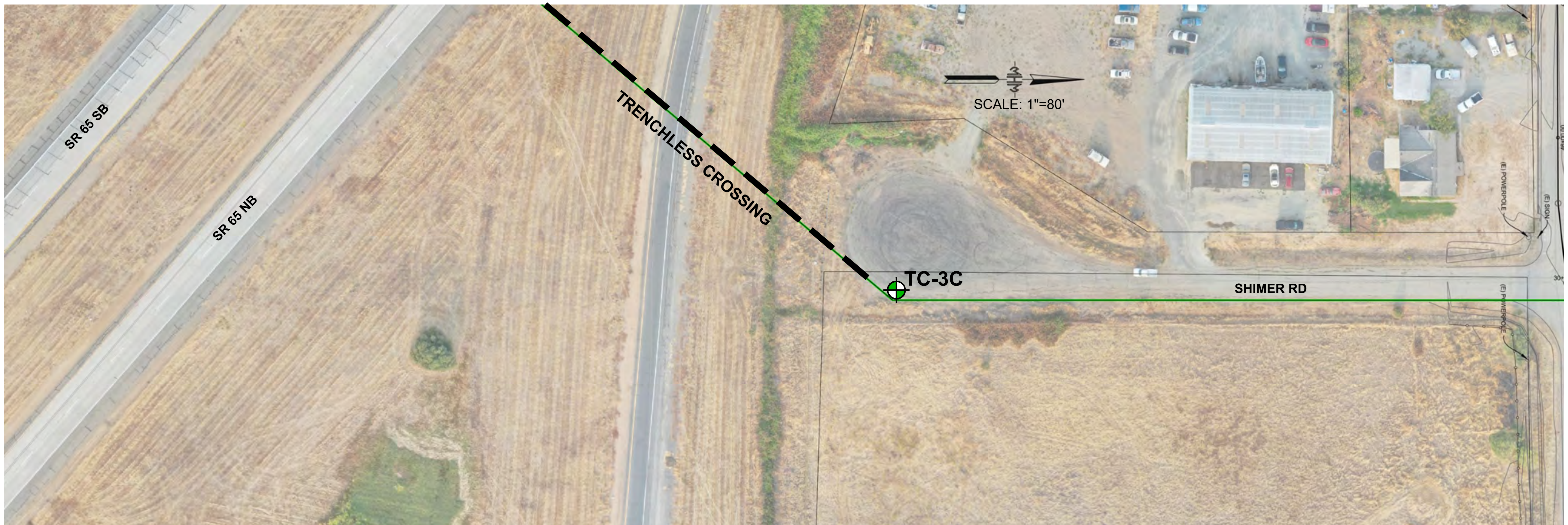

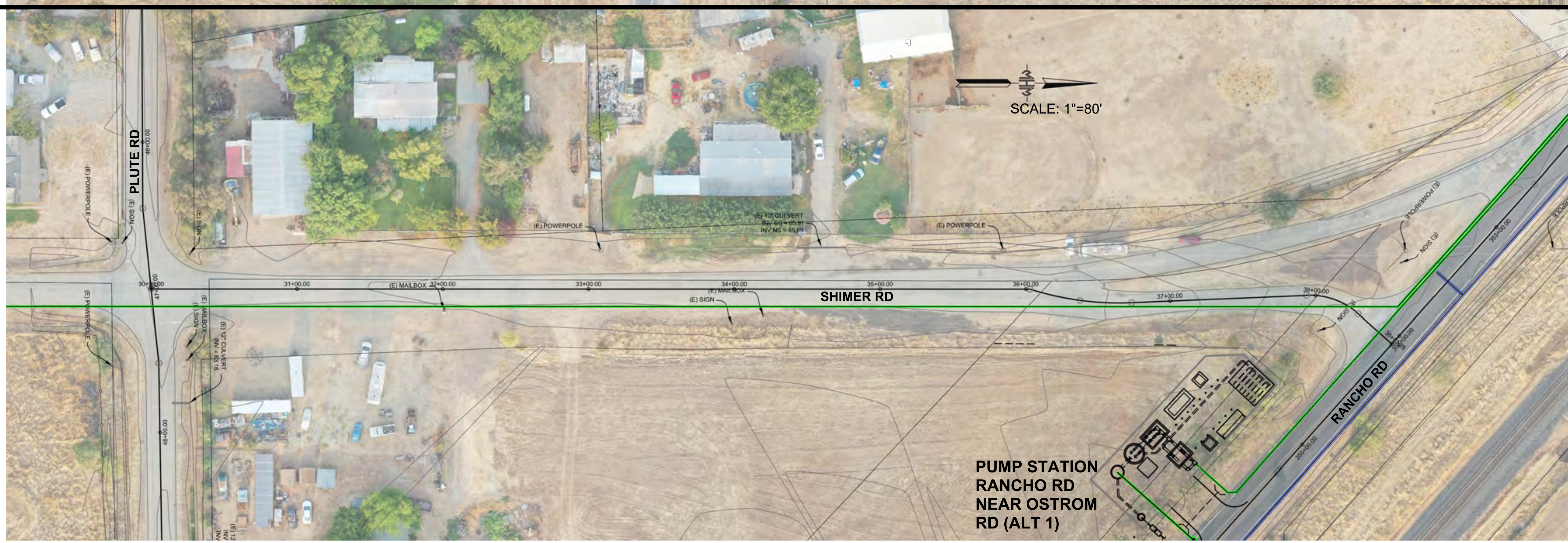

PIPELINE ALIGNMENT PLAN

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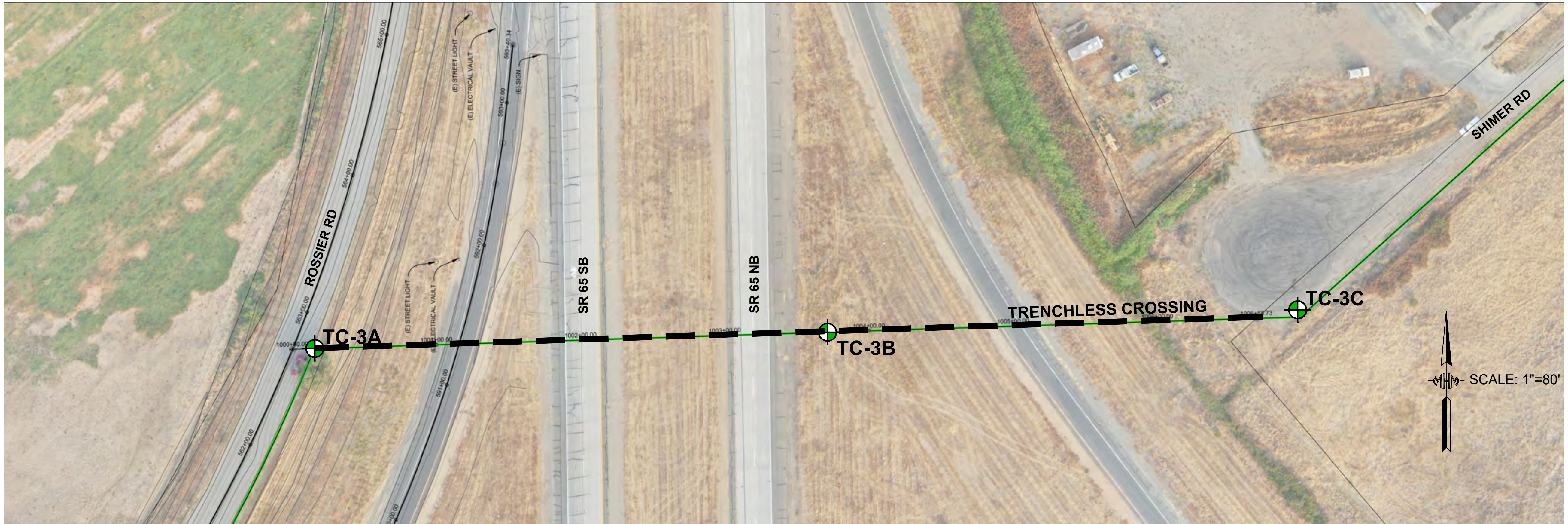

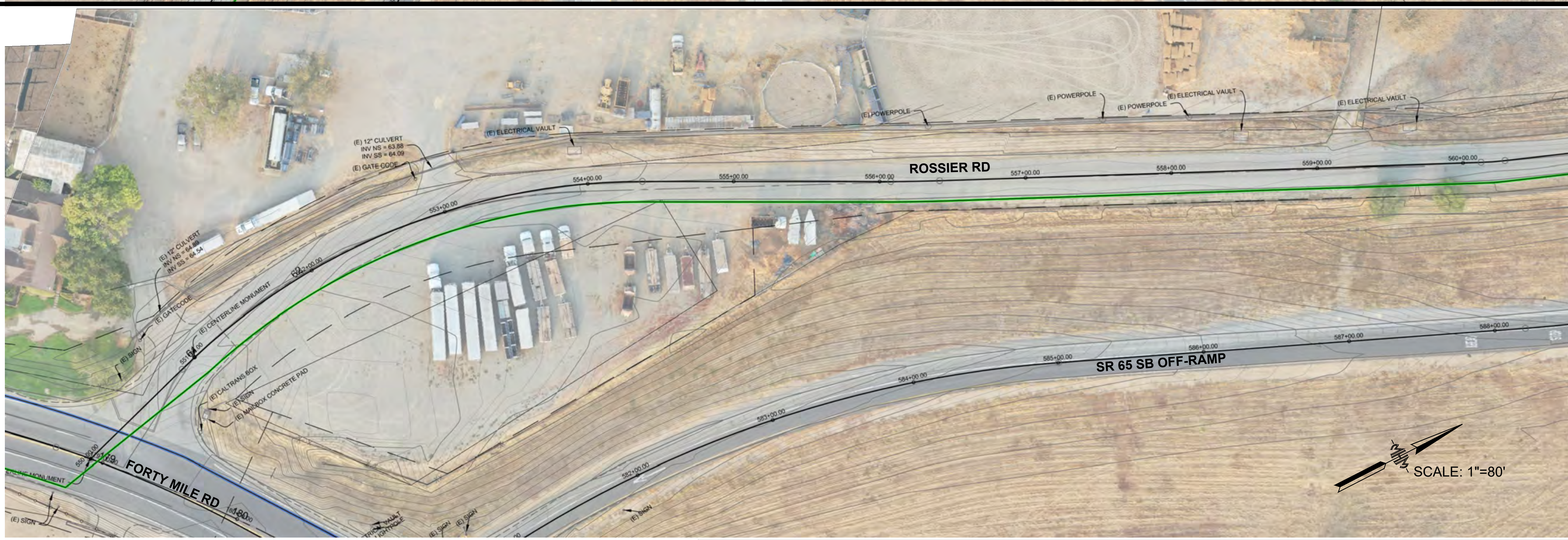

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PIPELINE ALIGNMENT PLAN

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Olivehurst, California

File No. 3842.x

April 2021

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4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg

BLACKBURN CONSULTING

PIPELINE ALIGNMENT PLAN

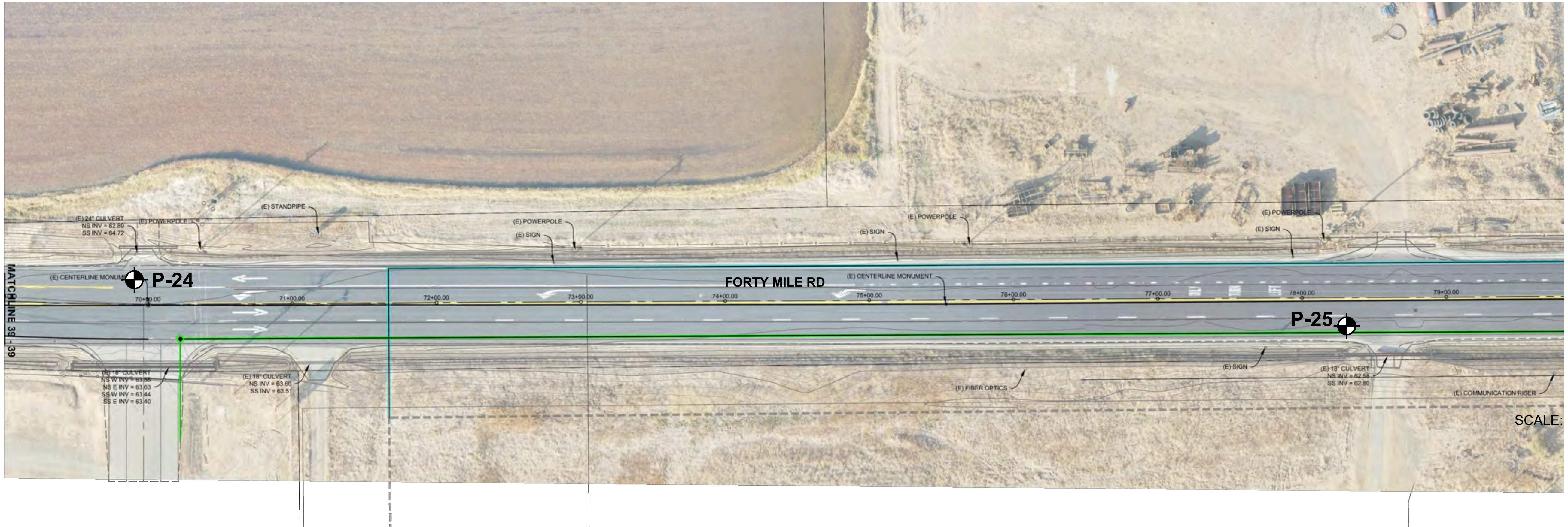
OPUD Yuba County Sewer and Water
Infrastructure Project
Olivehurst, California

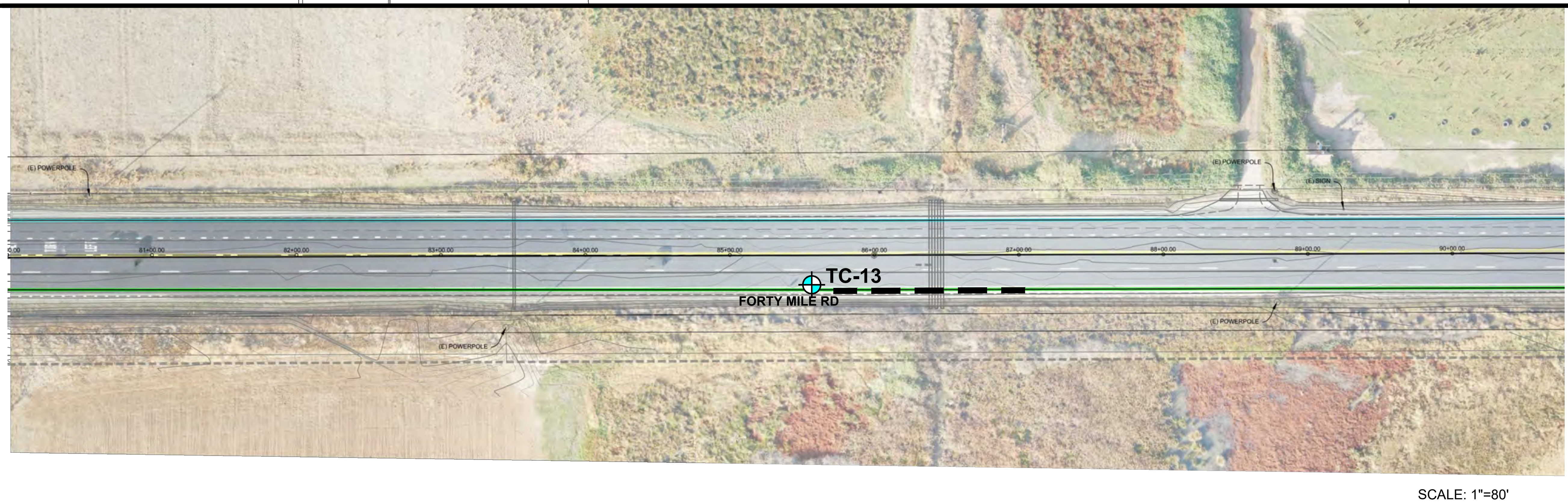
File No. 3842.x

April 2021

Appendix A1s

4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg





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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
Infrastructure Project
Olivehurst, California

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April 2021

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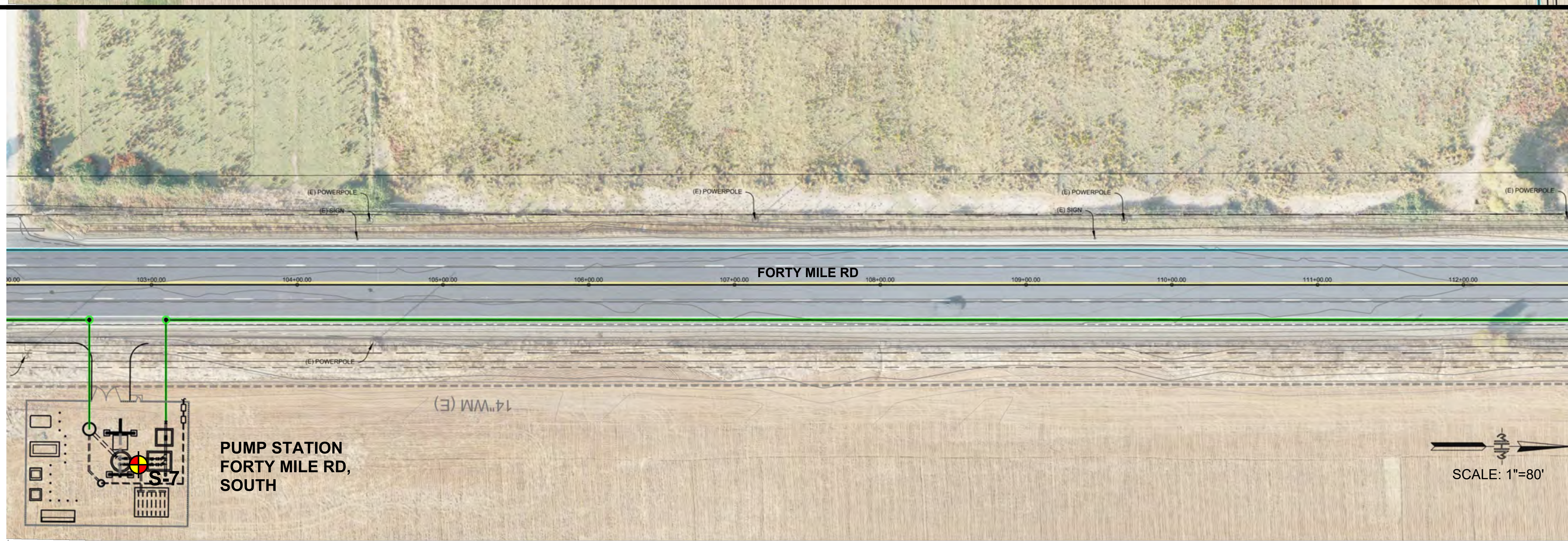
4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg



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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
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Olivehurst, California

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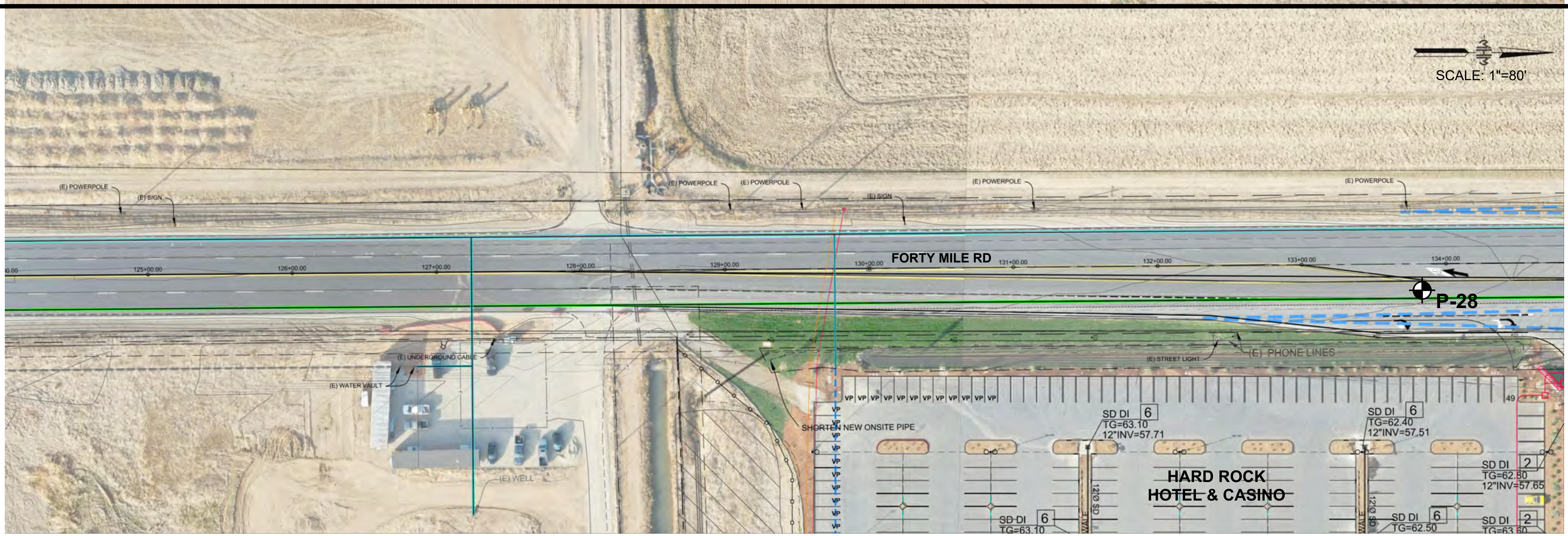
Appendix A1u

4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg



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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
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Olivehurst, California

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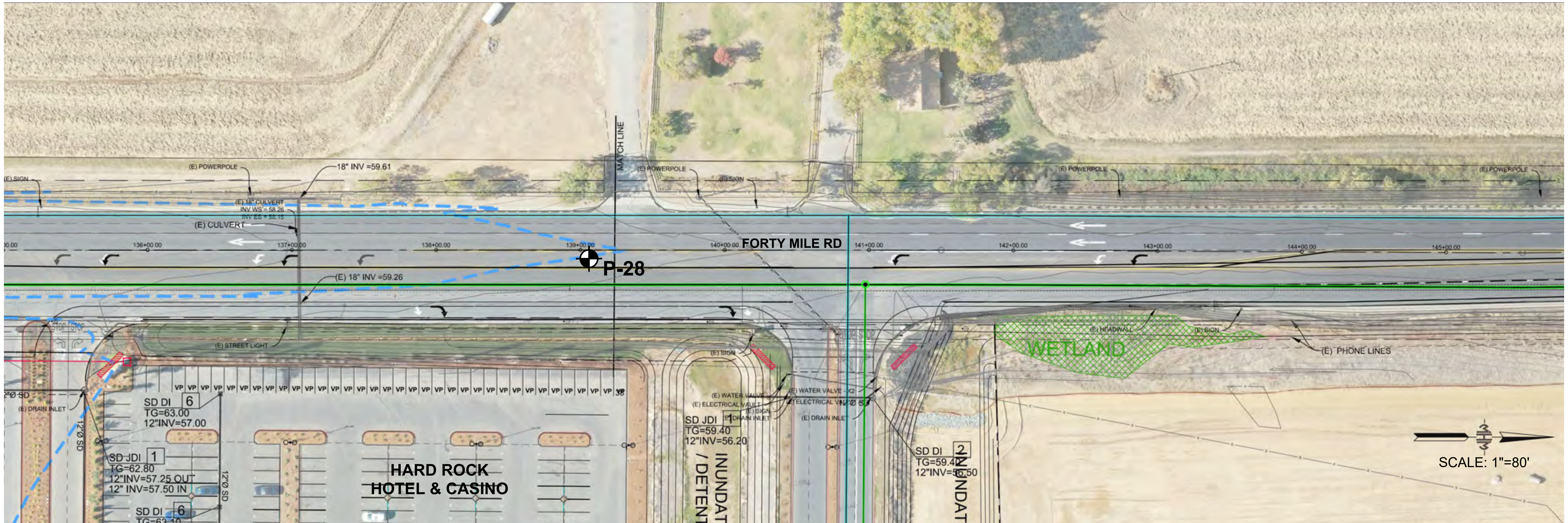
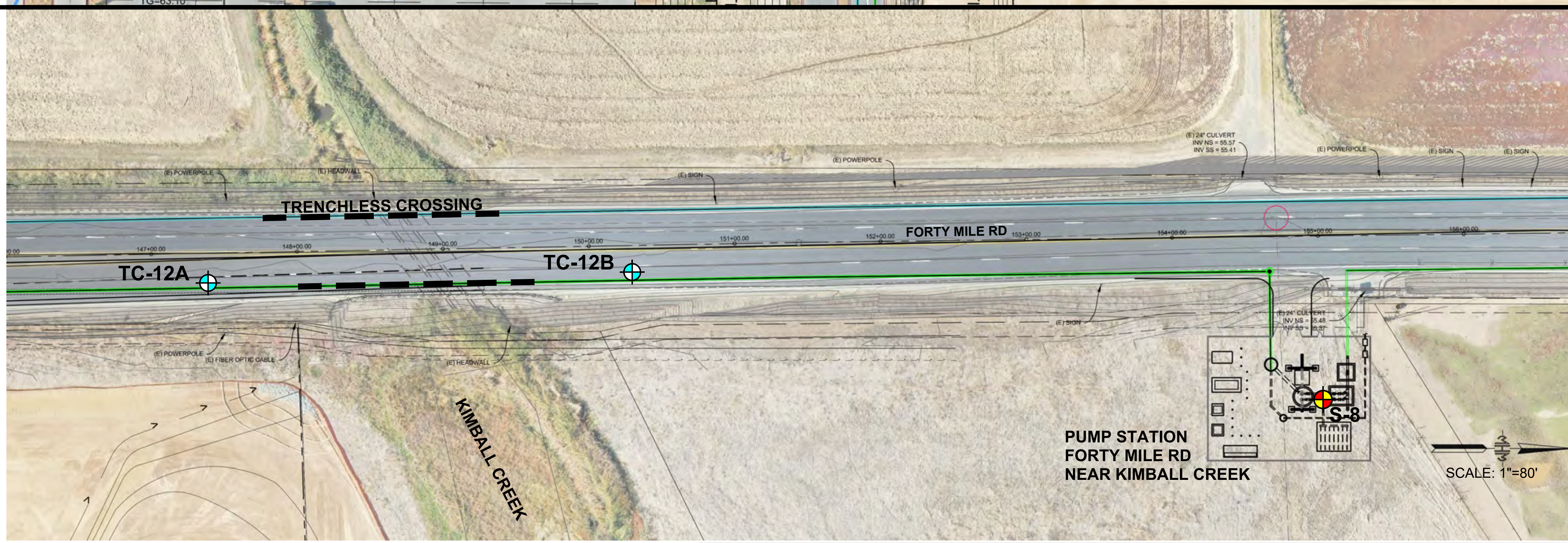
Appendix A1v

4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg





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PIPELINE ALIGNMENT PLAN

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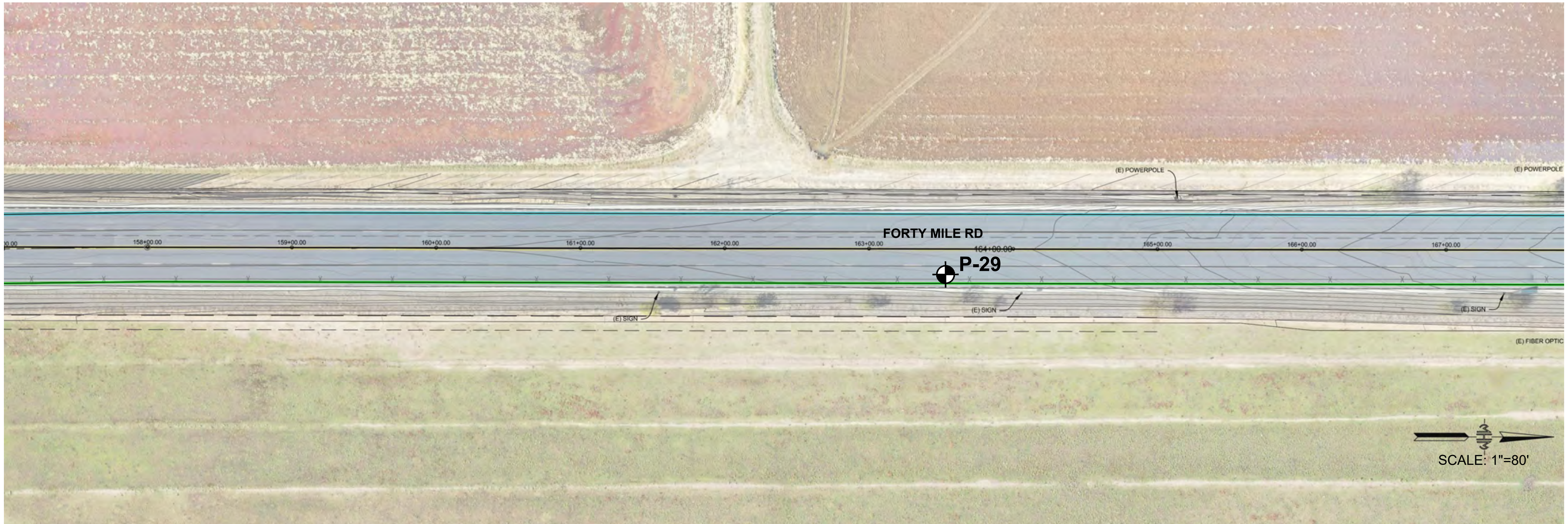
4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg



4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg

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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
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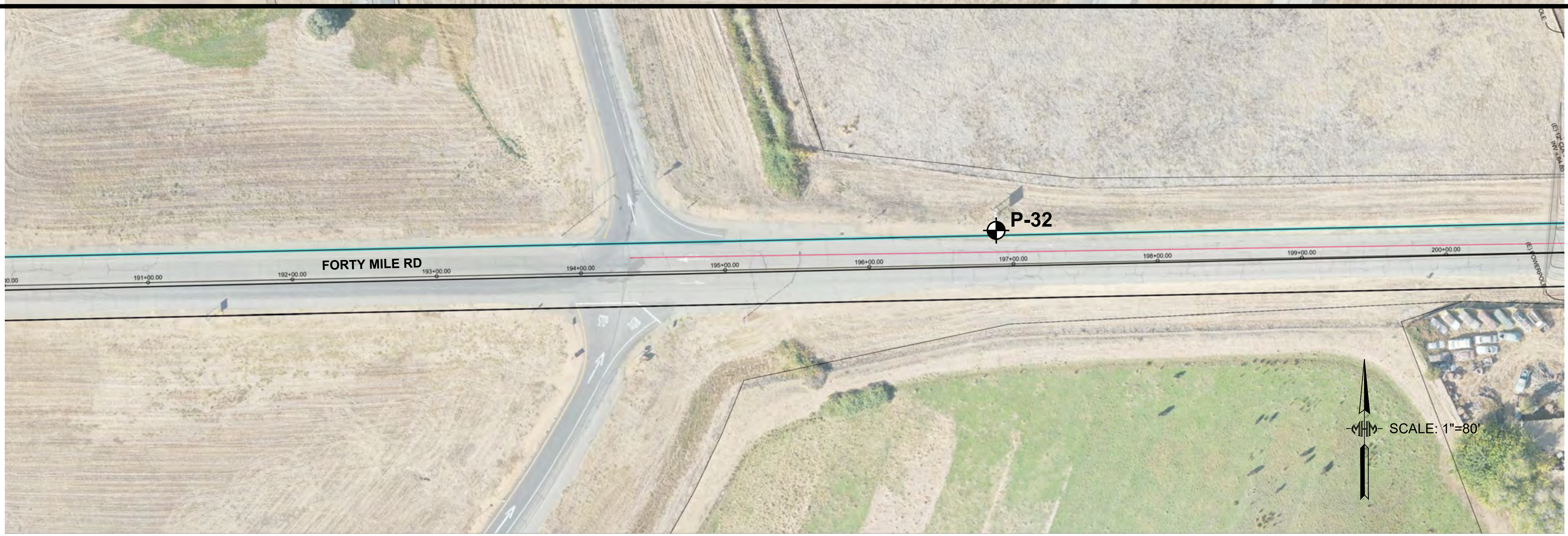

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PIPELINE ALIGNMENT PLAN

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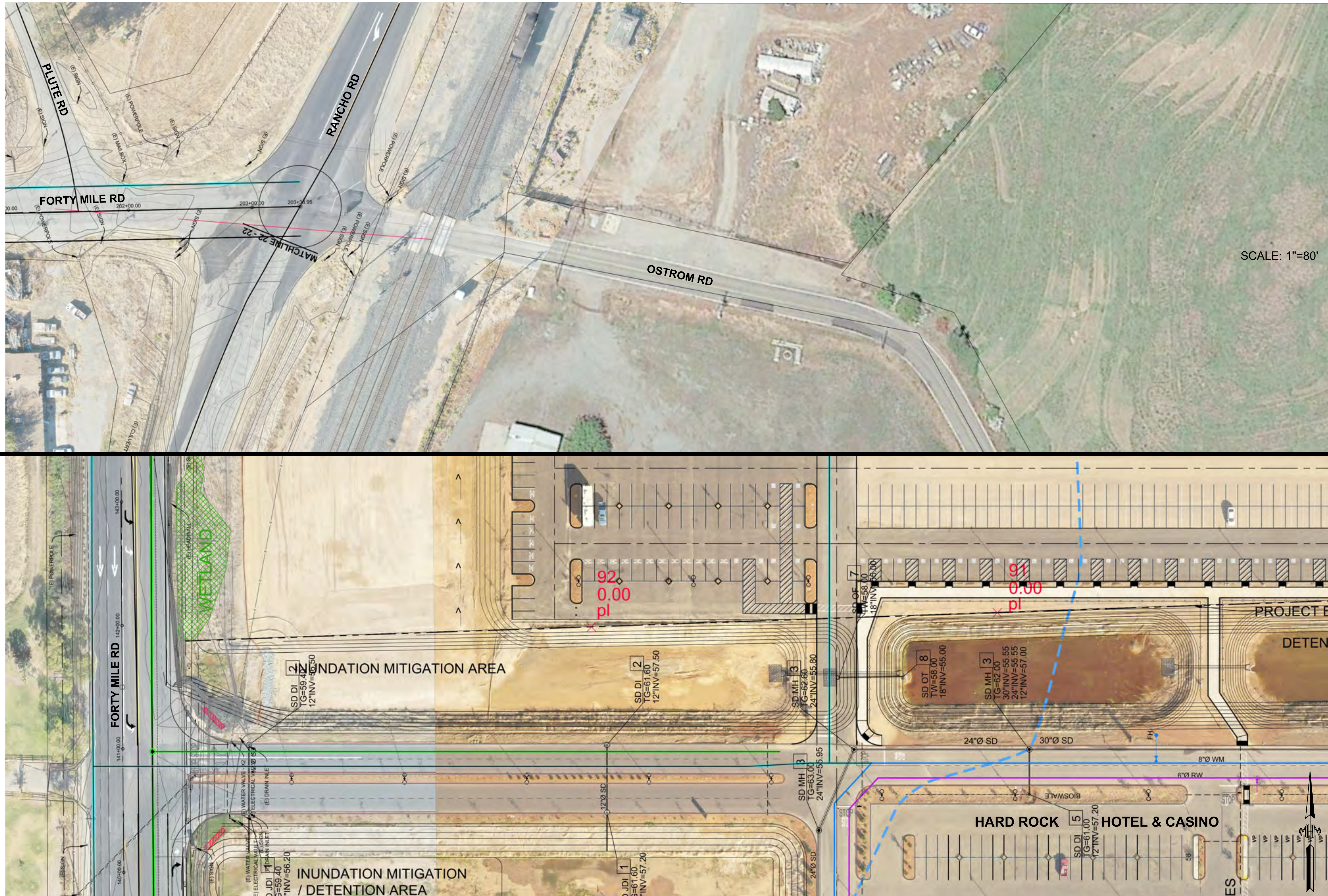
4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg



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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
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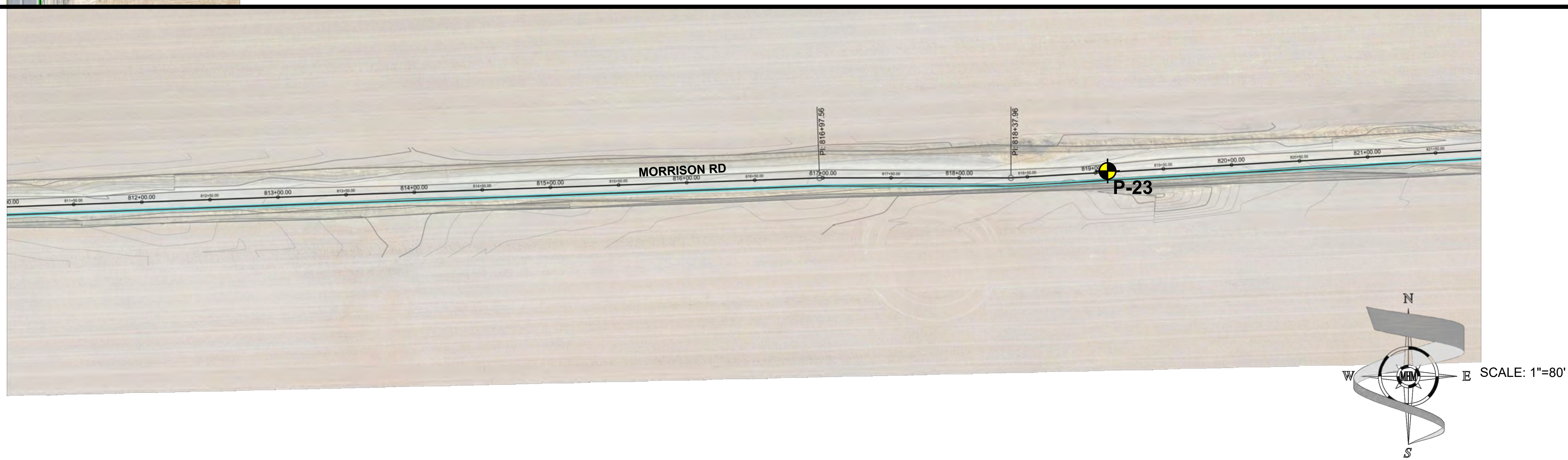
4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg



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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
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PIPELINE ALIGNMENT PLAN
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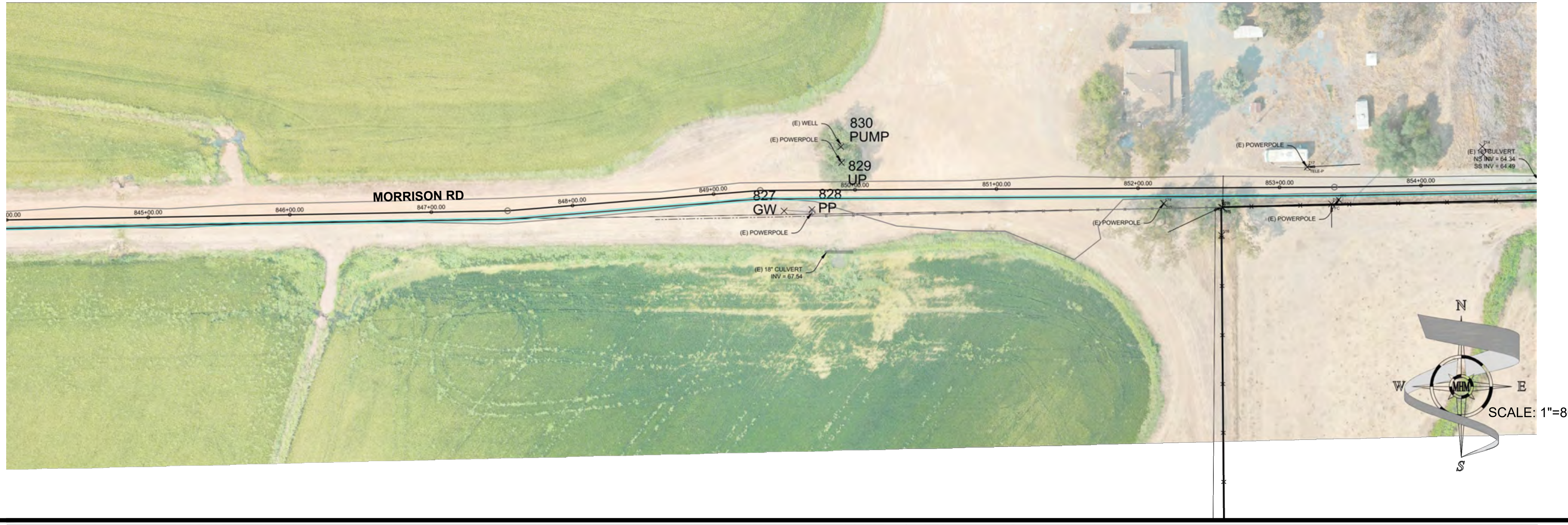

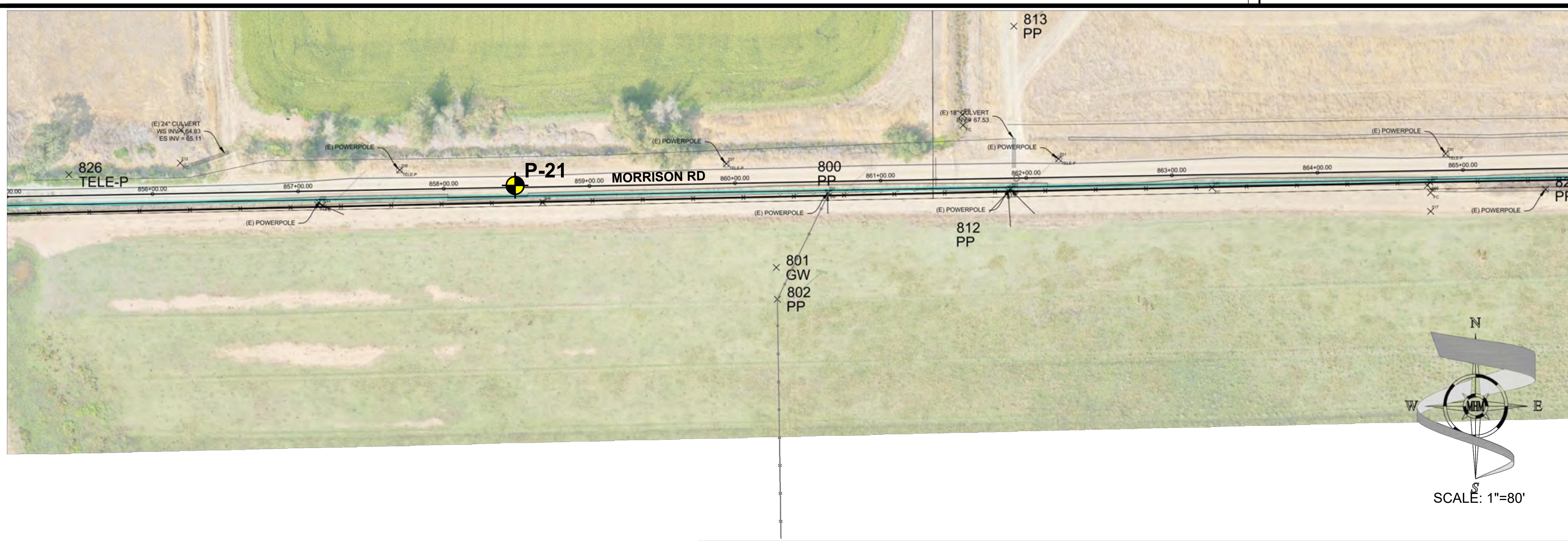

4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg

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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
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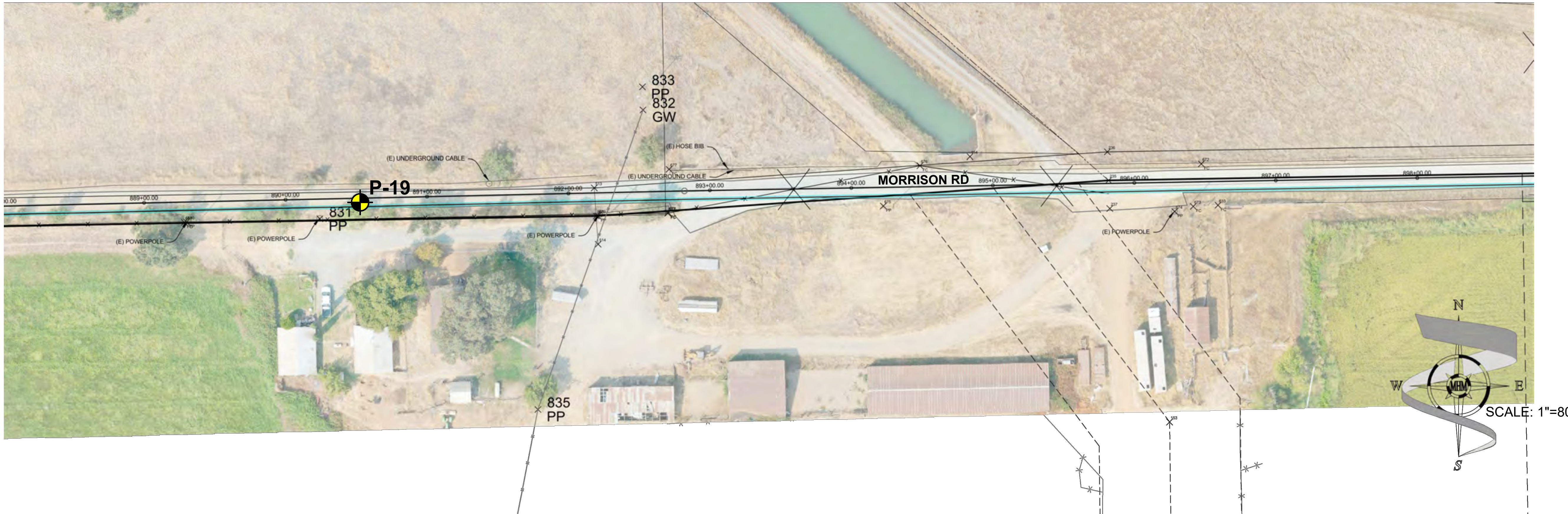
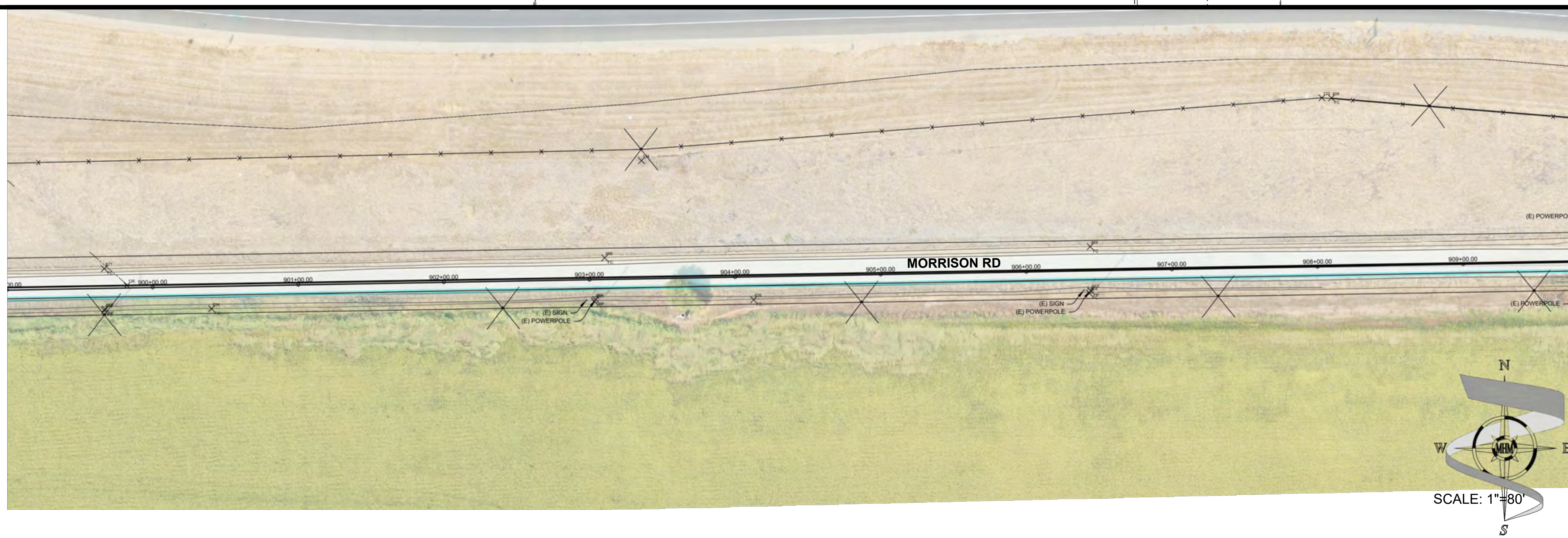
4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg





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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
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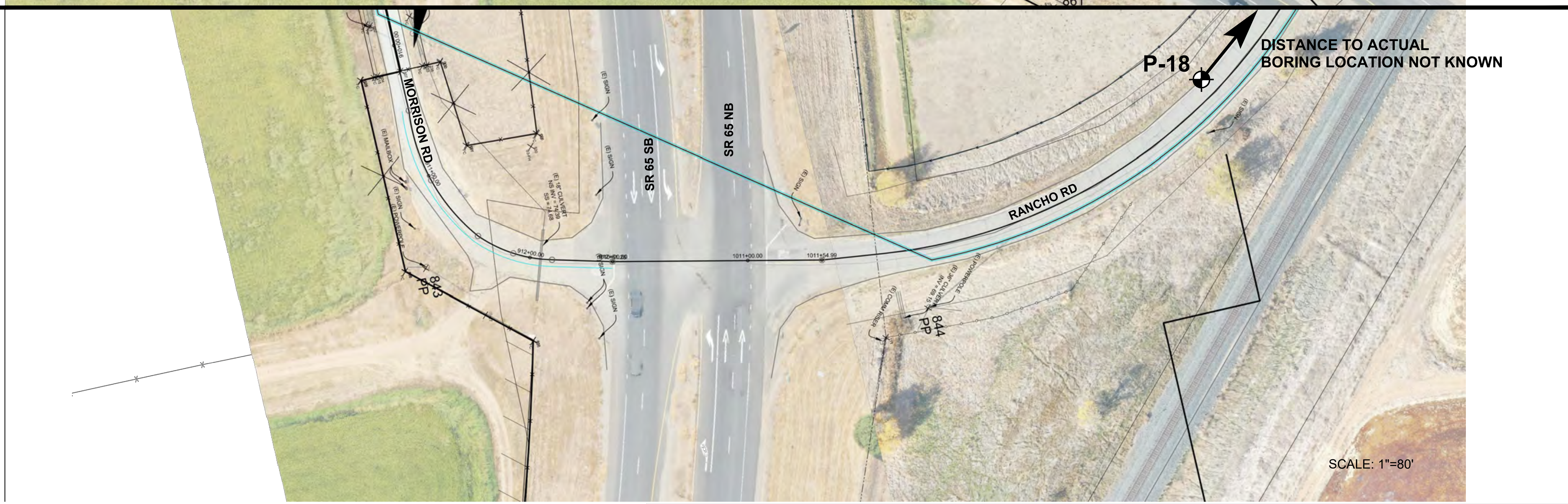
Olivehurst, California

File No. 3842.x

April 2021

Appendix A1ee

4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg



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PIPELINE ALIGNMENT PLAN

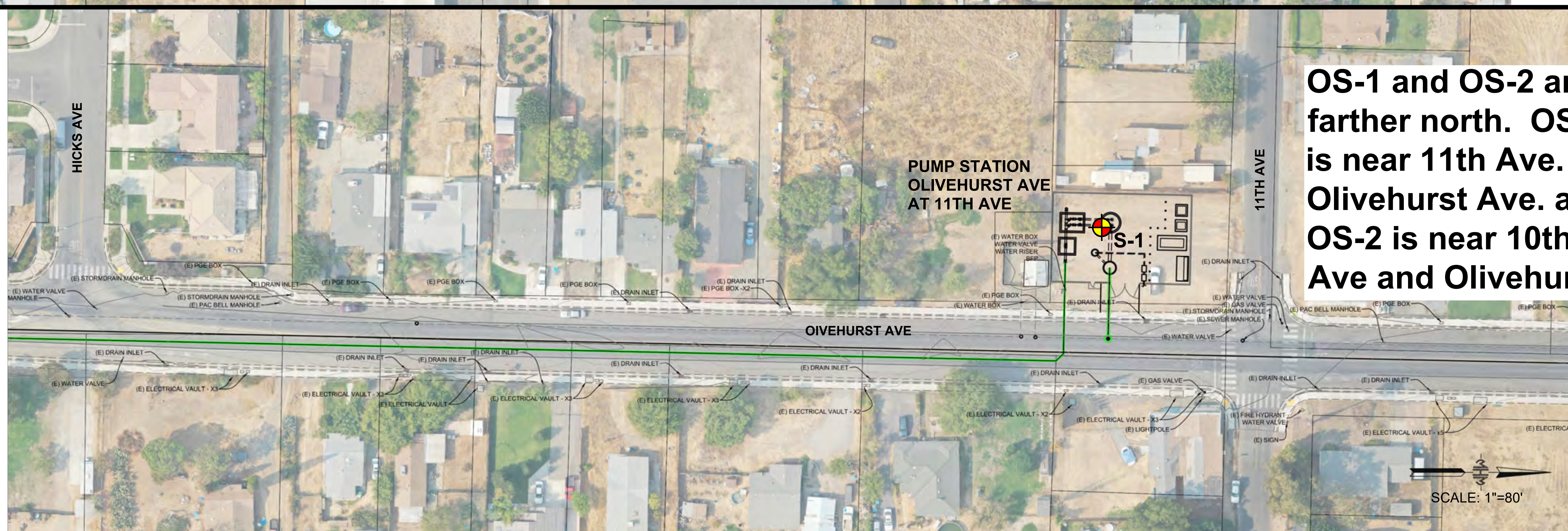
OPUD Yuba County Sewer and Water
Infrastructure Project
Olivehurst, California

File No. 3842.x

April 2021

Appendix A1ff

4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg



OS-1 and OS-2 are farther north. OS-1 is near 11th Ave. and Olivehurst Ave. and OS-2 is near 10th Ave and Olivehurst.

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PIPELINE ALIGNMENT PLAN

OPUD Yuba County Sewer and Water
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4/30/2021 3842.x AppA1 OPUD South Yuba Sewer.dwg

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435)
CL	Collapse Potential (ASTM D 5333)
CP	Compaction Curve (ASTM D 698 & 1557, CTM 216)
CR	Corrosion, Sulfates, Chlorides (CTM 643, CTM 417, CTM 422)
CU	Consolidated Undrained Triaxial (ASTM D 4767)
DS	Direct Shear (ASTM D 3080)
EI	Expansion Index (ASTM D 4829)
M	Moisture Content (ASTM D 2216)
OC	Organic Content (ASTM D 2974)
P	Permeability (ASTM D 5084)
PA	Particle Size Analysis (ASTM D 6913 & 7928)
PI	Liquid Limit, Plastic Limit, Plasticity Index (ASTM D 4318)
PL	Point Load Index (ASTM D 5731)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301)
SE	Sand Equivalent (CTM 217)
SG	Specific Gravity (AASHTO T100)
SL	Shrinkage Limit (ASTM D 4943)
SW	Swell Potential (ASTM D 4546)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D 2166) Unconfined Compression - Rock (ASTM D 7012)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850)
UW	Unit Weight (ASTM D 7263)
VS	Vane Shear (AASHTO T223 / ASTM D 2573)

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- California Sampler (2" ID)
- Modified California Sampler (2.4" ID)
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (short-term)
- Static Water Level Reading (long-term)

BLACKBURN CONSULTING

BORING RECORD LEGEND

CONSISTENCY OF COHESIVE SOILS

Descriptor	Unconfined Compressive Strength (tsf)	Pocket Penetrometer (tsf)	Torvane (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Extrudes between fingers when squeezed
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS

Descriptor	SPT N_{60} - Value (blows / foot)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Descriptor	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Descriptor	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE

Descriptor		Size
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS

Descriptor	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION

Descriptor	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

NOTE: This legend sheet provides descriptors and associated criteria for required soil description components only. Refer to Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010), Section 2, for tables of additional soil description components and discussion of soil description and identification.

8/5/2019 Boring Legend for Reports 2019.dwg

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BORING RECORD LEGEND

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	**9-10-20**	**9-10-20**	**39.09495° / -121.55168°**	**OS-1**
CONTRACTOR **Taber**			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Rick**	HELPER'S NAME **Nick/Mike**		EQUIPMENT **Diedrich D120**	TOTAL DEPTH **21.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**			HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Top Pour Cement Grout Backfill**			GROUND WATER READINGS DURING **Not Encountered** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (6")															
	0.5		AGGREGATE BASE (6")															
	1		Lean CLAY (CL); very stiff; dark yellowish brown; moist; few fine SAND															
	3				1	5 8 11	19		85	3.75								
	5		SANDY Lean CLAY (CL); hard; dark yellowish brown; moist; some fine to medium SAND		2	19 32 47	79		80	>4.5	18	111						
	9		CLAYEY SAND (SC); very dense; dark yellowish brown; moist; fine to medium SAND; some fines; some moderate to strong cementation															
	11				3	30 50/3.5	50/3.5"		100	>4.5					38			
	15.5		Lean CLAY with SAND (CL); very stiff; dark yellowish brown; moist; little fine to medium SAND		4	14 24 28	52		65	3.5	19	107						
	20.5				5	19 43 50/5"	93/11"		85	>4.5								
	21		SANDY SILT (ML); hard; grayish green; moist; some fine to medium SAND															

Bottom of exploration at 21.5 ft below ground surface (bgs)

No groundwater encountered

Top Pour Cement Grout Backfill

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 10/21/20

BLACKBURN CONSULTING

PROJECT NAME		FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water		**3842.X**	**OS-1**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	9-10-20	9-10-20	39.09024° / 121.55182°	OS-2

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME Rick HELPER'S NAME Nick/Mike	EQUIPMENT Diedrich D120	TOTAL DEPTH 21.5 ft
EXCAVATION METHOD Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Top Pour Cement Grout Backfill	GROUND WATER READINGS — DURING: Not Encountered; AFTER (DATE):	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (9")															
	0.75	Lean CLAY (CL); hard; dark yellowish brown; moist; few fine SAND															
	5–6.5			1	12 17 24	41		95	>4.5	21	106						
	10–11.5	very stiff; reddish brown		2	10 18 24	42		90	3.25								
	15–16.5			3	6 10 14	24		90	4.5								
	18	SANDY Lean CLAY (CL); very stiff; olive gray; moist; fine SAND; some fines															
	20–21.5			4	5 5 10	15		90	2.25	38	79			56			

Bottom of exploration at 21.5 ft below ground surface (bgs)

No groundwater encountered
Bulk A obtained 1-5 ft bgs

Top Pour Cement Grout Backfill

BLACKBURN CONSULTING	PROJECT NAME OPUD South Yuba Sewer and Water	FILE NO. 3842.X	HOLE ID OS-2
	COUNTY YUB	ROUTE	POSTMILE
	CLIENT Jacobs Engineering		
	PREPARED BY LDM	CHECKED BY	SHEET 1 of 1

LOGGED BY **LDM**	BEGIN DATE **9-11-20**	COMPLETION DATE **9-11-20**	LOCATION (Lat/Long or North/East and Datum) **39.06729° / -121.54802°**		HOLE ID **P-01**
CONTRACTOR **Taber**			LOCATION (Offset, Station, Line)		SURFACE ELEVATION
OPERATOR'S NAME **Chad**	HELPER'S NAME **Caleb/Cody**		EQUIPMENT **CME 75**		TOTAL DEPTH **21.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH		BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**			HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**		HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Top Pour Cement Grout Backfill**			GROUND WATER READINGS	DURING AFTER (DATE) **Not Encountered**	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (6.5")															
	0.5–4.5	Lean CLAY with SAND (CL); (hard); dark brown; moist; little fine SAND hand auger first 5 feet															
	4.5–7.5	SILT (ML); hard; light grayish brown with orangish brown streaks; dry; few very fine SAND															
	5			1	22 50/5"	50/5"		83	>4.5								
	7.5–15.5	Lean CLAY (CL); stiff; brown; moist; trace very fine SAND															
	10			2	3 4 6	10		78	1.25	31	91						
	15.5–18.5	CLAYEY SAND (SC); medium dense; dark yellowish brown; moist; fine SAND; some fines															
	15			3	3 4 9	13		89	NA					37	DS		
	20			4	5 5 7	12		100	1.25								

Bottom of exploration at 21.5 ft below ground surface (bgs)

No groundwater encountered
Bulk A obtained 0.5-4.5 ft bgs

Top Pour Cement Grout Backfill

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 10/21/20

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**	FILE NO. **3842.X**	HOLE ID **P-01**
COUNTY **YUB**	ROUTE	POSTMILE
CLIENT **Jacobs Engineering**		
PREPARED BY **LDM**	CHECKED BY	SHEET **1 of 1**

LOGGED BY **LDM**	BEGIN DATE **9-11-20**	COMPLETION DATE **9-11-20**	LOCATION (Lat/Long or North/East and Datum) **39.07126° / -121.5474°**	HOLE ID **P-02**
CONTRACTOR **Taber**			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Chad**	HELPER'S NAME **Caleb/Cody**		EQUIPMENT **CME 75**	TOTAL DEPTH **21.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**			HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Top Pour Cement Grout Backfill**			GROUND WATER READINGS — DURING **Not Encountered** — AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (4")															
			AGGREGATE BASE (3")															
	1–2		Lean CLAY with SAND (CL); (very stiff); dark brown; moist; very fine SAND hand auger first 5 feet															
	4		increasing SAND content															
	5–6		Lean CLAY with SAND (CL); very stiff; mottled dark yellowish brown and grayish brown with reddish streaks; moist; little very fine SAND		1	20 27 30	57		72	3.75								
	10–11		hard; dark brown		2	6 12 17	29		78	>4.5	23	99	32	12				
	15–16				3	7 13 15	28		83	4.0								
	20–21		mottled dark yellowish brown and orangish brown and black		4	7 11 15	26		100	3.5	32	89						

Bottom of exploration at 21.5 ft below ground surface (bgs)

No groundwater encountered
Bulk A obtained 0.6-4.5 ft bgs

Top Pour Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **P-02**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	9-11-20	9-11-20	39.07525° / -121.54735°	P-03

CONTRACTOR	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Taber		

OPERATOR'S NAME	HELPER'S NAME	EQUIPMENT	TOTAL DEPTH
Chad	Caleb/Cody	CME 75	21.5 ft

EXCAVATION METHOD	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER
Solid-Stem Auger		4 in

SAMPLER TYPE(S) AND SIZE(S) (ID)	HAMMER TYPE	HAMMER EFFICIENCY, ERi
CalMod (2.4")	Safety semi-automatic drop (140#/ 30")	

BACKFILL AND COMPLETION	GROUND WATER READINGS	DURING	AFTER (DATE)	CASING TYPE AND DIAMETER(in)
Top Pour Cement Grout Backfill		Not Encountered		

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (1")															
			AGGREGATE BASE (6")															
	1		Lean CLAY (CL); (hard); dark brown; moist; few very fine SAND															
	5		Lean CLAY with SAND (CL); hard; mottled dark yellowish brown and light grayish brown with orangish brown streaks; dry; very fine SAND		1	28 50/6"	50/6"		75	>4.5								
	10		very stiff; dark yellowish brown; moist		2	8 14 22	36		89	3.75	30	120						
	15				3	4 8 12	20		100	3.0								
	18.5		CLAYEY SAND (SC); medium dense; mottled dark yellowish brown and grayish brown with black streaks; moist; fine SAND; some fines															
	20				4	12 9 13	22		100	NA	33	86						

Bottom of exploration at 21.5 ft below ground surface (bgs)

No groundwater encountered
Bulk A obtained 0.6-5 ft bgs

Top Pour Cement Grout Backfill

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	3842.X	P-03

COUNTY	ROUTE	POSTMILE
YUB		

CLIENT		
Jacobs Engineering		

PREPARED BY	CHECKED BY	SHEET
LDM		1 of 1

BLACKBURN CONSULTING

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	9-10-20	9-10-20	39.07729° / -121.54499°	P-04

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME: Chad HELPER'S NAME: Caleb/Cody	EQUIPMENT CME 75	TOTAL DEPTH 15.0 ft
EXCAVATION METHOD Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Backfill native cuttings	GROUND WATER READINGS — DURING: Not Encountered; AFTER (DATE):	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (6")															
	0.5		AGGREGATE BASE (15")															
	2		SANDY Lean CLAY (CL); hard; dark reddish brown; moist; some fine SAND		1	7 6 9	15		83	4.5					51			
	5		Lean CLAY with SAND (CL); hard; light grayish brown with dark reddish brown streaks; dry; strong cementation		2	45 50/1"	50/1"		100	>4.5								
	7		Lean CLAY (CL); medium stiff to stiff; dark brown; moist															
	10				3	4 6 7	13		78	1.0	27	93						
	14		medum stiff; moist to wet		4	2 3 4	7		100	0.75	44	77						
	15		Bottom of exploration at 15.0 ft below ground surface (bgs)															

No Groundwater Encountered

Backfill native cuttings

PROJECT NAME OPUD South Yuba Sewer and Water		FILE NO. 3842.X	HOLE ID P-04
COUNTY YUB	ROUTE		POSTMILE
CLIENT Jacobs Engineering			
PREPARED BY LDM	CHECKED BY		SHEET 1 of 1

BLACKBURN CONSULTING

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	9-14-20	9-14-20		P-05
CONTRACTOR Taber			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME David	HELPER'S NAME Jeff/Tanner		EQUIPMENT CME 75	TOTAL DEPTH 21.5 ft
EXCAVATION METHOD Solid-Stem Auger			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")			HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Top Pour Cement Grout Backfill			GROUND WATER READINGS DURING AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (3")															
			AGGREGATE BASE (3")															
	1		SANDY Lean CLAY (CL); hard; dark yellowish brown; moist; some fine to medium SAND															
	2–3		Lean CLAY (CL); very stiff to hard; mottled olive gray and brown; moist; trace fine SAND; moderate cementation		1	9 19 33	52		90	2.75/ >4.5								
	4–5		SILT (ML); Hard; mottled olive gray and brown; moist; fine SAND; some fines															
	6				2	15 28 44	72		65	>4.5	29	95			87			
	9		Lean CLAY (CL); hard; brown; moist; few fine to medium SAND															
	11				3	13 23 40	63		95	>4.5	23	104						
	16		dark yellowish brown		4	14 34 50/4.5"	84/10.5"		75	>4.5								
	21				5	14 29 38	67		85	>4.5								

Bottom of exploration at 21.5 ft below ground surface (bgs)

No Goundwater Encountered

Top Pour Cement Grout Backfill

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 10/21/20

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	3842.X	P-05
COUNTY YUB	ROUTE	POSTMILE
CLIENT Jacobs Engineering		
PREPARED BY LDM	CHECKED BY	SHEET 1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	9-14-20	9-14-20		P-06

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David** / HELPER'S NAME **Jeff/Tanner**	EQUIPMENT **CME 75**	TOTAL DEPTH **16.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Backfill native cuttings**	GROUND WATER READINGS — DURING — AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (4")															
			AGGREGATE BASE (6")															
	1		Lean CLAY (CL); (stiff); dark yellowish brown; moist; [FILL]															
	3.5		SANDY Lean CLAY (CL); soft; mottled dark yellowish brown and dark gray and brown; very moist; [FILL]															
	5				1	0			100	0.25	27	94			32			
	8		Lean CLAY with SAND (CL); hard; dark yellowish brown; moist; little fine SAND															
	10				2	8 21 37	58		80	>4.5	24	102						
	15				3	11 25 33	58		65	>4.5								

Bottom of exploration at 16.5 ft below ground surface (bgs)

No Goundwater Encountered
Bulk A obtained 1-5 ft bgs

Backfill native cuttings

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 10/21/20

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	3842.X	P-06
COUNTY: YUB	ROUTE	POSTMILE
CLIENT: Jacobs Engineering		
PREPARED BY: LDM	CHECKED BY	SHEET 1 of 1

LOGGED BY **DWC** / BEGIN DATE **9-14-20** / COMPLETION DATE **9-14-20**	LOCATION (Lat/Long or North/East and Datum)	HOLE ID **P-07**
CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David** / HELPER'S NAME **Jeff/Tanner**	EQUIPMENT **CME 75**	TOTAL DEPTH **16.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Backfill native cuttings**	GROUND WATER READINGS DURING / AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (3")															
		AGGREGATE BASE (4")															
	1	SANDY Lean CLAY (CL); hard; reddish brown; moist; some fine to medium SAND; trace coarse SAND															
	2.5–3.0			1	4 9 15	24		65	4.25	17	112			34			
	5	Lean CLAY with SAND (CL); hard; strong brown; slightly moist; little fine to medium SAND; trace coarse SAND		2	13 37 50/4"	87/10"		60	>4.5			38	19				
	9	Lean CLAY (CL); hard; dark yellowish brown; dry; strongly cemented															
	10			3	3 24 50/0.5"	74/6.5"		70	>4.5								
	14	Lean CLAY with SAND (CL); hard; dark yellowish brown; dry; little medium SAND; moderately cemented															
	15			4	6 31 50/4"	81/10"		65	>4.5								

Bottom of exploration at 16.5 ft below ground surface (bgs)

No Goundwater Encountered

Backfill native cuttings

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 10/21/20

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**	FILE NO. **3842.X**	HOLE ID **P-07**
COUNTY **YUB**	ROUTE	POSTMILE
CLIENT **Jacobs Engineering**		
PREPARED BY **LDM**	CHECKED BY	SHEET **1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	9-1-20	9-1-20	39.07897° / -121.5265°	P-08

CONTRACTOR: Taber	LOCATION (Offset, Station, Line):	SURFACE ELEVATION:
OPERATOR'S NAME: Toby; HELPER'S NAME: Ernesto/Lawrence	EQUIPMENT: CME 75	TOTAL DEPTH: 15.0 ft
EXCAVATION METHOD: Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH:	BOREHOLE DIAMETER: 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID): CalMod (2.4")	HAMMER TYPE: Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi:
BACKFILL AND COMPLETION: Backfill native cuttings	GROUND WATER READINGS: DURING: Not Encountered; AFTER (DATE):	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		Lean CLAY (CL); hard; orangish brown; dry; few very fine SAND															
	2.5–3.5				1	21 50/2.5	50/2.5"		50	>4.5								
	4.5		Lean CLAY with SAND (CL); hard; dark brown; moist; little fine SAND; few medium SAND															
	5.5–6.5				2	8 13 13	26		100	>4.5	16	112	31	17				
	10–11.5		yellowish brown; dry; little very fine SAND		3	7 38 50/5"	88/11"		100	>4.5								
	13.5–15				4	4 33 50/3"	83/9"		61	>4.5								
	15		Bottom of exploration at 15.0 ft below ground surface (bgs)															

No groundwater encountered
Bulk A obtained 0-5 ft bgs

Backfill native cuttings

BLACKBURN CONSULTING	PROJECT NAME: OPUD South Yuba Sewer and Water	FILE NO.: 3842.X	HOLE ID: P-08
	COUNTY: YUB	ROUTE:	POSTMILE:
	CLIENT: Jacobs Engineering		
	PREPARED BY: LDM	CHECKED BY:	SHEET: 1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	9-1-20	9-1-20	39.0734° / -121.51844°	P-09

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME: Toby HELPER'S NAME: Ernesto/Lawrence	EQUIPMENT CME 75	TOTAL DEPTH 15.0 ft
EXCAVATION METHOD Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Backfill native cuttings	GROUND WATER READINGS — DURING: Not Encountered; AFTER (DATE):	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		Lean CLAY (CL); hard; reddish brown; moist															
	2–3.5				1	6 13 19	32		83	>4.5								
	4		Lean CLAY with SAND (CL); hard; dark yellowish brown with grayish brown streaks; moist; little fine SAND															
	5–6.5				2	11 13 33	46		89	4.5	22	104						
	8.5		Poorly Graded SAND with CLAY (SP-SC); medium dense; dark brown; moist															
	10–11.5				3	11 11 11	22		100	NA	14	104						
	12.5		CLAYEY GRAVEL with SAND (GP-GC); dense; dark brown; moist															
	13.5–15				4	27 29 32	61		100	>4.5								
	14.7		Lean CLAY with SAND (CL); hard; yellowish brown; moist; little to some very fine SAND															

Bottom of exploration at 15.0 ft below ground surface (bgs)

No groundwater encountered
Bulk A obtained 0-5 ft bgs

Backfill native cuttings

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 10/21/20

BLACKBURN CONSULTING

PROJECT NAME OPUD South Yuba Sewer and Water	FILE NO. 3842.X	HOLE ID P-09
COUNTY YUB	ROUTE	POSTMILE
CLIENT Jacobs Engineering		
PREPARED BY LDM	CHECKED BY	SHEET 1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**8-31-20**	**8-31-20**	**39.07025° / -121.51411°**	**P-10**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Toby** / HELPER'S NAME **Ernesto/Lawrence**	EQUIPMENT **CME 75**	TOTAL DEPTH **15.0 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Backfill native cuttings**	GROUND WATER READINGS DURING **Not Encountered** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		Lean CLAY (CL); (hard); brown; dry; few SAND Hand auger first 5 feet															
	4		Lean CLAY with SAND (CL); hard; yellowish brown; dry; very fine SAND															
	5				1	18 39 50/6"	89/12"		80	>4.5								
	9		CLAYEY SAND (SC); dense; dark yellowish brown; dry; fine SAND; some fines															
	10				2	5 18 35	53		70	NA	10	116						
	12.5		SILTY SAND (SM); dense to very dense; dark brown and grayish brown; moist; trace fines															
	13.5				3	10 26 30	56		80	NA					42			
	15		Bottom of exploration at 15.0 ft below ground surface (bgs) No Goundwater Encountered Bulk A obtained 0-4 ft bgs Backfill native cuttings															

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

BLACKBURN CONSULTING

PROJECT NAME		FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water		**3842.X**	**P-10**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**8-31-20**	**8-31-20**	**39.066925° / -121.50914°**	**P-11**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Toby** / HELPER'S NAME **Ernesto/Lawrence**	EQUIPMENT **CME 75**	TOTAL DEPTH **21.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Backfill native cuttings**	GROUND WATER READINGS DURING **Not Encountered** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
											Laboratory Data							
	0		Lean CLAY (CL); hard; yellowish red; dry; trace very fine SAND															
	2.5–4				1	14 33 49	82		70	>4.5	16	113						
	5–6.5				2	10 20 24	44		90	>4.5								
	10–11.5				3	4 12 22	34		50	>4.5	18	102					UC	
	11		SANDY SILT (ML) interbedded with Lean CLAY (CL). SANDY SILT (ML); hard; dark yellowish brown; moist; little very fine SAND. Lean CLAY (CL); hard; orangish brown with grayish streaks; moist; few fine SAND															
	15–16.5				4	13 37 50/6"	87/12"		55	>4.5								
	18		Lean CLAY (CL); hard; dark brown; moist; trace very fine SAND															
	20–21.5				5	8 15 16	31		85	>4.5								
	21.2		CLAYEY SAND (SC); medium dense; orangish brown; moist; some fines															

Bottom of exploration at 21.5 ft below ground surface (bgs)

No Goundwater Encountered
Bulk A obtained 0-5 ft bgs

Backfill native cuttings

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **P-11**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **1 of 1**

BLACKBURN CONSULTING

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
SS	**9-2-20**	**9-2-20**		**P-12**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Toby** / HELPER'S NAME **Ernesto/Jason**	EQUIPMENT **CME 75**	TOTAL DEPTH **14.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Backfill native cuttings**	GROUND WATER READINGS DURING AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (9")															
	1		AGGREGATE BASE (15")															
	2		Lean CLAY with SAND (CL); hard; dark reddish brown; little fine to medium SAND; dry; few moderate cementation		1	13 18 18	36		95	>4.5	7	104						
	5		SANDY Lean CLAY (CL); hard; reddish brown; dry; some fine to medium SAND		2	33 50/4"	50/4"		100	>4.5								
	10		CLAYEY SAND (SC); very dense; dark yellowish brown; dry; fine to medium SAND; little fines; little moderate cementation		3	50/4"	50/4"		100	NA	15	105						
	14		SILT with SAND (ML); hard; yellowish brown; dry; little fine SAND; trace cementation		4	13 50/6"	50/6"		100	>4.5								

Bottom of exploration at 14.5 ft below ground surface (bgs)

No Goundwater Encountered
Bulk A obtained 2-5 ft bgs

Backfill native cuttings

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **P-12**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	8-24-20	8-24-20	39.06067° / -121.50016°	P-13

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME: David HELPER'S NAME: Nick/Tanner	EQUIPMENT CME 75	TOTAL DEPTH 21.5 ft
EXCAVATION METHOD Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Top Pour Cement Grout Backfill	GROUND WATER READINGS — DURING: Not Encountered; AFTER (DATE):	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		Lean CLAY (CL); hard; dark brown; moist; few medium SAND															
	2.5				1	12 13 18	31		70	>4.5	20	105						
	4.5		Lean CLAY with SAND (CL); hard; dark yellowish brown; dry; little fine SAND; moderate cementation															
	5				2	25 27 24	51		80	>4.5								
	9		SANDY Lean CLAY (CL); hard; dark yellowish brown; moist; some fine SAND															
	10				3	16 24 50/6"	74/12"		70	>4.5	23	94						
	15				4	28 40 50/5"	90/11"		70	>4.5	12	90			7			
	15.5		Poorly Graded SAND with SILT (SP-SM); medium dense; dark yellow brown; moist; fine to medium SAND; lenses of SILTY SAND															

Bottom of exploration at 21.5 ft below ground surface (bgs)

No Goundwater Encountered

Top Pour Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME OPUD South Yuba Sewer and Water		FILE NO. 3842.X	HOLE ID P-13
COUNTY YUB	ROUTE		POSTMILE
CLIENT Jacobs Engineering			
PREPARED BY LDM	CHECKED BY		SHEET 1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	**8-25-20**	**8-25-20**	**39.05473° / -121.49171°**	**P-14**
CONTRACTOR **Taber**			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David**	HELPER'S NAME **Nick/Tanner**		EQUIPMENT **CME 75**	TOTAL DEPTH **21.0 ft**
EXCAVATION METHOD **Solid-Stem Auger**			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**			HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Top Pour Cement Grout Backfill**			GROUND WATER READINGS DURING **Not Encountered** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE															
		AGGREGATE BASE															
	1	Lean CLAY (CL); (Stiff); Dark Reddish Brown; Moist															
	2.5	Lean CLAY with SAND (CL); Hard; Dark Yellowish Brown; Moist; Little Fine SAND; Some Moderate Cementation		1	9 23 25	48		75	>4.5								
	5			2	16 24 33	57		80	>4.5	16	116			56		UC	
	6	SANDY Lean CLAY (CL); Hard; Strong Brown; Moist; Some Fine through Coarse SAND; Few Fine GRAVEL; Trace Coarse GRAVEL															
	10	Less GRAVEL		3	17 36 50/5"	86/11"		70	>4.5	22	105						
	10.5	Lean CLAY with SAND (CL); Hard; Mottled Olive and Dark Yellowish Brown; Moist; Little Medium SAND															
	12	CLAYEY SAND (SC); Very Dense; Dark Yellowish Brown; Dry; Strongly Cemented															
	15			4	50/5"	50/5"		100	>4.5								
	20	Moist		5	28 50/5"	50/5"			>4.5								

Bottom of exploration at 21.0 ft below ground surface (bgs)

No Goundwater Encountered

Top Pour Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**P-14**
COUNTY **YUB**	ROUTE	POSTMILE
CLIENT **Jacobs Engineering**		
PREPARED BY **SS**	CHECKED BY	SHEET **1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	8-24-20	8-24-20	39.05341° / -121.48963°	P-15

Field	Value
CONTRACTOR	Taber
LOCATION (Offset, Station, Line)	
SURFACE ELEVATION	
OPERATOR'S NAME	David
HELPER'S NAME	Nick/Tanner
EQUIPMENT	CME 75
TOTAL DEPTH	16.5 ft
EXCAVATION METHOD	Solid-Stem Auger
DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	
BOREHOLE DIAMETER	4 in
SAMPLER TYPE(S) AND SIZE(S) (ID)	CalMod (2.4")
HAMMER TYPE	Safety semi-automatic drop (140#/ 30")
HAMMER EFFICIENCY, ERi	
BACKFILL AND COMPLETION	Backfill native cuttings
GROUND WATER READINGS — DURING	Not Encountered
GROUND WATER READINGS — AFTER (DATE)	
CASING TYPE AND DIAMETER(in)	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		Lean CLAY (CL); hard; dark brown; dry; medium plasticity															
	3		moist		1	12 13 18	31		70	>4.5	16	114						
	4.5		SANDY Lean CLAY (CL); hard; strong brown; dry; some fine SAND; medium plasticity															
	6				2	25 27 24	51		80	>4.5	14	115					UC	
	10.5		SILT (ML); hard; yellowish brown; dry; few very fine SAND		3	16 24 50	74		70	>4.5	21	102						
	16				4	28 40 50/5"	90/11"		70	>4.5								

Bottom of exploration at 16.5 ft below ground surface (bgs)

No Goundwater Encountered

Backfill native cuttings

LOGGED BY **DWC**	BEGIN DATE **8-25-20**	COMPLETION DATE **8-25-20**	LOCATION (Lat/Long or North/East and Datum)	HOLE ID **P-16**
CONTRACTOR **Taber**			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David**	HELPER'S NAME **Nick/Tanner**		EQUIPMENT **CME 75**	TOTAL DEPTH **21.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**			HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Top Pour Cement Grout Backfill**			GROUND WATER READINGS DURING **Not Encountered** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (4")															
	0.3–3		AGGREGATE BASE (32")															
	3		Lean CLAY with SAND (CL); (stiff); dark reddish brown; little medium SAND; odor															
	4		CLAYEY SAND (SC); medium dense; dark reddish brown; moist; fine to medium SAND; some fines															
	5–6.5				1	9 13 15	28		85	3.75	16	116	30	16	41			
	10–11.5		little fines		2	9 14 19	33		80	>4.5								
	11		SANDY Lean CLAY (CL); hard; mottled dark yellowish brown and olive brown; moist; some moderate cementation; some fine through coarse SAND															
	14		Lean CLAY with SAND (CL); hard; mottled dark yellowish brown and olive brown; moist; little fine to medium SAND; some weak cementation															
	15–16				3	25 50/6"	50/6"		90	>4.5	21	104						
	20–21.5		mottled gray and dark yellowish brown; some moderate to strong cementation		4	18 25 30	55		95	>4.5								

Bottom of exploration at 21.5 ft below ground surface (bgs)

No Goundwater Encountered
Bulk A obtained 3-5 ft bgs

Top Pour Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **P-16**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	9-1-20	9-1-20	39.04718° / -121.4808°	P-17

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME: Toby HELPER'S NAME: Ernesto/Lawrence	EQUIPMENT CME 75	TOTAL DEPTH 21.5 ft
EXCAVATION METHOD Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Top Pour Cement Grout Backfill	GROUND WATER READINGS — DURING: Not Encountered; AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		Lean CLAY (CL); hard; orangish brown; dry; few very fine SAND															
	2–3				1	14 50/5"	50/5"		67	>4.5								
	5		CLAYEY SAND (SC); medium dense; dark reddish brown; moist; some fine SAND		2	7 9 10	19		83	3.0	18	110			36			
	8.5		CLAYEY SAND (SC); dense; dark yellowish brown; moist; fine SAND; little fines															
	10–11				3	11 23 19	42		83	NA	13	117			31			
	14		Lean CLAY (CL); hard; light grayish brown; dry; few very fine SAND															
	15–16				4	16 34 50/6"	84/12"		89	>4.5								
	20–21		mottled dark yellowish brown and grayish brown; trace very fine SAND		5	26 50/5"	50/5"		100	>4.5								

Bottom of exploration at 21.5 ft below ground surface (bgs)

No groundwater encountered
Bulk A obtained 0-5 ft bgs

Top Pour Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME OPUD South Yuba Sewer and Water	FILE NO. 3842.X	HOLE ID P-17
COUNTY YUB	ROUTE	POSTMILE
CLIENT Jacobs Engineering		
PREPARED BY LDM	CHECKED BY	SHEET 1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**9-1-20**	**9-1-20**	**39.04409° / -121.47634°**	**P-18**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Toby** / HELPER'S NAME **Ernesto/Lawrence**	EQUIPMENT **CME 75**	TOTAL DEPTH **15.0 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Backfill native cuttings**	GROUND WATER READINGS — DURING **Not Encountered** — AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		Lean CLAY (CL); hard; orangish brown; dry; few medium coarse GRAVEL															
	2–3.5		No GRAVEL		1	14 15 16	31		61	>4.5								
	5–6.5		dark yellowish brown with grayish streaks; trace very fine SAND		2	29 33 38	71		89	>4.5	18	111						
	10–11.5				3	13 33 49	82		61	>4.5								
	13.5–15		dark yellowish brown; moist		4	5 19 28	47		100	>4.5	27	96						

Bottom of exploration at 15.0 ft below ground surface (bgs)

No groundwater encountered
Bulk A obtained 0-5 ft bgs

Backfill native cuttings

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**P-18**
COUNTY **YUB**	ROUTE	POSTMILE
CLIENT **Jacobs Engineering**		
PREPARED BY **LDM**	CHECKED BY	SHEET **1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
SS	9-8-20	9-8-20		P-24

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME Rick HELPER'S NAME	EQUIPMENT CME 75	TOTAL DEPTH 15.0 ft
EXCAVATION METHOD Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Backfill native cuttings	GROUND WATER READINGS DURING Not Encountered AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (7")															
	1	AGGREGATE BASE (10")															
	2	Lean CLAY (CL); very stiff; reddish brown; dry															
	3	moist		1	6 7 11	18		100	2.25	17	109	48	33				
	5	hard; dry to moist; few fine SAND; little moderate cementation		2	11 18 38	56		90	>4.5								
	10	dry															
	11	Lean CLAY with SAND (CL); hard; yellowish brown; slightly moist; little fine SAND; strong cementation		3	3 6 47	53		80	>4.5	17	101						
	14	SILT (ML); hard; dark yellowish brown with white specks; slightly moist		4	9 16 23	39		100	>4.5								
	15	Bottom of exploration at 15.0 ft below ground surface (bgs)															

No groundwater encountered
Bulk A obtained 1.4-5 ft bgs

Backfill native cuttings

BLACKBURN CONSULTING

PROJECT NAME OPUD South Yuba Sewer and Water	FILE NO. 3842.X	HOLE ID P-24
COUNTY YUB	ROUTE	POSTMILE
CLIENT Jacobs Engineering		
PREPARED BY LDM	CHECKED BY	SHEET 1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
SS	**9-8-20**	**9-8-20**		**P-25**

CONTRACTOR	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Taber		
OPERATOR'S NAME: **Rick** / HELPER'S NAME:	EQUIPMENT: **CME 75**	TOTAL DEPTH: **20.0 ft**
EXCAVATION METHOD: **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER: **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID): **CalMod (2.4")**	HAMMER TYPE: **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION: **Top Pour Cement Grout Backfill**	GROUND WATER READINGS — DURING: **Not Encountered** — AFTER (DATE):	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (7")															
	0.6		AGGREGATE BASE (10")															
	1.4		Lean CLAY with SAND (CL); hard; reddish brown; dry; little fine to medium SAND; indurated slightly; trace cementation															
	2–3			X	1	22 50/6"	50/6"		85	>4.5	13	114	31	10				
	5–6.5			X	2	15 26 40	66		85	>4.5								
	6.5		Lean CLAY with SAND (CL); hard; dark yellowish brown; moist; little fine to medium SAND; black specks															
	10–11.5		grayish brown; dry; some white cementation	X	3	21 46 50	96		85	>4.5								
	14–15			X	4	14 50/6"	50/6"		85	>4.5	25	91						
	18.5–20		SILT with SAND (ML); hard; yellowish brown; moist; little fine SAND; few cementation	X	5	12 18 25	43		100	>4.5								

Bottom of exploration at 20.0 ft below ground surface (bgs)

No groundwater encountered
Bulk A obtained 1.4-5 ft bgs

Top Pour Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**P-25**
COUNTY: **YUB**	ROUTE	POSTMILE
CLIENT: **Jacobs Engineering**		
PREPARED BY: **LDM**	CHECKED BY	SHEET: **1 of 1**

LOGGED BY: LDM	BEGIN DATE: 9-10-20	COMPLETION DATE: 9-10-20	LOCATION (Lat/Long or North/East and Datum): 39.03908° / -121.51503°	HOLE ID: P-26
CONTRACTOR: Taber			LOCATION (Offset, Station, Line):	SURFACE ELEVATION:
OPERATOR'S NAME: Chad	HELPER'S NAME: Caleb/Cody		EQUIPMENT: CME 75	TOTAL DEPTH: 21.5 ft
EXCAVATION METHOD: Solid-Stem Auger			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH:	BOREHOLE DIAMETER: 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID): CalMod (2.4")			HAMMER TYPE: Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi:
BACKFILL AND COMPLETION: Top Pour Cement Grout Backfill			GROUND WATER READINGS — DURING: Not Encountered; AFTER (DATE):	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (6.5")															
	0.5	AGGREGATE BASE (14")															
	1.7	Lean CLAY (CL); hard; dark grayish brown; moist; some weak cementation															
	2–3.5			1	4, 15, 50/4"	65/10"		94	>4.5								
	3	SANDY SILT (ML); hard; orangish brown; dry; some fine SAND															
	4.5	Lean CLAY (CL); hard; mottled orangish brown and dark yellowish brown with grayish brown streaks; moist; few fine SAND															
	5–6.5			2	13, 27, 34	61		89	>4.5	19	111						
	10–11.5	grayish brown; trace fine SAND		3	18, 39, 50/6"	89/12"		72	>4.5								
	13.5	SILT with SAND (ML); hard; dark yellowish brown with grayish brown streaks; moist; little very fine SAND															
	15–16.5			4	16, 38, 50/5"	88/11"		83	>4.5	25	100						
	18.5	Poorly Graded SAND with SILT (SP); very dense; dark yellowish brown; moist; fine SAND															
	20–21.5			5	21, 37, 39	76		100	NA					8			

Bottom of exploration at 21.5 ft below ground surface (bgs)

No Groundwater Encountered

Top Pour Cement Grout Backfill

PROJECT NAME: OPUD South Yuba Sewer and Water		FILE NO.: 3842.X	HOLE ID: P-26
COUNTY: YUB	ROUTE:		POSTMILE:
CLIENT: Jacobs Engineering			
PREPARED BY: LDM	CHECKED BY:		SHEET: 1 of 1

BLACKBURN CONSULTING

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**9-10-20**	**9-10-20**	**39.04651° / -121.51497°**	**P-27**

CONTRACTOR **Taber**		LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Chad**	HELPER'S NAME **Caleb/Cody**	EQUIPMENT **CME 75**	TOTAL DEPTH **21.0 ft**
EXCAVATION METHOD **Solid-Stem Auger**		DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**		HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Top Pour Cement Grout Backfill**		GROUND WATER READINGS — DURING: **Not Encountered** — AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (6")															
	0.5		AGGREGATE BASE (12")															
	1.5		Lean CLAY (CL); (hard); mottled dark brown and dark grayish brown; moist															
	5				1	7 15 50/4"	65/10"		100	>4.5								
	6		SILT with SAND (ML); hard; mottled light brown and orangish brown; dry; some weak cementation; little fine SAND															
	9		hard augering															
	10		light grayish brown with dark orangish brown streaks		2	44 50/6"	50/6"		100	>4.5	19	104						
	15		dark brown with blackish streaks; moist; some moderate cementation		3	28 50/5"	50/5"		100	>4.5	26	96						
	18.5		Lean CLAY with SAND (CL); hard; dark yellowish brown with blackish streaks; moist; little fine SAND; some weak cementation															
	20				4	22 50/4"	50/4"		100	>4.5								
	21		Bottom of exploration at 21.0 ft below ground surface (bgs)															

No Groundwater Encountered
Bulk A obtained 1.5-5 ft bgs

Top Pour Cement Grout Backfill

BLACKBURN CONSULTING	PROJECT NAME **OPUD South Yuba Sewer and Water**	FILE NO. **3842.X**	HOLE ID **P-27**
	COUNTY **YUB**	ROUTE	POSTMILE
	CLIENT **Jacobs Engineering**		
	PREPARED BY **LDM**	CHECKED BY	SHEET **1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	**9-8-20**	**9-8-20**		**P-28**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Chad** HELPER'S NAME **Caleb/Cody**	EQUIPMENT **CME 75**	TOTAL DEPTH **21.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Top Pour Cement Grout Backfill**	GROUND WATER READINGS DURING **Not Encountered** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
											Laboratory Data							
	0		ASPHALT CONCRETE (6")															
	0.5		AGGREGATE BASE (12")															
	1.5		Lean CLAY (CL); very stiff; dark grayish brown; moist															
	2–3.5				1	7 9 14	23		80	2.25	19	111						
	4		SANDY Lean CLAY (CL); hard; dark yellowish brown; moist; some fine SAND; moderate cementation															
	5				2	53 50/4"	50/4"		80	>4.5								
	8		CLAYEY SAND (SC); very dense; dark yellowish brown; moist; fine to medium SAND; little fines; strongly cemented															
	10				3	50/6"	50/6"		100	>4.5								
	14		Poorly Graded SAND with CLAY (SP-SC); medium dense to dense; yellowish brown; moist; fine to medium SAND; few fines															
	15–16.5				4	15 16 20	36		70	NA	10	104						
	19		Poorly Graded SAND (SP); medium dense to dense; olive gray; very moist; fine to medium SAND															
	20–21.5				5	12 16 19	35		100	NA								

Bottom of exploration at 21.5 ft below ground surface (bgs)

No Groundwater Encountered

Top Pour Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **P-28**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **1 of 1**

LOGGED BY DWC	BEGIN DATE 9-8-20	COMPLETION DATE 9-8-20	LOCATION (Lat/Long or North/East and Datum)	HOLE ID P-29
CONTRACTOR Taber			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME Chad	HELPER'S NAME Caleb/Cody		EQUIPMENT CME 75	TOTAL DEPTH 16.5 ft
EXCAVATION METHOD Solid-Stem Auger			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")			HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Backfill native cuttings			GROUND WATER READINGS DURING Not Encountered AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (6")															
	1		AGGREGATE BASE (12")															
	2		SANDY Lean CLAY (CL); stiff; brown; moist															
	4		CLAYEY SAND (SC); medium dense to dense; dark yellowish brown; moist; fine SAND; some fines															
	5-6.5				1	12 16 20	36		100	NA	21	100						
	10-11.5		fine to coarse SAND		2	8 12 17	29		90	NA	20	102						
	15-16.5		medium to coarse SAND; little fines		3	10 16 20	36		95	NA								

Laboratory Data

Bottom of exploration at 16.5 ft below ground surface (bgs)

No Groundwater Encountered
Bulk A obtained 1.5-5 ft bgs

Backfill native cuttings

PROJECT NAME OPUD South Yuba Sewer and Water		FILE NO. 3842.X	HOLE ID P-29
COUNTY YUB	ROUTE		POSTMILE
CLIENT Jacobs Engineering			
PREPARED BY LDM	CHECKED BY	SHEET 1 of 1	

BLACKBURN CONSULTING

LOGGED BY: **SS** BEGIN DATE: **9-4-20** COMPLETION DATE: **9-4-20**	LOCATION (Lat/Long or North/East and Datum)	HOLE ID: **P-30**
CONTRACTOR: **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME: **Toby** HELPER'S NAME: **Ernesto/Jason**	EQUIPMENT: **CME 75**	TOTAL DEPTH: **14.5 ft**
EXCAVATION METHOD: **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER: **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID): **CalMod (2.4")**	HAMMER TYPE: **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION: **Backfill native cuttings**	GROUND WATER READINGS DURING AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		SANDY Lean CLAY (CL); hard; dark yellowish brown; dry; some fine to medium SAND; trace fine to coarse GRAVEL															
	2				1	9 20 21	41		80	>4.5	10	117						
	3		GRAVELLY Lean CLAY (CL); hard; mottled black and dark yellowish brown; little fine to coarse GRAVEL; few COBBLES; few fine to coarse SAND; few ASPHALT CONCRETE debris															
	5		SANDY Lean CLAY (CL); stiff; dark yelowish brown; dry; some fine to medium SAND		2	14 16 10	26		90	1.5								
	10		hard; trace fine to coarse GRAVEL; trace COBBLES		3	16 45 50/4"	95/10"		100	>4.5	17	115			67			
	14		SILT with SAND (ML); hard; yellowish brown; dry; little fine SAND		4	32 50/4"	50/4"		100	>4.5								

Bottom of exploration at 14.5 ft below ground surface (bgs)

No Goundwater Encountered
Bulk A obtained 0-5 ft bgs

Backfill native cuttings

BLACKBURN CONSULTING	PROJECT NAME: **OPUD South Yuba Sewer and Water**	FILE NO.: **3842.X**	HOLE ID: **P-30**
	COUNTY: **YUB**	ROUTE	POSTMILE
	CLIENT: **Jacobs Engineering**		
	PREPARED BY: **LDM**	CHECKED BY	SHEET: **1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
SS	9-4-20	9-4-20		P-32

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME Toby HELPER'S NAME Ernesto/Jason	EQUIPMENT CME 75	TOTAL DEPTH 15.0 ft
EXCAVATION METHOD Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Backfill native cuttings	GROUND WATER READINGS DURING AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		SILT with SAND (ML); very stiff; yellowish brown; dry; little fine SAND															
	2-3				1	6 7 9	16		60	3.25								
	3		Lean CLAY (CL); hard; dark yellowish brown; dry; few fine SAND															
	5-6				2	5 7 13	20		100	>4.5	23	97						
	10		Lean CLAY with SAND (CL); hard; dark yellowish brown; dry; little fine SAND		3	20 35 38	73		90	>4.5	20	109						
	14		some cementation		4	11 18 45	63		100	>4.5								
	15		Bottom of exploration at 15.0 ft below ground surface (bgs)															

No Goundwater Encountered
Bulk A obtained 0-5ft bgs

Backfill native cuttings

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 10/21/20

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	3842.X	P-32

COUNTY	ROUTE	POSTMILE
YUB		

CLIENT
Jacobs Engineering

PREPARED BY	CHECKED BY	SHEET
LDM		1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	**9-10-20**	**9-10-20**	**39.07996° / -121.53077°**	**TC-02A**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Rick** / HELPER'S NAME **Nick/Mike**	EQUIPMENT **Diedrich D120**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**	GROUND WATER READINGS DURING **29.0 ft** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (6")															
	1		SANDY Lean CLAY (CL); very stiff; dark yellowish brown; moist; some fine to medium SAND															
	2–3				1	4 6 10	16		90	2.25								
	5–6		mottled dark yellowish brown and black and brown; strong cementation		2	28 50/4"	50/4"		100	>4.5								
	8		Lean CLAY with SAND (CL); hard; dark yellowish brown; moist; little fine SAND															
	10–11				3	8 12 15	27		90	4.25								
	15–16		fine to medium SAND		4	17 28 35	63		100	>4.5								
	17		SANDY Lean CLAY (CL); hard; olive brown; moist; some fine to medium SAND															
	20–21				5	9 16 35	51		90	>4.5								
	21		Lean CLAY with SAND (CL); hard; mottled olive gray and brown and black; moist; little fine SAND; some moderate cementation															
	24–25		SANDY Lean CLAY (CL); hard; mottled dark olive gray and brown; moist; some fine to medium SAND; some moderate															

(continued)

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**TC-02A**
COUNTY **YUB**	ROUTE	POSTMILE
CLIENT **Jacobs Engineering**		
PREPARED BY **LDM**	CHECKED BY **DWC**	SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		cementation SANDY Lean CLAY (CL) *(continued)*.		6	22 50/5"	50/5"		100	>4.5								
	29		SANDY Lean CLAY (CL); very stiff; olive gray; moist; some fine SAND															
	30				7	7 13 21	34		85	2.25								
	35		hard; mottled olive brown and brown		8	12 16 27	43		100	>4.5								
	38		Lean CLAY with SAND (CL); hard; olive gray; moist; little fine to medium SAND; moderate cementation															
	40				9	24 38 50/4"	88/10"		85	>4.5								
	45		some strong cementation		10	17 34 50/4.5"	84/10.5"		100	>4.5								
	50		dark reddish brown veins; moderate cementation		11	14 24 50/6"	74/12"		100	>4.5								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Groundwater Encountered at 29 ft bgs

Tremie Cement Grout Backfill

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-02A**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY **DWC**		SHEET **2 of 2**

BLACKBURN CONSULTING

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	8-31-20	8-31-20	39.08058° / -121.52931°	TC-02C

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME: Toby HELPER'S NAME: Ernesto/Lawrence	EQUIPMENT CME 75	TOTAL DEPTH 51.5 ft
EXCAVATION METHOD Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4"), SPT (1.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Tremie Cement Grout Backfill	GROUND WATER READINGS: DURING 27.5 ft; AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (2.5")															
			AGGREGATE BASE (12")															
	1.5		SILT (ML); hard; mottled dark yellowish brown and grayish brown; dry; few very fine SAND															
	3				1	35 40 49	89		100	>4.5			29	4				
	5				2	25 50/4.5"	50/4.5"		100	>4.5								
	10		medium stiff to stiff; moist; trace fine SAND		3	3 4 5	9		100	1.0								
	11.5				4	4 6 8	14		90									
	14		Lean CLAY with SAND (CL); hard; mottled dark yellowish brown and grayish brown with blackish streaks; moist; little very fine SAND															
	15				5	8 19 24	43		100	>4.5								
	20		grayish brown with dark reddish brown streaks		6	17 37 50/4"	87/10"		90	>4.5								
	25																	

(continued)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
											Laboratory Data							
	25		Lean CLAY with SAND (CL) *(continued)*. grayish brown with orangish brown streaks; increasing SAND content		7	15 50/6"	50/6"		70	>4.5								
	27.5		SILTY SAND (SM); dense; dark yellowish brown; wet; fine to medium SAND															
	30				8	11 20 23	43		100	NA			NP	NP	20			
	35		sand catcher		9	7 14 18	32		90	NA								
	38.5		Lean CLAY (CL); hard; grayish brown with orangish brown streaks; moist; few very fine SAND															
	40				10	20 46 50/4"	96/10"		100	>4.5			44	19				
	43.5		SANDY SILT (ML); hard; grayish brown with orangish brown streaks; moist; very fine SAND															
	45				11	20 26 22	48		100	>4.5								
	50				12	16 19 21	40		100	NA								
	50.8		Poorly Graded SAND with CLAY (SP-SC); dense; dark brown; moist; fine SAND															

Bottom of exploration at 51.5 ft below ground surface (bgs)

Groundwater Encountered at 27.5 ft bgs
Bulk A obtained 1.2-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING	PROJECT NAME: OPUD South Yuba Sewer and Water	FILE NO. 3842.X	HOLE ID TC-02C
	COUNTY: YUB	ROUTE	POSTMILE
	CLIENT: Jacobs Engineering		
	PREPARED BY: LDM	CHECKED BY: DWC	SHEET 2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	**8-24-20**	**8-24-20**	**39.04217° / -121.47595°**	**TC-06A**

CONTRACTOR	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Taber		

OPERATOR'S NAME	HELPER'S NAME	EQUIPMENT	TOTAL DEPTH
David	**Nick/Tanner**	**CME 75**	**41.5 ft**

EXCAVATION METHOD	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER
Solid-Stem Auger/ Rotary Wash		**4 in**

SAMPLER TYPE(S) AND SIZE(S) (ID)	HAMMER TYPE	HAMMER EFFICIENCY, ERi
CalMod (2.4")	**Safety semi-automatic drop (140#/ 30")**	

BACKFILL AND COMPLETION	GROUND WATER READINGS	DURING	AFTER (DATE)	CASING TYPE AND DIAMETER(in)
Tremie Cement Grout Backfill		**Not Encountered**		

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
											Laboratory Data							
	0		Lean CLAY (CL); Hard; Reddish Brown; Dry; Medium Plasticity															
	4		Moist															
	5–6.5				1	10 12 18	30		95	>4.5								
	6.5		CLAYEY SAND (SC); Medium Dense; Reddish Brown; Moist; Mostly Fine to Medium SAND; Some CLAY															
	7.5		Lean CLAY with SAND (CL); Hard; Yellowish Brown; Moist; Little Medium SAND															
	10–11.5				2	3 14 28	42		50	>4.5			41	20				
	14		Lean CLAY (CL); Hard; Mottled Dark Yellowish Brown, Olive, and Gray; Few Medium SAND; Some Moderate Cementation															
	15–16.5				3	28 39 50/5"	89/11"		70	>4.5			43	22				
	19		Lean CLAY (CL); Hard; Mottled Olive and Dark Yellowish Brown; Moist; Trace SAND; Trace Moderate Cementation															
	20–21.5				4	25 43 50/5"	93/11"		79	>4.5			42	22				
	23.5		Fat CLAY (CH); Hard; Yellowish Brown; Moist															
	25																	

(continued)

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 10/21/20

BLACKBURN CONSULTING

PROJECT NAME		FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water		**3842.X**	**TC-06A**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **SS**	CHECKED BY		SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	25	Fat CLAY (CH) *(continued)*.	5	11 13 18	31		75	>4.5	29	93	57	32			UC
	30	SANDY Lean CLAY (CL); Very Stiff; Mottled Olive and Brown; Moist; Some Fine SAND; Low to Medium Plasticity	6	12 14 17	31		70	3.5							
	34	SANDY Lean CLAY (CL); Hard; Dark Yellowish Brown; Moist; Some Fine to Medium SAND; Medium Plasticity													
	35		7	16 32 27	59		95	4.5							
	38	Lean CLAY (CL); Hard; Dark Yellow Brown; Moist; Medium Plasticity													
	40		8	12 21 39	60		100	>4.5							

Bottom of exploration at 41.5 ft below ground surface (bgs)

No Goundwater Encountered

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	3842.X	TC-06A
COUNTY: YUB	ROUTE	POSTMILE
CLIENT: Jacobs Engineering		
PREPARED BY: SS	CHECKED BY	SHEET: 2 of 2

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 10/21/20

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	8-28-20	8-28-20	39.0769° / -121.52352°	TC-07A

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David** / HELPER'S NAME **Nick/Tanner**	EQUIPMENT **CME 75**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger/ Rotary Wash**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**	GROUND WATER READINGS — DURING **23.0 ft** — AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	0	ASPHALT CONCRETE (9")													
	1	AGGREGATE BASE (12")													
	2	Lean CLAY (CL); stiff; dark reddish brown; moist; few very fine SAND													
	3		1	10 7 6	13		80	1.25							
	5		2	14 50/5"	50/5"		55	>4.5							
	6	Lean CLAY with SAND (CL); hard; yellowish brown; little very fine SAND; moderate cementation													
	11	stiff; increasing SAND content; no cementation	3	6 8 10	18		20	1.25							
	14	SILT (ML); hard; mottled grayish brown and orangish brown; moist													
	16		4	13 26 40	66		100	>4.5			42	4			
	19	Lean CLAY (CL); hard; dark brown with orangish streaks; moist; moderate cementation; trace very fine SAND													
	21		5	12 19 35	54		100	>4.5			38	16			
	23	SANDY SILT (ML); (hard); mottled dark yellowish brown and grayish brown with orangish streaks; moist, some SAND; moderate cementation													
	25														

(continued)

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**	FILE NO. **3842.X**	HOLE ID **TC-07A**
COUNTY **YUB**	ROUTE	POSTMILE
CLIENT **Jacobs Engineering**		
PREPARED BY **LDM**	CHECKED BY	SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25	switched to mud rotary SANDY SILT (ML) *(continued)*.		6	9 15 20	35		90				NP	NP	57			
	29	Poorly Graded SAND (SP); dense; dark brown; moist; fine to medium SAND; trace fines															
	30			7	15 18 23	41		65	NA								
	35	dark brown with golden specs; wet		8	10 16 18	34		70	NA					5			
	40	dark brown		9	19 24 23	47		70	NA								
	45	dark brown with golden specs		10	11 23 25	48		70	NA								
	50	trace coarse SAND		11	13 19 30	49		70	NA								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Groundwater Encountered at 23 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-07A**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	8-28-20	8-28-20	39.07654° / -121.52298°	TC-07B

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME David / HELPER'S NAME Nick/Tanner	EQUIPMENT CME 75	TOTAL DEPTH 51.5 ft
EXCAVATION METHOD Solid-Stem Auger/ Rotary Wash	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Tremie Cement Grout Backfill	GROUND WATER READINGS DURING 15.0 ft AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	0	ASPHALT CONCRETE (8.5")													
	0.7	AGGREGATE BASE (16")													
	2	Lean CLAY (CL); very stiff; dark brown; moist; few very fine SAND	1	5 5 5	10		50	2.25							
	6	reddish brown	2	3 4 10	14		100	3.75			24	9			
	8.5	Lean CLAY with SAND (CL); hard; yellowish brown; moist; little very fine SAND	3	16 50/6"	50/6"		60	>4.5							
	14	increasing SAND content													
	15	SANDY SILT (ML); (hard); mottled reddish brown and dark yellowish brown; wet; fines; fine SAND; some weak cementation	4	12 20 25	45		90	NA			NP	NP	51		
	17	Lean CLAY (CL); hard; yellowish brown; moist; few very fine SAND	5	11 19 19	38		70	4.5							
	23	SANDY SILT (ML); very stiff; brown; moist; some very fine SAND													

(continued)

BLACKBURN CONSULTING

PROJECT NAME OPUD South Yuba Sewer and Water	FILE NO. 3842.X	HOLE ID TC-07B
COUNTY YUB	ROUTE	POSTMILE
CLIENT Jacobs Engineering		
PREPARED BY LDM	CHECKED BY	SHEET 1 of 2

Depth (ft)	Description	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
25	SANDY SILT (ML) *(continued)*.	6	5 12 19	31		90	2.5			36	10			
26.5	Poorly GRADED SAND with CLAY (SP-SC); medium dense; dark brown; moist; fine to medium SAND													
30		7	17 25 27	52		100	NA					9		
32	switched to mud rotary													
33	Poorly GRADED SAND (SP); dense; dark brown; wet; fine to medium SAND													
35	medium dense; moist; trace fines	8	12 17 18	35		75	NA							
40	wet; few coarse SAND	9	12 13 9	22		80	NA							
44	CLAYEY SAND (SC); very dense; dark yellowish brown; moist; mostly fine SAND; some fines													
45		10	17 35 50/5.5"	85/11.5"		100	NA							
48	Poorly GRADED SAND (SP); medium dense; dark brown; moist; fine to medium SAND; trace fines													
50		11	12 17 19	36		100	NA							

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 15 ft bgs
Bulk A obtained 2-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-07B**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**8-27-20**	**8-27-20**	**39.07538° / -121.5213°**	**TC-08A**

CONTRACTOR	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Taber		

OPERATOR'S NAME	HELPER'S NAME	EQUIPMENT	TOTAL DEPTH
David	**Nick/Tanner**	**CME 75**	**51.5 ft**

EXCAVATION METHOD	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER
Solid-Stem Auger/ Rotary Wash		**4 in**

SAMPLER TYPE(S) AND SIZE(S) (ID)	HAMMER TYPE	HAMMER EFFICIENCY, ERi
CalMod (2.4")	**Safety semi-automatic drop (140#/ 30")**	

BACKFILL AND COMPLETION	GROUND WATER READINGS	DURING	AFTER (DATE)	CASING TYPE AND DIAMETER(in)
Tremie Cement Grout Backfill		**14.0 ft**		

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	0	ASPHALT CONCRETE (9")													
	0.75	AGGREGATE BASE (9")													
	1.5	Lean CLAY (CL); Very Stiff; Dark Brown; Moist; trace SAND													
	5–6.5		1	5 10 13	23		100	2.75							
	8.5	Lean CLAY with SAND (CL); Hard; Dark Yellowish Brown with Black Streaks; Moist; Little Fine SAND; Trace Fine GRAVEL													
	10–11.5		2	16 30 37	67		90	>4.5							
	14	CLAYEY SAND (SC); (Medium Dense); Mottled Dark Brown and Grayish Brown; Wet; Fine SAND; Little Fines													
	15–16.5		3	6 9 7	16		80	NA			28	15	17		
	15.75	Poorly-graded SAND with CLAY (SP-SC); Medium Dense; Mottled Dark Brown and Black; Wet; Fine to Medium SAND													
	18.5	Lean CLAY (CL); Stiff; Mottled Light Gray and Dark Yellowish Brown; Moist; Medium Plasticity													
	20–21.5		4	3 6 12	18		90	1.25							
	21.25	CLAYEY SAND (SC); Medium Dense; mottled light gray and dark yellow brown with black streaks; moist; little to some fines													
	24	Lean CLAY (CL); hard; bluish gray; moist; few fine SAND													

(continued)

DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
25	Lean CLAY (CL) *(continued)*.	5	3 13 37	50		100	>4.5					91		
29	Lean CLAY (CL); (stiff); dark gray; wet; few very fine SAND													
30		6	3 5 9	14		45	NA							
35	hard; moist; weak cementation	7	10 16 19	35		100	>4.5			27	12			
38	Poorly-graded SAND (SP); dense; mottled dark brown and black; moist; fine to medium SAND; trace fines													
40		8	15 19 24	43		70	NA							
45	very dense; wet	9	20 31 31	62		65	NA							
50		10	15 26 32	58		65	NA							

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 14 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME: **OPUD South Yuba Sewer and Water**		FILE NO.: **3842.X**	HOLE ID: **TC-08A**
COUNTY: **YUB**	ROUTE		POSTMILE
CLIENT: **Jacobs Engineering**			
PREPARED BY: **SS**	CHECKED BY: **DWC**		SHEET: **2 of 2**

LOGGED BY **LDM**	BEGIN DATE **8-27-20**	COMPLETION DATE **8-27-20**	LOCATION (Lat/Long or North/East and Datum) **39.07514° / -121.52096°**	HOLE ID **TC-08B**
CONTRACTOR **Taber**			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David**	HELPER'S NAME **Nick/Tanner**		EQUIPMENT **CME 75**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger / Mud Rotary**			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**			HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**			GROUND WATER READINGS — DURING **15.0 ft** — AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	0	ASPHALT CONCRETE (8")													
	0.7	AGGREGATE BASE (16")													
	2	Lean CLAY (CL); hard; dark brown; moist; trace fine GRAVEL	1	6 11 12	23		100	>4.5							
	4.5	Lean CLAY with SAND (CL); hard; dark yellowish brown; moist; little very fine SAND; some moderate cementation	2	8 12 22	34		70	>4.5							
	10.5	dark yellowish brown with gray streaks and black specks; increasing SAND content	3	6 9 10	19		50	2.75			30	17			
	15	Poorly-graded GRAVEL with CLAY and SAND (GP-GC); very dense; grayish brown; wet; mostly fine GRAVEL; little fine to coarse SAND; few fines	4	31 42 28	70		75	>4.5					9		
	16.3	SANDY Lean CLAY (CL); hard; mottled orangish brown and light gray; moist; some fine SAND													
	18.5	Lean CLAY with SAND (CL); (very stiff); bluish gray; moist; moderate cementation	5	3 8 16	24		100	NA							
	20.8	CLAYEY SAND (SC); medium dense; dark yellowish brown with orangish brown and grayish brown streaks and golden specks; wet													

Groundwater encountered during drilling at 15.0 ft.

(continued)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		Lean CLAY (CL); hard; grayish brown with orangish brown streaks; moist; few fine SAND		6	8 12 23	35		100	>4.5								
	28.5		SILTY SAND (SM); medium dense; dark brown with orangish brown streaks and golden specks; wet															
	30				7	9 12 15	27		100	3.25			NP	NP	43			
	31.2		SANDY Lean CLAY (CL); very stiff; grayish brown; moist; some fine SAND															
	34		CLAYEY SAND (SC); medium dense; grayish brown with orangish brown streaks; moist; mostly fine SAND															
	35				8	7 10 16	26		90	NA			27	11	49			
	40				9	7 10 15	25		0	NA								
	41		Poorly Graded SAND (SP); dense; yellowish brown and black with golden specks; wet; fine to medium SAND no recovery, switched to mud rotary															
	45				10	22 25 26	51		75	NA								
	50		very dense		11	26 34 42	76		75	NA								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Groundwater Encountered 15 ft bgs
Bulk A obtained 2-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-08B**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY **DWC**		SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	**8-26-20**	**8-26-20**	**39.07174° / -121.51609°**	**TC-09A**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David** / HELPER'S NAME **Nick/Tanner**	EQUIPMENT **CME 75**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**	GROUND WATER READINGS — DURING **25.0 ft** — AFTER (DATE) **24.0 ft on 8-26-20**	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (8")															
	1		AGGREGATE BASE (16")															
	2		Lean CLAY (CL); Hard; Dark Brown; Dry; Medium to High Plasticity															
	5–6.5				1	8 8 8	16		70	>4.5								
	10–11.5				2	16 9 9	18		95	NA			27	12	46			
	10.5		CLAYEY SAND (SC); Medium Dense; Dark Reddish Brown; Moist; Fine to Medium SAND															
	14		Lean CLAY (CL); Very Stiff; Reddish Brown; Moist; Trace Fine SAND															
	15–16.5				3	10 7 10	17		90	3.5			34	19				
	18		SANDY Lean CLAY (CL); (Stiff to Very Stiff); Olive; Moist; Some Fine through Coarse SAND; Few Fine GRAVEL															
	20–21.5				4	6 7 10	17		100	3.0								
	20.5		Lean CLAY with SAND (CL); Very Stiff; Olive; Moist; Little Fine SAND															
	25																	

(continued)

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-09A**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **SS**	CHECKED BY		SHEET **1 of 2**

BLACKBURN CONSULTING

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		Lean CLAY (CL); Stiff; Olive Gray; Moist; Interbedded Lenses of CLAYEY SAND (SC); (Medium Dense); Dark Yellowish Brown; Wet; Fine to Medium SAND; Few to Little Fines		5	5 6 6	12		100	1.75			38	17	56			
	30				6	4 6 9	15		100	2.75								
	33		SILTY SAND (SM); Medium Dense; Reddish Brown; Wet; Mostly Fine SAND; Some Medium SAND; Interbedded Lenses of SANDY SILT (ML); (Stiff); Reddish Brown; Moist; Some Fine SAND															
	35				7	8 10 13	23		85	NA			NP	NP	34			
	38		Lean CLAY (CL); Medium Stiff; Dark Reddish Brown; Moist; Little Weak Cementation															
	40				8	6 9 12	21		80	1.25 2.0								
	41		SANDY Lean CLAY/CLAYEY SAND (CL/SC); Stiff/Medium Dense; Dark Reddish Brown; Moist to Wet; Some Fine to Medium SAND; Some Weak Cementation															
	44		SANDY Lean CLAY (CL); Stiff; Dark Reddish Brown; Moist; Some Fine SAND															
	45				9	8 11 11	22		80	1.75								
	50		Some Fine to Medium SAND; Weak to Moderate Cementation		10	14 29 33	62		85	>4.5								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 25 ft bgs
Bulk A obtained 2-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-09A**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **SS**	CHECKED BY	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	**8-26-20**	**8-26-20**	**39.07146° / -121.5157°**	**TC-09B**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David** / HELPER'S NAME **Nick/Tanner**	EQUIPMENT **CME 75**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**	GROUND WATER READINGS — DURING **23.0 ft** — AFTER (DATE) **25.0 ft on 8-26-20**	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	0	ASPHALT CONCRETE (6")													
	0.5	AGGREGATE BASE (12")													
	1.5	Lean CLAY (CL); Hard; Dark Reddish Brown; Moist; Trace Medium SAND; Few Moderate Cementation													
	2–3.5		1	6 9 9	18		60	>4.5							
	4	SILTY CLAY (CL-ML); Hard; Dark Reddish Brown; Moist; Trace Medium SAND													
	5–6.5		2	5 6 8	14		90	>4.5			22	7			
	8	Lean CLAY (CL); Hard; Dark Yellowish Brown; Dry; Strong Cementation													
	10	Lean CLAY (CL); Hard; Dark Brown; Moist													
	10–11.5		3	9 8 8	16		80	>4.5							
	13	SANDY Lean CLAY (CL); Stiff; Olive Brown; Moist; Some Fine to Medium SAND													
	15–16.5		4	5 7 10	17		70	1.5 3.0							
	16	SANDY Lean CLAY with GRAVEL (CL); Very Stiff; Olive Brown; Moist; Some Fine to Medium SAND; Little Fine GRAVEL													
	19	Lean CLAY (CL); Hard; Mottled Olive Gray and Dark Reddish Brown; Moist; Medium Plasticity; Few Moderate to Strong Cementation													
	20–21.5		5	6 13 21	34		95	>4.5							
	23	CLAYEY SAND (SC); (Medium Dense); Dark Reddish Brown; Wet; Fine to Medium SAND; Some CLAY													
	25														

(continued)

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-09B**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **SS**	CHECKED BY		SHEET **1 of 2**

BLACKBURN CONSULTING

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		CLAYEY SAND (SC) *(continued)*.															
	26		Lean CLAY with SAND (CL); Very Stiff; Strong Brown; Some Weak Cementation		6	4 4 6	10		100	2.75	40	81	42	17			UC	
	29		SILTY SAND (SC); (Medium Dense); Dark Reddish Brown; Wet; Fine SAND; Some Fines															
	31		SILT (ML); Very Stiff; Dark Yellowish Brown; Moist		7	5 7 12	19		100	3.25	43	79	46	16			UC	
	34		SANDY Lean CLAY (CL); Very Stiff; Dark Yellowish Brown; Moist; Some Fine SAND															
	36				8	7 10 11	21		80	2.5								
	38		CLAYEY SAND (SC); Loose to Medium Dense; Dark Yellowish Brown; Wet															
	41				9	5 5 6	11		85	1.0								
	42				10	3 5 9	14		100	NA								
	45		SANDY Lean CLAY (CL); Very Stiff; Dark Yellowish Brown; Moist; Some Fine to Medium SAND		11	16 21 30	51		85	4.0								
	48		CLAYEY SAND (SC); Medium Dense; Dark Yellowish Brown; Wet; Fine to Medium SAND; Some Fines; Weak Cementation															
	51				12	8 9 12	21		85	1.5								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Groundwater Encountered at 25 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	3842.X	TC-09B

COUNTY	ROUTE	POSTMILE
YUB		

CLIENT: Jacobs Engineering

PREPARED BY	CHECKED BY	SHEET
SS		2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
SS	**9-2-20**	**9-2-20**	**39.06253° / -121.5029°**	**TC-10A**

Field	Value	Field	Value	Field	Value
CONTRACTOR	**Taber**	LOCATION (Offset, Station, Line)		SURFACE ELEVATION	
OPERATOR'S NAME	**Toby**	EQUIPMENT	**CME 75**	TOTAL DEPTH	**51.5 ft**
HELPER'S NAME	**Ernesto/Jason**				
EXCAVATION METHOD	**Solid-Stem Auger/ Rotary Wash**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH		BOREHOLE DIAMETER	**4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID)	**CalMod (2.4")**	HAMMER TYPE	**Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi	
BACKFILL AND COMPLETION	**Tremie Cement Grout Backfill**	GROUND WATER READINGS	DURING **24.0 ft**; AFTER (DATE)	CASING TYPE AND DIAMETER(in)	

DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Liquid Limit	Plasticity Index
0	ASPHALT CONCRETE (7")								
0.6	AGGREGATE BASE (10")								
1.4	SANDY Lean CLAY (CL); hard; reddish brown; dry; some fine through coarse SAND; few fine to coarse GRAVEL								
2–3.5		1	4 6 11	17		80	>4.5		
5–6.5		2	12 18 21	39		95	4.0		
5.3	Lean CLAY (CL); very stiff to hard; dark yellowish brown; dry; little fine SAND								
9	CLAYEY SAND (SC); medium dense; strong brown; moist; fine through coarse SAND; some fines								
10–11.5		3	8 9 14	23		100	2.0	47	29
15	SANDY SILT (ML); very stiff; olive; dry; some fine to medium SAND								
15–16.5		4	7 14 22	36		90	3.0		
19	Poorly Graded SAND with SILT (SP-SM); medium dense; dark yellowish brown; wet; fine through coarse SAND								
20–21.5		5	8 12 10	22		100	2.25		
23	Poorly-graded SAND (SP); medium dense; dark yellowish brown; moist; fine to medium SAND; interbedded lenses with few fines								

(continued)

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**TC-10A**
COUNTY: **YUB**	ROUTE	POSTMILE
CLIENT: **Jacobs Engineering**		
PREPARED BY: **LDM**	CHECKED BY	SHEET **1 of 2**

BLACKBURN CONSULTING

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		Poorly Graded SAND (SP) *(continued)*.		6	10 13 15	28		100	NA								
	26		SANDY SILT (ML); very stiff; dark yellowish brown; moist; some very fine SAND															
	29		SILTY SAND (SM); dense; mottled dark yellowish brown and olive gray; moist; fine SAND; some fines															
	30				7	13 22 27	49		100	>4.5					43			
	33		switched to mud rotary															
	35		dark yellowish brown; fine to medium SAND; little fines		8	13 22 27	49		100	>4.5			NP	NP			UC	
	38		Poorly Graded SAND (SP); medium dense; dark yellowish brown; wet; fine to medium SAND; trace fines															
	40				9	12 16 15	31		85	NA								
	42		SILTY SAND (SM); medium dense; dark yellowish brown; moist; fine to medium SAND; little fines															
	43		Poorly Graded SAND (SP); medium dense; gray; wet; fine to medium SAND															
	45				10	15 16 18	34		95	NA								
	50		fine through coarse SAND; trace GRAVEL in shoe		11	20 29 30	59		80	NA								

Depth scale: 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 24 ft bgs
Bulk A obtained 1.4-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**TC-10A**

COUNTY	ROUTE	POSTMILE
YUB		

CLIENT
Jacobs Engineering

PREPARED BY	CHECKED BY	SHEET
LDM		**2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	8-25-20	8-25-20	39.06202° / -121.50216°	TC-10B

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME: David / HELPER'S NAME: Nick/Tanner	EQUIPMENT CME 75	TOTAL DEPTH 51.5 ft
EXCAVATION METHOD Solid-Stem Auger/ Rotary Wash	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Tremie Cement Grout Backfill	GROUND WATER READINGS: DURING 24.0 ft; AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	0	Lean CLAY (CL); Stiff; Reddish Brown; Moist; Medium Plasticity													
	2.5		1	3 4 5	9		60	1.0							
	5.5		2	2 2 3	5		80	1.25							
	8	SANDY Lean CLAY (CL); (Very Stiff); Reddish Brown; Moist													
	10	Lean CLAY (CL); Hard; Dark Yellowish Brown; Moist; Weakly Cemented	3	14 31 32	63		90	>4.5							
	14	Well Graded GRAVEL with CLAY and SAND (GW-GC); Very Dense; Dark Yellowish Brown; Moist; Fine to Coarse GRAVEL; Some Fine through Coarse SAND	4	33 30 45	75		80	NA					11		
	17	Lean CLAY with SAND (CL); Hard; Yellowish Brown; Moist; Little Fine to Medium Sand													
	20.5		5	10 14 19	33		100	4.0			46	21			
	24	SILTY SAND (SM); Medium Dense; Dark Olive Brown; Wet; Fine to Medium SAND; Little SILT													

(continued)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	25	SILTY SAND (SM) *(continued)*.	6	7 8 9	17		95	NA			NP	NP	19		
	29	SANDY Lean CLAY (CL); Hard; Dark Yellowish Brown; Moist; Some Fine to Medium SAND													
	30		7	20 23 23	46		100	4.5 2.0			27	10			
	31	Lean CLAY (CL); Stiff; Dark Yellowish Brown; Moist; Trace SAND; Some Moderate Cementation													
	35	Hard	8	16 24 30	54		100	>4.5							
	38	SILTY SAND (SM); Dense; Dark Yellowish Brown; Moist; Mostly Fine to Medium SAND; Some SILT													
	40		9	16 18 18	36		100	NA							
	43	Poorly-graded SAND (SP); Dense; Olive Gray; Moist; Fine to Medium SAND; Interbedded Lens of SANDY SILT (ML)													
	45		10	15 16 22	38		100	NA							
	50	Little Coarse SAND	11	13 14 16	30		60	NA							

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 24 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**TC-10B**
COUNTY: **YUB**	ROUTE	POSTMILE
CLIENT: **Jacobs Engineering**		
PREPARED BY: **SS**	CHECKED BY	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
SS	**9-9-20**	**9-9-20**	**39.05402° / -121.51507°**	**TC-12A**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Rick** / HELPER'S NAME **Nick/Mike**	EQUIPMENT **Diedrich D120**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger/ Rotary Wash**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**	GROUND WATER READINGS: DURING **24.0 ft**; AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (3')															
			AGGREGATE BASE (4")															
	1		Lean CLAY (CL); very stiff; dark yellowish brown; moist; few fine SAND															
	2.5–4				1	6 8 12	20		100	2.25								
	5		some cementation; few fine through coarse SAND		2	5 8 13	21		85	1.25			40	26				
	6		Lean CLAY (CL); stiff; mottled dark yellowish brown and olive; moist; few very fine to fine SAND; trace cementation															
	10		SILT with SAND (ML); very stiff; dark yellowish brown; moist; little fine SAND; black specks (organics?)		3	3 6 8	14		85	2.0								
	15		CLAYEY SAND (SC); medium dense; dark yellowish brown; moist; fine to medium SAND; some fines		4	4 7 9	16		100	NA								
	20		Poorly Graded SAND with SILT (SP-SM); medium dense; dark brown; moist; fine to medium SAND; few fines		5	9 11 13	24		85	NA			NP	NP	9			
	24		▽															
	25																	

(continued)

BLACKBURN CONSULTING	PROJECT NAME **OPUD South Yuba Sewer and Water**	FILE NO. **3842.X**	HOLE ID **TC-12A**
	COUNTY **YUB**	ROUTE	POSTMILE
	CLIENT **Jacobs Engineering**		
	PREPARED BY **LDM**	CHECKED BY	SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		fine through coarse SAND; wet Poorly Graded SAND with SILT (SP-SM) *(continued)*.		6	4 7 12	19		60	NA								
	27		switched to mud rotary															
	30		SILT (ML); hard; yellowish brown; moist; trace fine SAND; weak cementation		7	8 15 23	38		95	>4.5			42	11				
	35		olive brown		8	20 50/4"	50/4"		100	>4.5								
	40		Poorly Graded SAND with SILT (SP-SM); very dense; dark brown; wet; fine to medium SAND; few fines		9	16 24 31	55		65	NA								
	45		dense; lenses of SILT with SAND (ML); (stiff); olive brown; moist; little fine SAND		10	18 20 22	42		65	NA								
	50				11	14 19 24	43		65	NA								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 24 ft bgs
Bulk A obtained 0.6-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**TC-12A**

COUNTY	ROUTE	POSTMILE
YUB		

CLIENT
Jacobs Engineering

PREPARED BY	CHECKED BY	SHEET
LDM		**2 of 2**

LOGGED BY: **DWC** / BEGIN DATE: **9-9-20** / COMPLETION DATE: **9-9-20**	LOCATION (Lat/Long or North/East and Datum): **39.05476° / -121.51507°**		HOLE ID: **TC-12B**
CONTRACTOR: **Taber**	LOCATION (Offset, Station, Line)		SURFACE ELEVATION
OPERATOR'S NAME: **Chad** / HELPER'S NAME: **Caleb/Cody**	EQUIPMENT: **CME 75**		TOTAL DEPTH: **51.5 ft**
EXCAVATION METHOD: **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH		BOREHOLE DIAMETER: **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID): **CalMod (2.4")**	HAMMER TYPE: **Safety semi-automatic drop (140#/ 30")**		HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION: **Tremie Cement Grout Backfill**	GROUND WATER READINGS — DURING: **17.0 ft**	AFTER (DATE): **18.0 ft on 9-9-20**	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (7")															
	1	AGGREGATE BASE (12")															
	2	Lean CLAY (CL); hard; dark gray; moist; few fine to medium SAND															
	5			1	10 22 36	58		85	>4.5								
	6	Lean CLAY (CL); hard; reddish brown; moist; few fine SAND; few moderate cementation															
	9	SILT with SAND (ML); hard; dark yellowish brown; dry; little fine to medium SAND															
	10			2	24 50/4"	50/4"		100	>4.5								
	15	fine SAND; some strong cementation		3	23 50/4"	50/4"		90	>4.5			43	15				
	17	▽															
	18	▼															
	20	trace cementation		4	9 15 20	35		85	4.5								
	22	CLAYEY SAND (SC); (medium dense); dark yellowish brown; wet; fine to medium SAND; some fines															
	25																

(continued)

BLACKBURN CONSULTING	PROJECT NAME: **OPUD South Yuba Sewer and Water**	FILE NO.: **3842.X**	HOLE ID: **TC-12B**
	COUNTY: **YUB**	ROUTE	POSTMILE
	CLIENT: **Jacobs Engineering**		
	PREPARED BY: **LDM**	CHECKED BY	SHEET: **1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		CLAYEY SAND (SC) *(continued)*.															
	26		Lean CLAY (CL); hard; olive gray; moist		5	7 12 20	32		95	4.0								
	29		SILT (ML); hard; mottled dark yellowish brown and brown; moist; few fine SAND															
	31				6	15 28 45	73		85	>4.5			39	8			UC	
	33		SILTY SAND (SM); hard; mottled dark olive gray and dark brown; moist															
	36				7	26 23 24	47		100	>4.5			NP	NP	46			
	37		Poorly Graded SAND (SP); (dense); dark gray; wet															
	40		SANDY SILT (ML); very stiff; dark gray; moist; some fine SAND		8	15 25 38	63		100	2.0								
	41		SILTY SAND (SM); very dense; dark gray; moist; fine to medium SAND; little fines															
	44		Poorly Graded SAND (SP); dense; dark gray; wet; fine to medium SAND; trace fines															
	46				9	9 23 31	54		60	NA								
	51				10	8 20 36	56		95	NA								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 17 ft bgs
Bulk A obtained 1.5-5 ft bgs

Tremie Cement Grout Backfill

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
SS	**9-8-20**	**9-8-20**	**39.03709° / -121.51498°**	**TC-13**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Rick** / HELPER'S NAME **Nick/Mike**	EQUIPMENT **Diedrich D120**	TOTAL DEPTH **51.4 ft**
EXCAVATION METHOD **Solid-Stem Auger/ Rotary Wash**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**	GROUND WATER READINGS — DURING **28.0 ft** — AFTER (DATE) **26.0 ft on 9-8-20**	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	0	ASPHALT CONCRETE (6.5")													
	0.5	AGGREGATE BASE (12")													
	2	SILT (ML); very stiff; dark brown; moist													
	2.5		1	5 6 7	13		80	2.25							
	5		2	3 4 6	10		95	1.75							
	5.5	Lean CLAY (CL); stiff; dark yellowish brown; moist; trace fine SAND													
	10	SILT (ML); hard; grayish brown; dry; few fine SAND; little cementation	3	18 50/4"	50/4"		90	>4.5							
	15	light brown	4	8 19 27	46		85	>4.5							
	20	trace cementation	5	10 14 19	33		100	4.0							
	25														

(continued)

BLACKBURN CONSULTING	PROJECT NAME **OPUD South Yuba Sewer and Water**	FILE NO. **3842.X**	HOLE ID **TC-13**
	COUNTY **YUB**	ROUTE	POSTMILE
	CLIENT **Jacobs Engineering**		
	PREPARED BY **LDM**	CHECKED BY	SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	25	SILT (ML); hard; mottled grayish brown and yellowish brown; moist; trace; fine SAND	6	16 47 50/4"	97/10"		100	>4.5							
	30		7	10 17 30	47		90	>4.5							
	32	switched to mud rotary													
	35	SANDY SILT (ML); hard; dark brown; moist; some very fine SAND; trace cementation	8	13 30 50/5.5"	80/11.5"		100	>4.5							
	40	SILTY SAND (SM); dense; dark brown; wet; very fine to fine SAND; some fines; interbedded lenses of fines	9	12 22 33	55		90	NA							
	45		10	15 26 31	57		85	2.75							
	46	SILT (ML); very stiff; light brown; moist													
	50	Poorly Graded SAND with SILT (SP-SM); very dense; dark brown; wet; fine through coarse SAND; few fines	11	22 41 50/5"	91/11"		90	NA							

Laboratory Data

Bottom of exploration at 51.4 ft below ground surface (bgs)

Goundwater Encountered at 28 ft bgs
Bulk A obtained 1.5-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	3842.X	TC-13
COUNTY: YUB	ROUTE	POSTMILE
CLIENT: Jacobs Engineering		
PREPARED BY: LDM	CHECKED BY	SHEET 2 of 2

LOGGED BY **DWC**	BEGIN DATE **9-8-20**	COMPLETION DATE **9-8-20**	LOCATION (Lat/Long or North/East and Datum) **39.05742° / -121.49553°**	HOLE ID **TC-14**
CONTRACTOR **Taber**			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Chad**	HELPER'S NAME **Caleb/Cody**		EQUIPMENT **CME 75**	TOTAL DEPTH **41.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**			HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**			GROUND WATER READINGS — DURING **28.0 ft** — AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (8")															
	1		AGGREGATE BASE (2")															
			Lean CLAY (CL); hard; brown; dry; trace fine SAND															
	3				1	20 36 29	65		60	>4.5								
	4		Lean CLAY with SAND (CL); hard; brown; moist; little fine to medium SAND															
	5–6		dry		2	10 50/4"	50/4"		90	>4.5								
	11		dark yellowish brown; moist; some moderate to strong cementation		3	12 28 50/6"	78/12"		80	>4.5								
	14		SILTY SAND (SM); dense; dark yellowish brown; moist; fine SAND; some fines															
	16				4	12 19 28	47		65	NA								
	20		Poorly Graded SAND (SP); medium dense to dense; olive gray; moist; fine to medium SAND; trace coarse SAND		5	12 16 16	32		90	NA								
	24		CLAYEY GRAVEL with SAND (GC); very dense; gray; dry; some fine GRAVEL; some fine through coarse SAND; little fines															
	25																	

(continued)

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-14**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		CLAYEY GRAVEL with SAND (GC) *(continued)*.		6	23 50/3"	50/3"		100	NA								
	29		CLAYEY SAND with GRAVEL (SC); dense; gray; wet; mostly fine to medium SAND; little fines; few fine GRAVEL; few coarse SAND															
	30				7	17 22 27	49		45	NA								
	34		CLAYEY SAND (SC); very dense; gray; moist; fine to medium SAND; some fines; trace fine GRAVEL															
	35				8	14 23 49	72		45	NA								
	38		Lean CLAY (CL); (stiff); dark yellowish brown; moist; trace fine SAND															
	40				9	10 11 11	22		30									

Bottom of exploration at 41.5 ft below ground surface (bgs)

Goundwater Encountered at 28 ft bgs

Tremie Cement Grout Backfill

PROJECT NAME **OPUD South Yuba Sewer and Water**	FILE NO. **3842.X**	HOLE ID **TC-14**
COUNTY **YUB**	ROUTE	POSTMILE
CLIENT **Jacobs Engineering**		
PREPARED BY **LDM**	CHECKED BY	SHEET **2 of 2**

BLACKBURN CONSULTING

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 10/21/20

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
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Date Reported 10/21/2020
Date Submitted 10/15/2020

To: Dan Contreras
Blackburn Consulting (W.SAC)
2491 Boatman Ave
West Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney RH
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : OS-2-3B.
Thank you for your business.

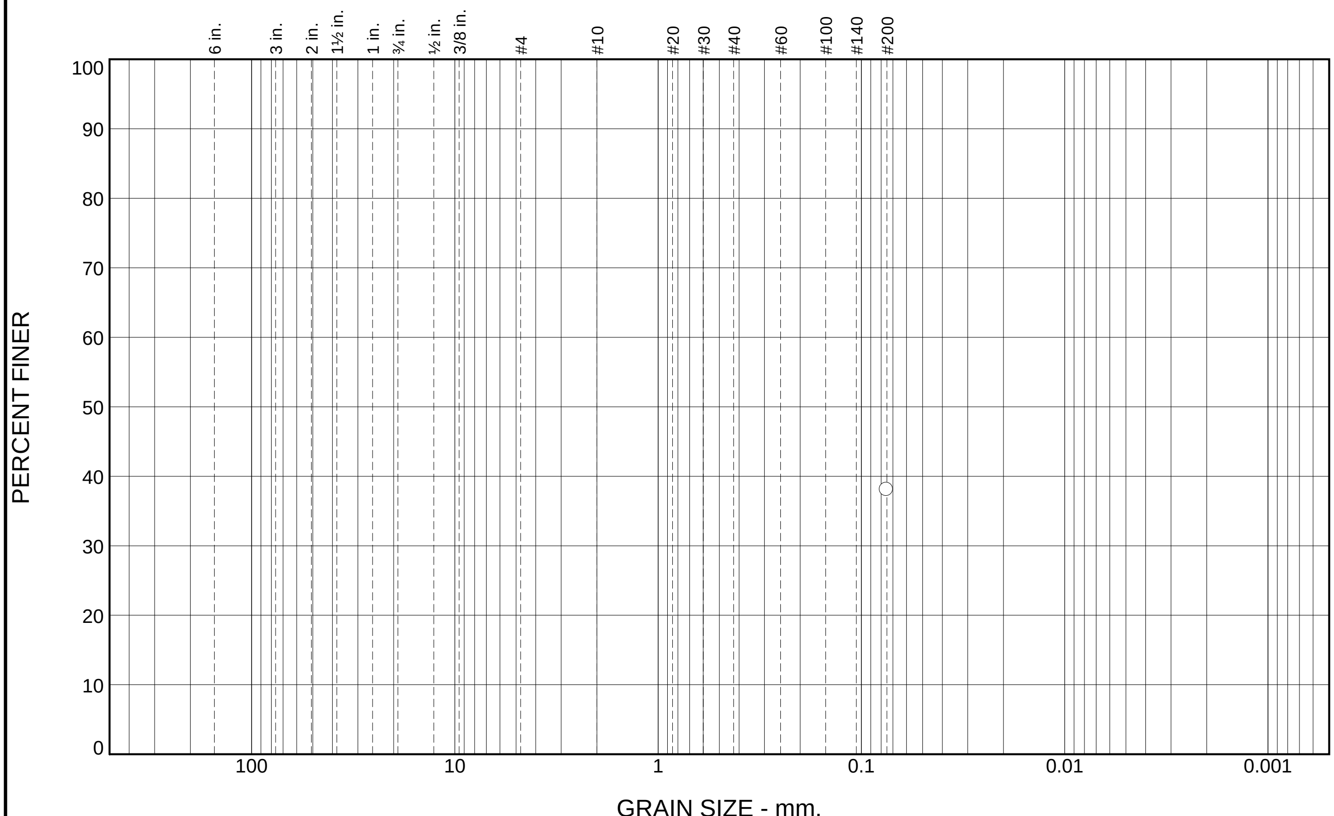
* For future reference to this analysis please use SUN # 83257-173751.

EVALUATION FOR SOIL CORROSION

Soil pH	6.92		
Moisture	26.5 %		
Minimum Resistivity	0.99 ohm-cm (x1000)		
Chloride	17.9 ppm	00.00179 %	
Sulfate	8.5 ppm	00.00085 %	
Redox Potential	(+) 208 mv		
Sulfides	Presence - NEGATIVE		

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m
Redox Potential ASTM G-200m, Sulfides AWWA C105/A25.5

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						38.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	38.1		

* (no specification provided)

Soil Description

CLAYEY SAND, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

Source of Sample: OS-1 **Depth:** 10.25-10.75'
Sample Number: 3C **Date:**

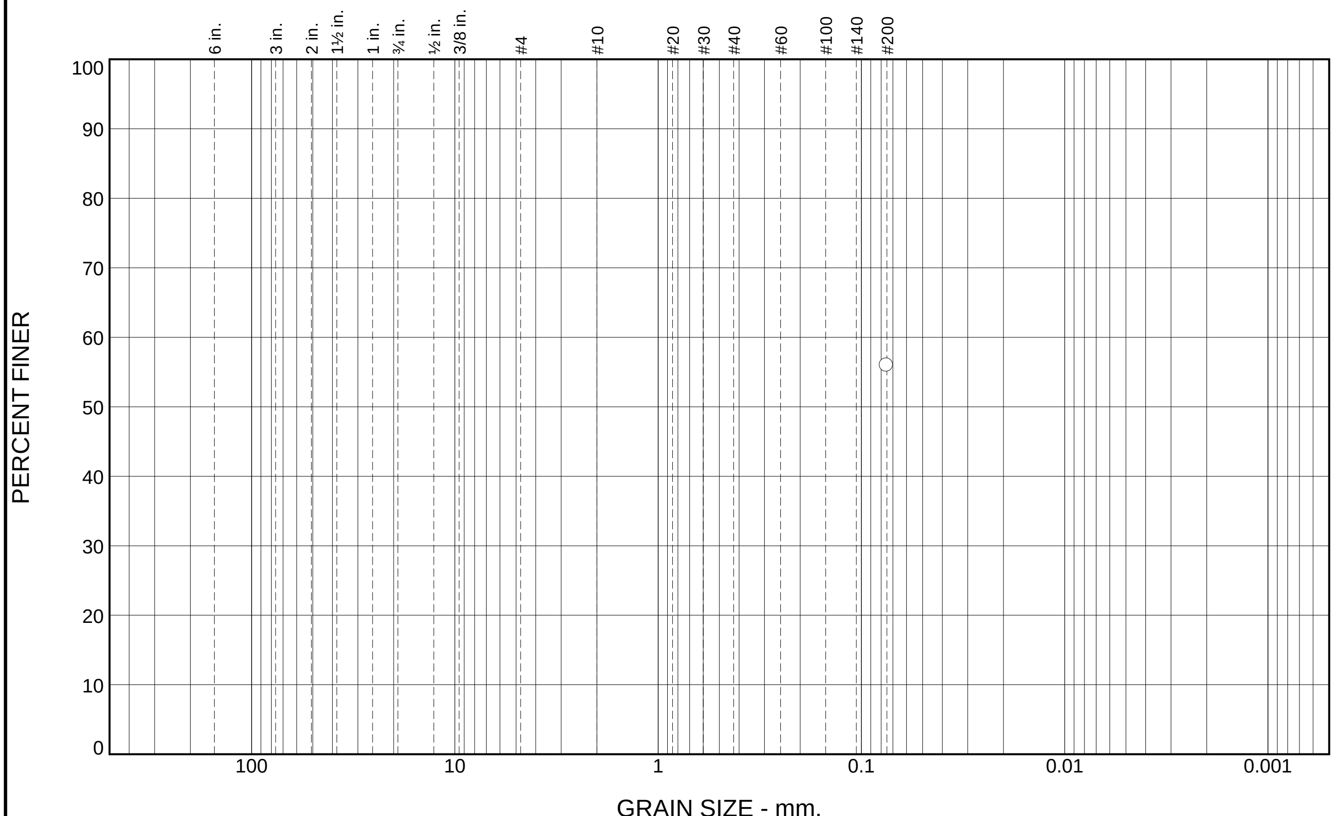
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						56.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	56.0		

* (no specification provided)

Soil Description

SANDY lean CLAY, olive gray

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

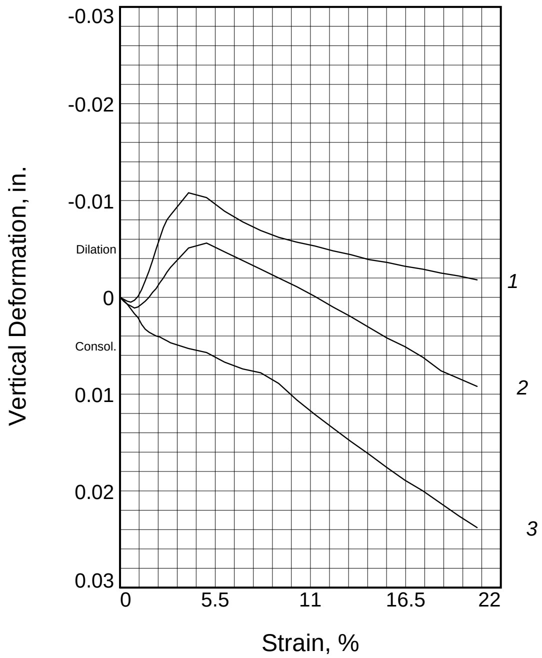
Classification

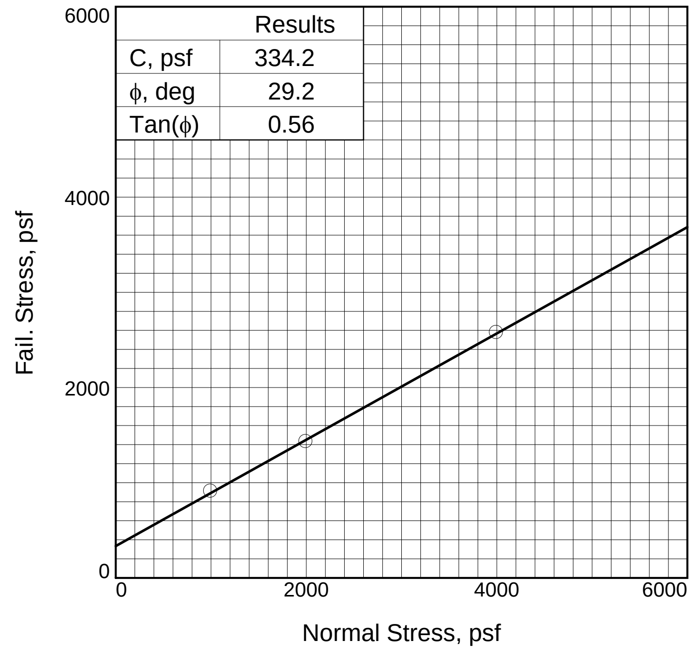
USCS= CL AASHTO=

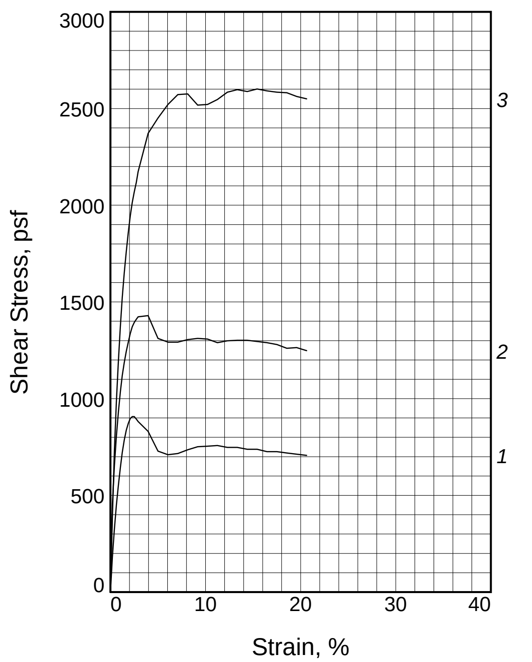
Remarks

Source of Sample: OS-2 **Depth:** 21-21.5'
Sample Number: 4C **Date:**

Blackburn Consulting	**Client:** Jacobs Engineering Group Inc.
	Project: OPUD South Yuba Sewer Infrastructure
W. Sacramento, CA	**Project No:** 3842.X **Figure**







	Sample No.	1	2	3
Initial	Water Content, %	19.1	23.9	24.8
	Dry Density, pcf	102.1	98.1	98.1
	Saturation, %	79.4	89.9	93.4
	Void Ratio	0.6509	0.7185	0.7180
	Diameter, in.	2.400	2.400	2.400
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	23.5	25.4	24.7
	Dry Density, pcf	103.1	100.0	101.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.6346	0.6862	0.6666
	Diameter, in.	2.400	2.400	2.400
	Height, in.	0.990	0.981	0.970
Normal Stress, psf		1000.0	2000.0	4000.0
Fail. Stress, psf		907.2	1429.2	2575.1
Strain, %		2.3	4.0	8.1
Ult. Stress, psf				
Strain, %				
Strain rate, in./min.		0.003	0.003	0.003

Sample Type: 2.4" Cal Mod

Description: CLAYEY SAND, dark yellowish brown

Assumed Specific Gravity= 2.7

Remarks:

Figure ________

Client: Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

Source of Sample: P-1 **Depth:** 16-16.5'

Sample Number: 3C

Proj. No.: 3842.X **Date Sampled:**

DIRECT SHEAR TEST REPORT

Blackburn Consulting

W. Sacramento, CA

Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	P-11-3C
Type of Sample:	2.4" Cal Mod
Sample Description:	SANDY SILT, reddish brown
Depth:	11-11.5’

Sample Data

Sample Length:	5.16	in	Sample + Tube:	738	g
Diameter:	2.41	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.15		Sample Weight:	738	g
Sample Area:	4.55	in^2	Wet Density:	119.8	pcf
Sample Volume:	23.5	in^3	Moisture:	18	%
Specific Gravity:	2.65	(assumed)	Dry Density:	101.8	pcf
			Saturation:	75.1	%

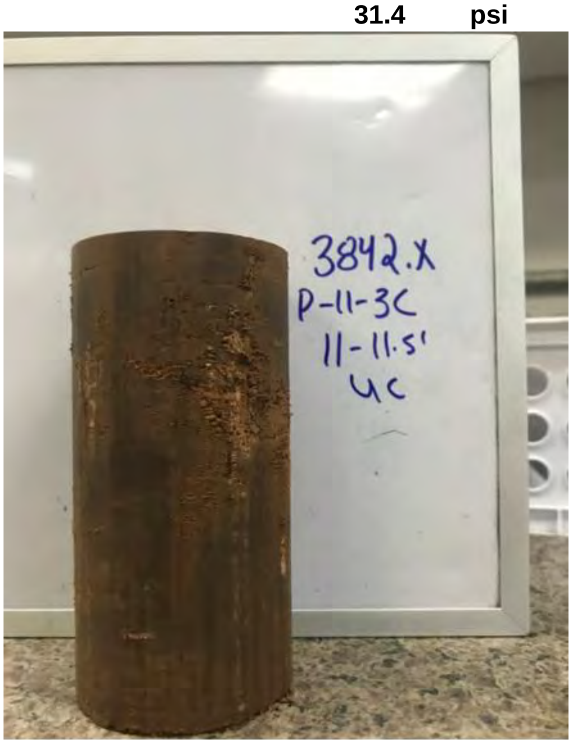
**Moisture content taken after test*

Test Results

Rate of Strain:	0.0300	in/min
Deflection at Max. Load:	0.072	in
Maximum Load:	145	lbs
Strain at Failure:	1.39	%
Average cross-sectional area at failure:	4.61	in^2
Compressive Strength:	**2.26**	**tsf**
	31.4	**psi**

Strain Information

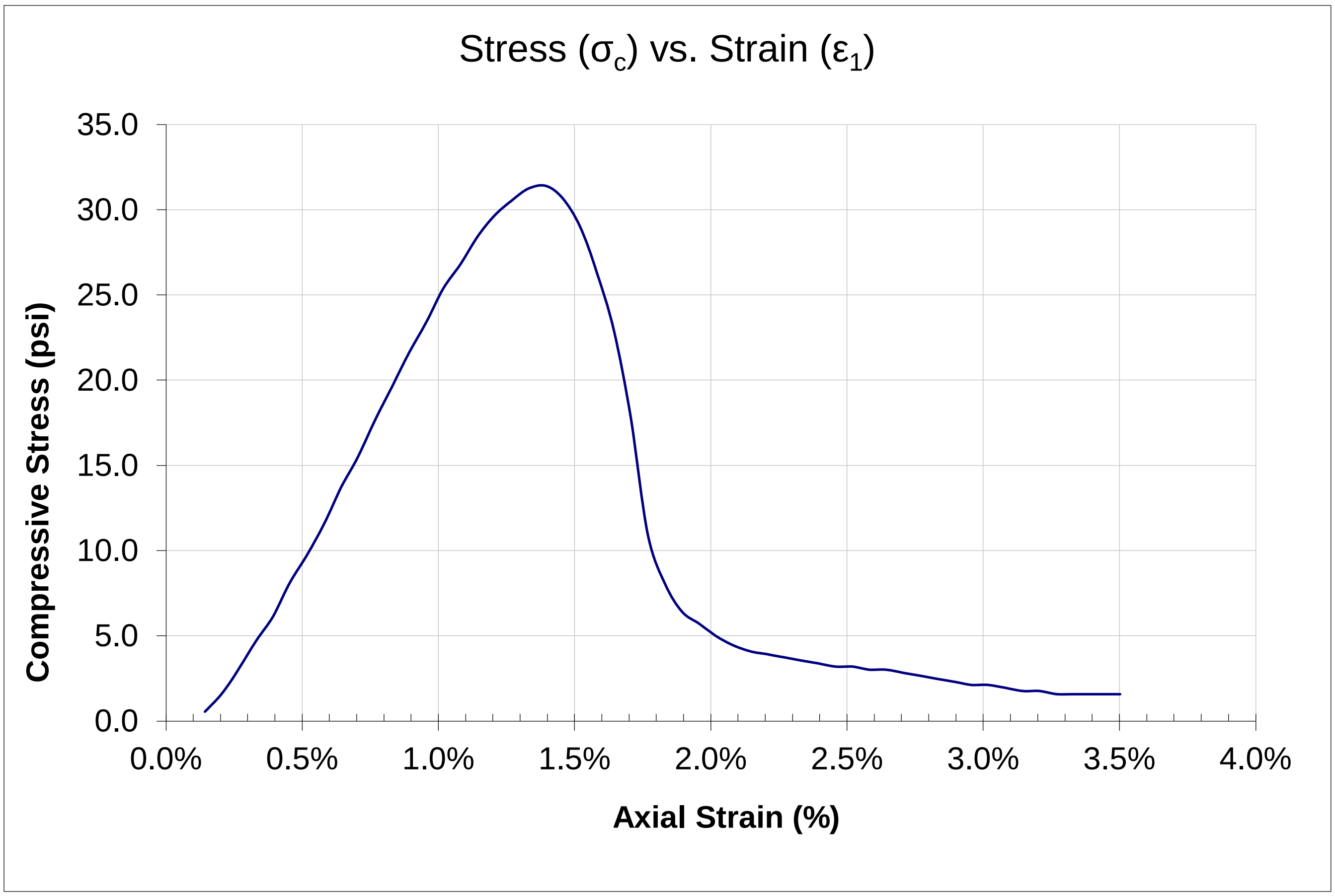
Rate of Strain ½%:	0.026	in/min
Rate of Strain 2%:	0.103	in/min
Strain Rate:	0.030	in/min
15% Strain:	0.774	in



Unconfined Compression
ASTM D 2166

Project Name: OPUD
Project Number: 3842.X
Sample ID: P-11-3C
Type of Sample: 2.4" Cal Mod
Sample Description: SANDY SILT, reddish brown
Depth: 11-11.5’

Compressive Strength:	**2.26**	**tsf**
	31.4	**psi**



Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	P-14, 2C
Type of Sample:	2.4" Cal Mod
Sample Description:	SANDY lean CLAY, strong brown
Depth:	6-6.5'

Sample Data

Sample Length:	5.39	in	Sample + Tube:	868	g
Diameter:	2.40	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.25		Sample Weight:	868	g
Sample Area:	4.53	in^2	Wet Density:	135.4	pcf
Sample Volume:	24.4	in^3	Moisture:	16.3	%
Specific Gravity:	2.65	(assumed)	Dry Density:	116.4	pcf
			Saturation:	102.9	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0300	in/min
Deflection at Max. Load:	0.136	in
Maximum Load:	215	lbs
Strain at Failure:	2.52	%
Average cross-sectional area at failure:	4.64	in^2
Compressive Strength:	**3.34**	**tsf**
	46.3	**psi**

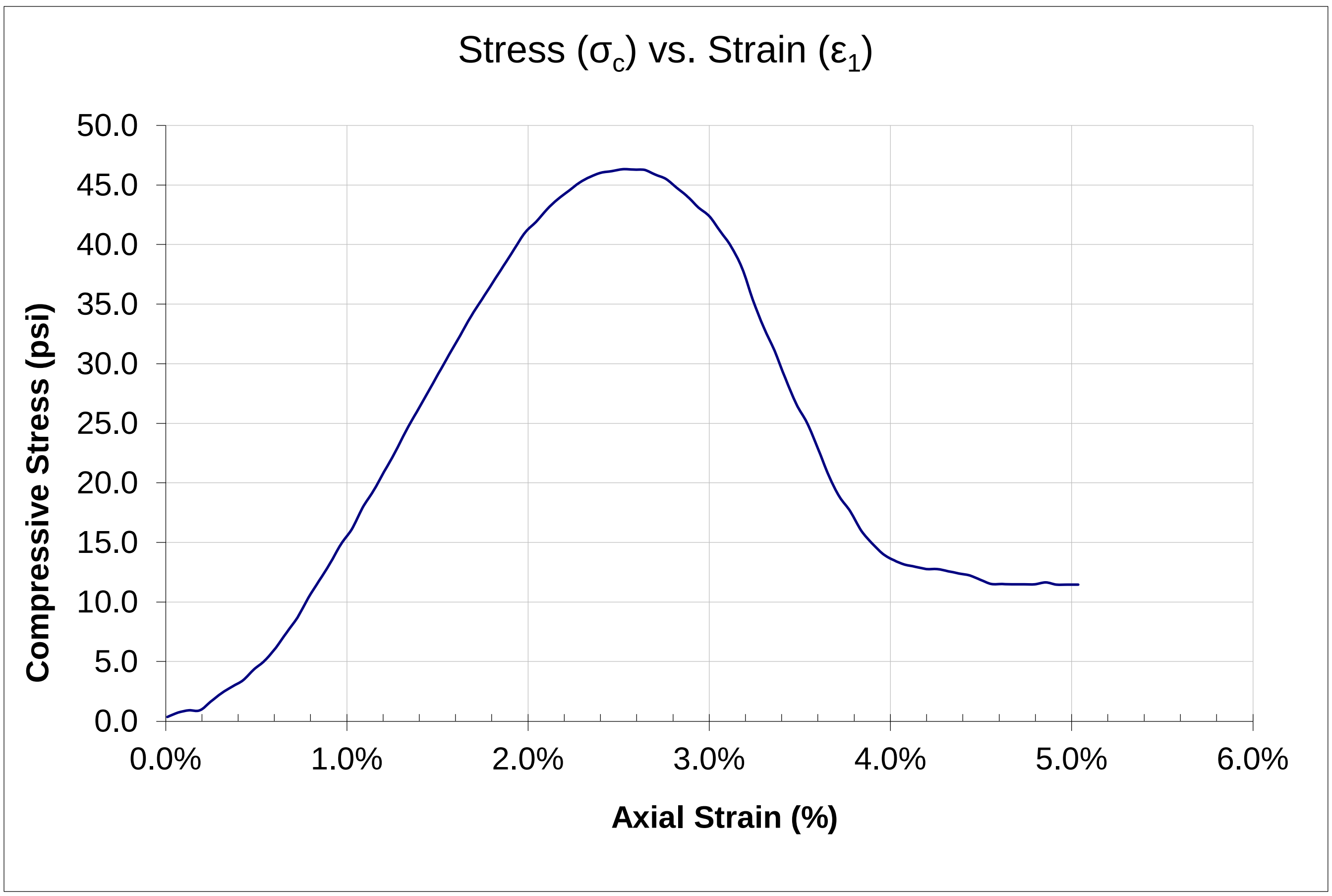
Strain Information

Rate of Strain ½%:	0.027	in/min
Rate of Strain 2%:	0.108	in/min
Strain Rate:	0.030	in/min
15% Strain:	0.809	in

Unconfined Compression
ASTM D 2166

Project Name: OPUD
Project Number: 3842.X
Sample ID: P-14, 2C
Type of Sample: 2.4" Cal Mod
Sample Description: SANDY lean CLAY, strong brown
Depth: 6-6.5’

Compressive Strength:	**3.34**	**tsf**
	46.3	**psi**



Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	P-15, 2C
Type of Sample:	2.4" Cal Mod
Sample Description:	SANDY lean CLAY, strong brown
Depth:	6-6.5’

Sample Data

Sample Length:	5.46	in	Sample + Tube:	846	g
Diameter:	2.39	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.28		Sample Weight:	846	g
Sample Area:	4.49	in^2	Wet Density:	131.4	pcf
Sample Volume:	24.5	in^3	Moisture:	14.4	%
Specific Gravity:	2.65	(assumed)	Dry Density:	114.9	pcf
			Saturation:	86.8	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0300	in/min
Deflection at Max. Load:	0.153	in
Maximum Load:	454	lbs
Strain at Failure:	2.79	%
Average cross-sectional area at failure:	4.62	in^2
Compressive Strength:	**7.08**	**tsf**
	98.4	**psi**

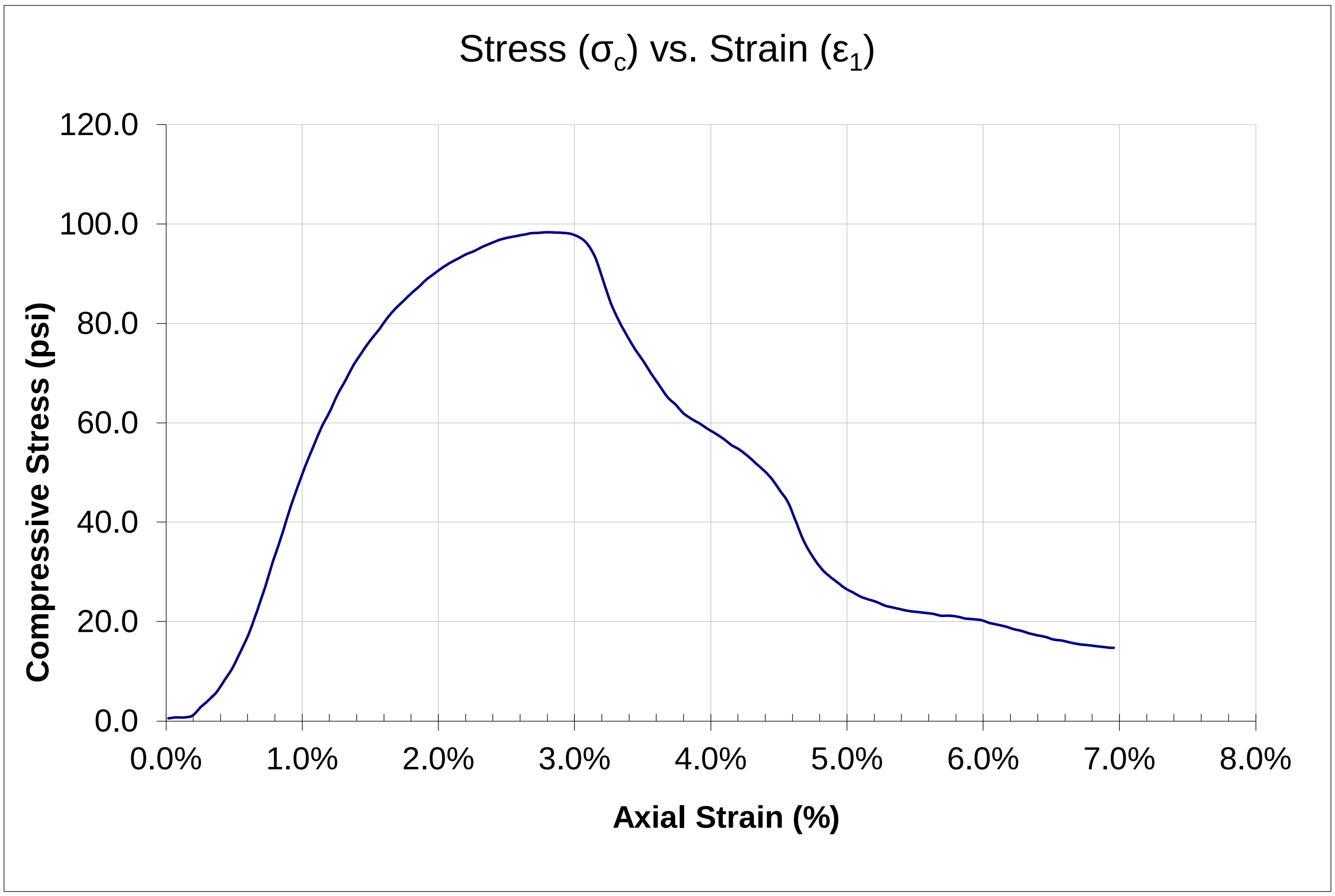
Strain Information

Rate of Strain ½%:	0.027	in/min
Rate of Strain 2%:	0.109	in/min
Strain Rate:	0.030	in/min
15% Strain:	0.819	in

Unconfined Compression
ASTM D 2166

Project Name: OPUD
Project Number: 3842.X
Sample ID: P-15, 2C
Type of Sample: 2.4" Cal Mod
Sample Description: SANDY lean CLAY, strong brown
Depth: 6-6.5’

Compressive Strength:	**7.08**	**tsf**
	98.4	**psi**



Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/30/2020
Date Submitted 09/23/2020

To: Rob Pickard
Blackburn Consulting (W.SAC)
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : P-2-3C.
Thank you for your business.

* For future reference to this analysis please use SUN # 83095-173433.

EVALUATION FOR SOIL CORROSION

Soil pH	6.02	
Minimum Resistivity	2.04 ohm-cm (x1000)	
Chloride	15.4 ppm	00.00154 %
Sulfate	4.1 ppm	00.00041 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/30/2020
Date Submitted 09/23/2020

To: Rob Pickard
Blackburn Consulting (W.SAC)
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : P-4-4C.
Thank you for your business.

* For future reference to this analysis please use SUN # 83095-173434.

EVALUATION FOR SOIL CORROSION

Soil pH	6.03	
Minimum Resistivity	3.22 ohm-cm (x1000)	
Chloride	6.7 ppm	00.00067 %
Sulfate	0.2 ppm	00.00002 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/30/2020
Date Submitted 09/23/2020

To: Rob Pickard
Blackburn Consulting (W.SAC)
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney RA
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : P-7-3B.
Thank you for your business.

* For future reference to this analysis please use SUN # 83095-173435.

EVALUATION FOR SOIL CORROSION

Soil pH	6.33		
Minimum Resistivity	1.42 ohm-cm (x1000)		
Chloride	9.1 ppm	00.00091	%
Sulfate	5.0 ppm	00.00050	%

METHODS

pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/30/2020
Date Submitted 09/23/2020

To: Rob Pickard
Blackburn Consulting (W.SAC)
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : P-8-3B.
Thank you for your business.

* For future reference to this analysis please use SUN # 83095-173436.

EVALUATION FOR SOIL CORROSION

Soil pH	6.24		
Minimum Resistivity	1.15	ohm-cm (x1000)	
Chloride	3.1 ppm	00.00031	%
Sulfate	19.8 ppm	00.00198	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/30/2020
Date Submitted 09/23/2020

To: Rob Pickard
Blackburn Consulting (W.SAC)
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney RA
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : P-11-3B.
Thank you for your business.

* For future reference to this analysis please use SUN # 83095-173437.

EVALUATION FOR SOIL CORROSION

Soil pH	7.09	
Minimum Resistivity	1.23 ohm-cm (x1000)	
Chloride	17.4 ppm	00.00174 %
Sulfate	40.7 ppm	00.00407 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/30/2020
Date Submitted 09/23/2020

To: Rob Pickard
Blackburn Consulting (W.SAC)
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : P-16-3C.
Thank you for your business.

* For future reference to this analysis please use SUN # 83095-173438.

EVALUATION FOR SOIL CORROSION

Soil pH	7.26		
Minimum Resistivity	1.63	ohm-cm (x1000)	
Chloride	2.2 ppm	00.00022	%
Sulfate	7.5 ppm	00.00075	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/30/2020
Date Submitted 09/23/2020

To: Rob Pickard
Blackburn Consulting (W.SAC)
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney RH
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : P-18-4B.
Thank you for your business.

* For future reference to this analysis please use SUN # 83095-173439.

EVALUATION FOR SOIL CORROSION

Soil pH	7.25		
Minimum Resistivity	0.91 ohm-cm (x1000)		
Chloride	10.9 ppm	00.00109	%
Sulfate	31.5 ppm	00.00315	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/30/2020
Date Submitted 09/23/2020

To: Rob Pickard
Blackburn Consulting (W.SAC)
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney RA
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : P-24-2B.
Thank you for your business.

* For future reference to this analysis please use SUN # 83095-173440.

EVALUATION FOR SOIL CORROSION

Soil pH	7.18		
Minimum Resistivity	1.02	ohm-cm (x1000)	
Chloride	1.3 ppm	00.00013	%
Sulfate	40.6 ppm	00.00406	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/30/2020
Date Submitted 09/23/2020

To: Rob Pickard
Blackburn Consulting (W.SAC)
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney RA
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : P-28-1C.
Thank you for your business.

* For future reference to this analysis please use SUN # 83095-173441.

EVALUATION FOR SOIL CORROSION

Soil pH	6.58		
Minimum Resistivity	1.07	ohm-cm (x1000)	
Chloride	2.5 ppm	00.00025	%
Sulfate	30.0 ppm	00.00300	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/30/2020
Date Submitted 09/23/2020

To: Rob Pickard
Blackburn Consulting (W.SAC)
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney RA
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3842.X OPUD Site ID : P-32-3B.
Thank you for your business.

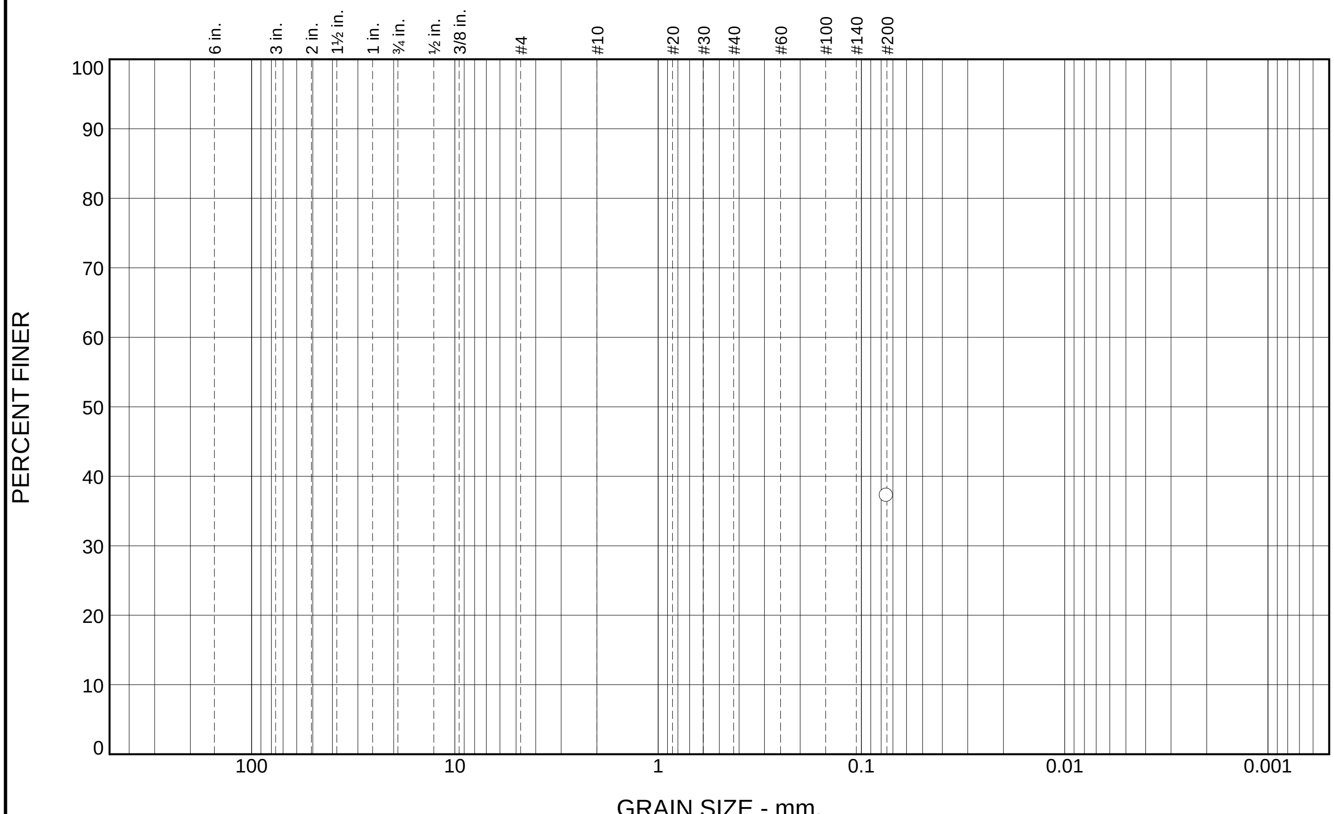
* For future reference to this analysis please use SUN # 83095-173442.

EVALUATION FOR SOIL CORROSION

Soil pH	7.33	
Minimum Resistivity	1.63 ohm-cm (x1000)	
Chloride	1.5 ppm	00.00015 %
Sulfate	8.0 ppm	00.00080 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						37.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	37.2		

* (no specification provided)

Soil Description

CLAYEY SAND, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

Source of Sample: P-1 **Depth:** 16-16.5'
Sample Number: 3C

Date:

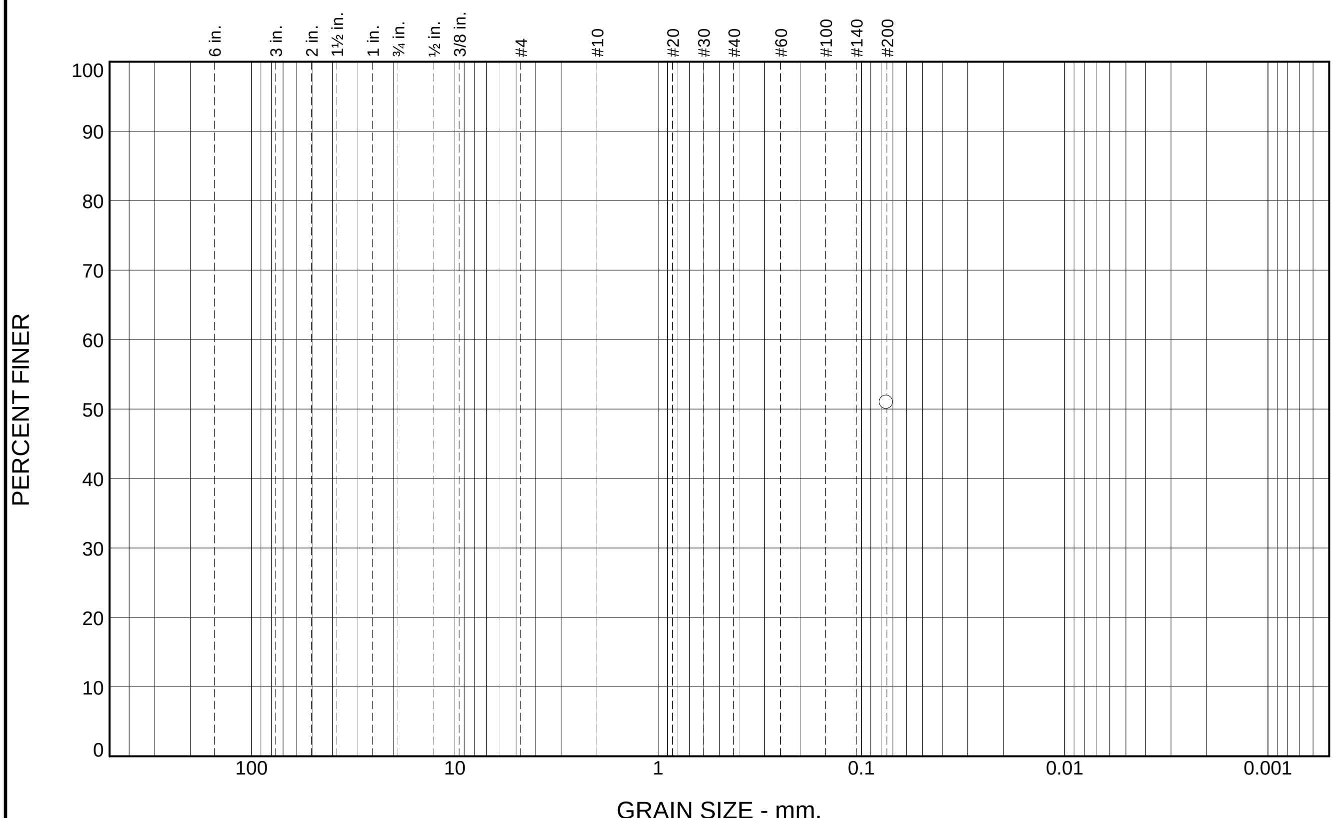
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						50.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	50.9		

* (no specification provided)

Soil Description

SANDY lean CLAY, dark reddish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Source of Sample: P-4 **Depth:** 3-3.5'
Sample Number: 1C **Date:**

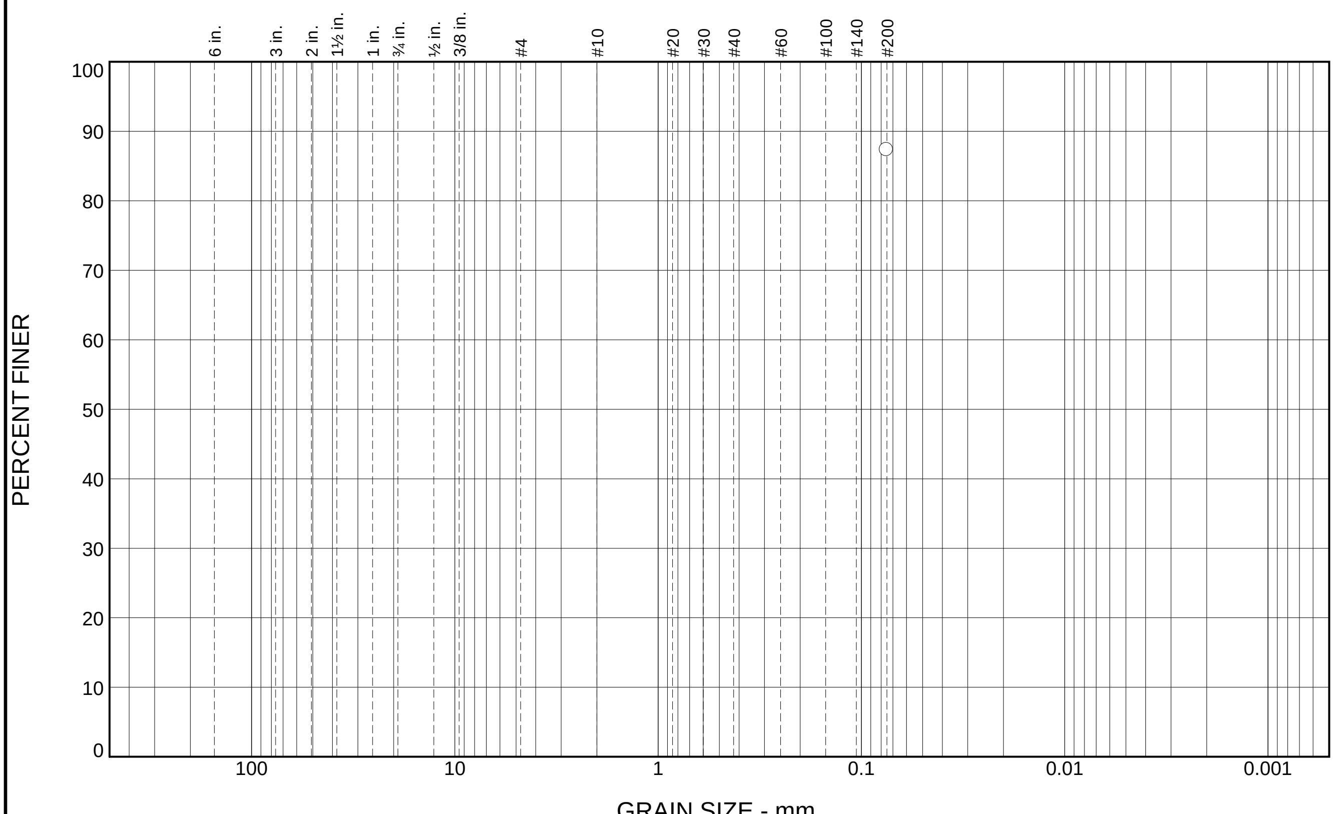
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						87.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	87.3		

* (no specification provided)

Soil Description

SILT, mottled olive gray and brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

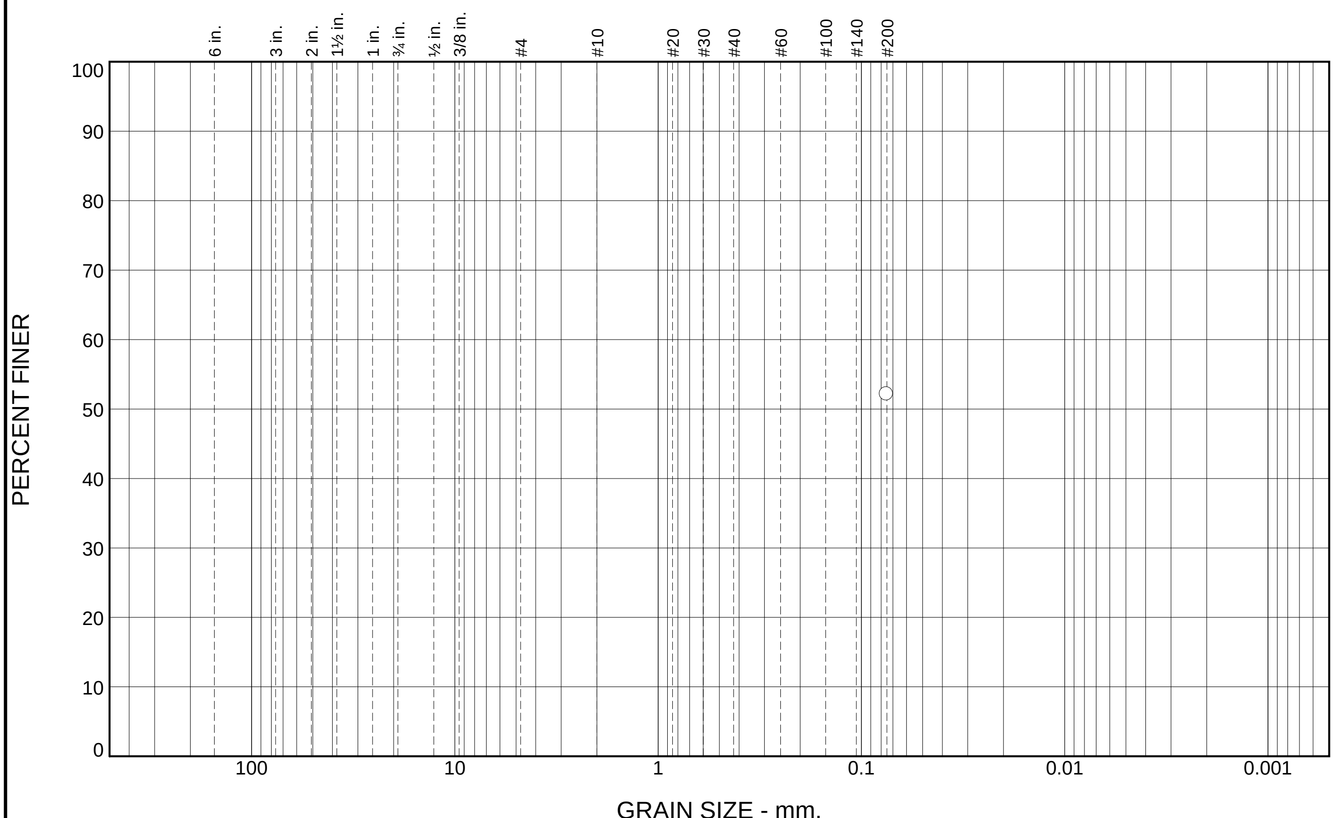
Source of Sample: P-5 **Depth:** 6-6.5'
Sample Number: 2C **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						52.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	52.1		

* (no specification provided)

Soil Description

SANDY Lean CLAY, dark brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Source of Sample: P-6 **Depth:** 6-6.5'
Sample Number: 1C

Date:

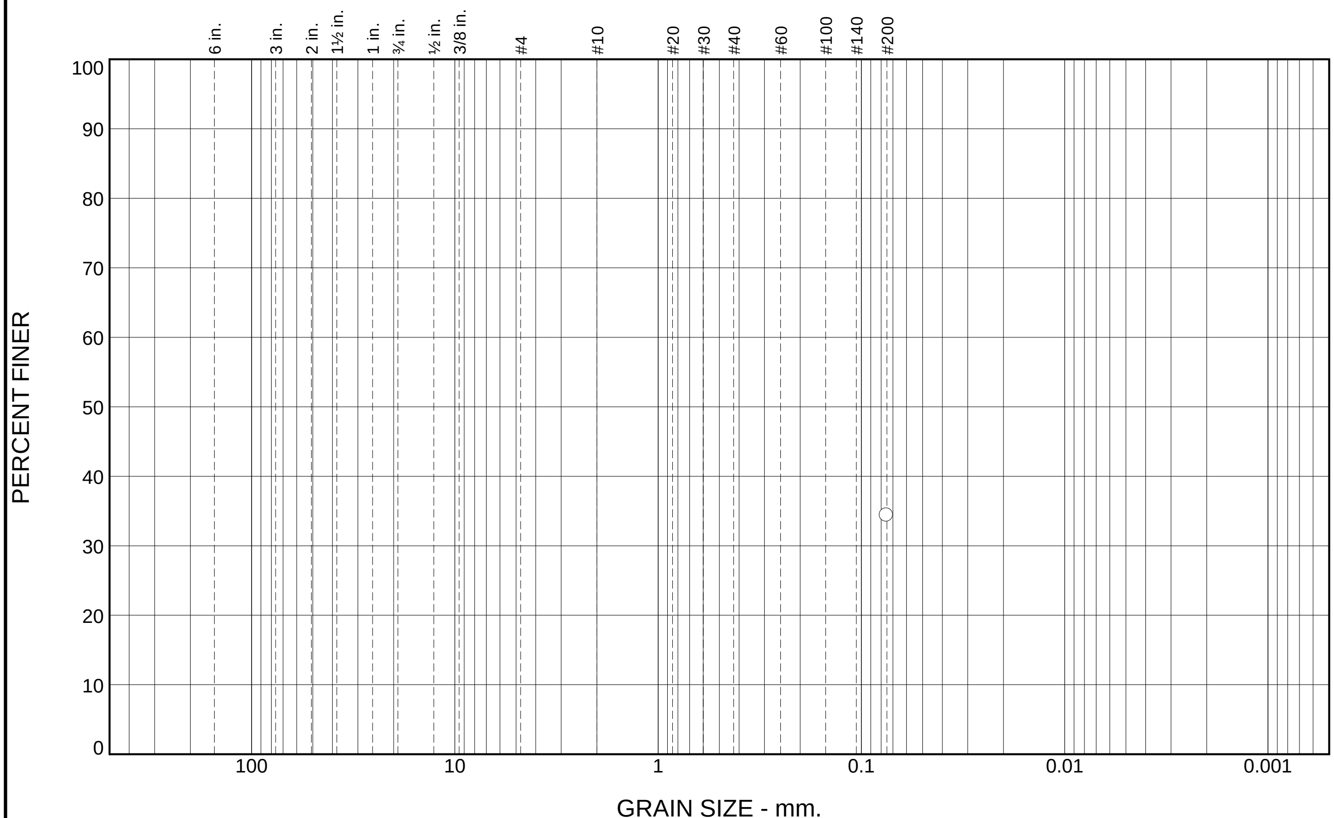
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						34.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	34.4		

* (no specification provided)

Soil Description

CLAYEY SAND, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

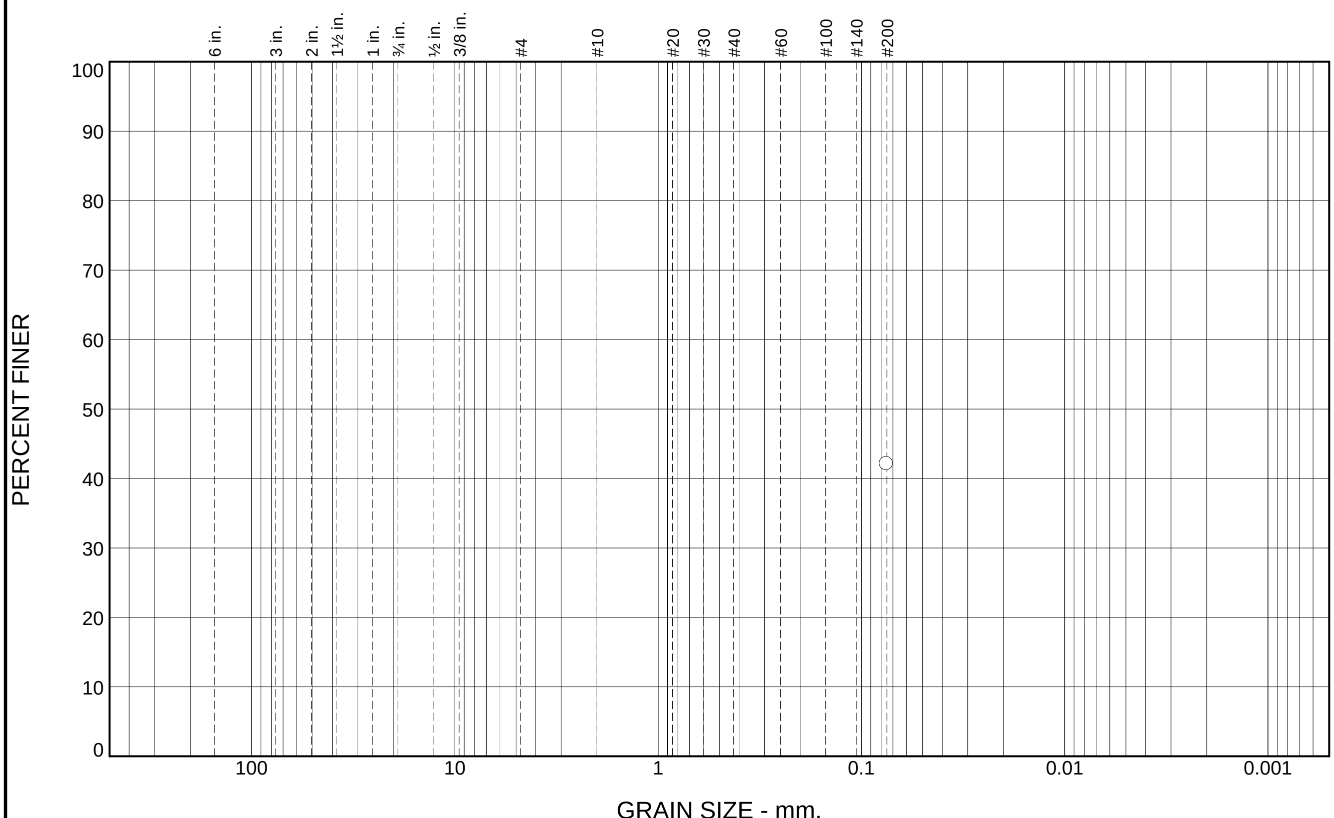
Source of Sample: P-7 **Depth:** 3-3.5'
Sample Number: 1C **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						42.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	42.1		

* (no specification provided)

Soil Description

SILTY SAND, dark brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

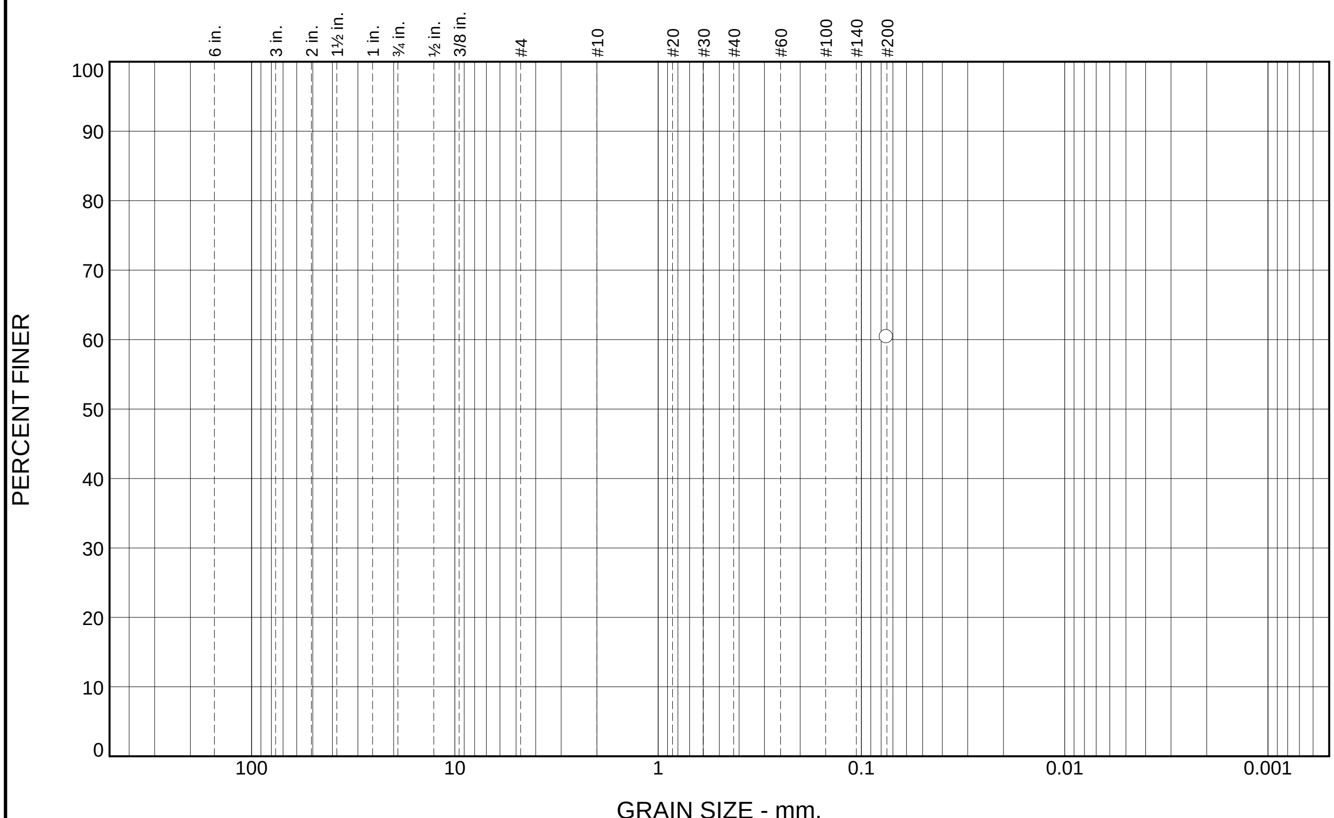
Source of Sample: P-10 **Depth:** 14.5-15'
Sample Number: 3C **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						60.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	60.4		

* (no specification provided)

Soil Description
SANDY SILT, reddish brown

Atterberg Limits
PL= LL= PI=

Coefficients
D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification
USCS= ML AASHTO=

Remarks

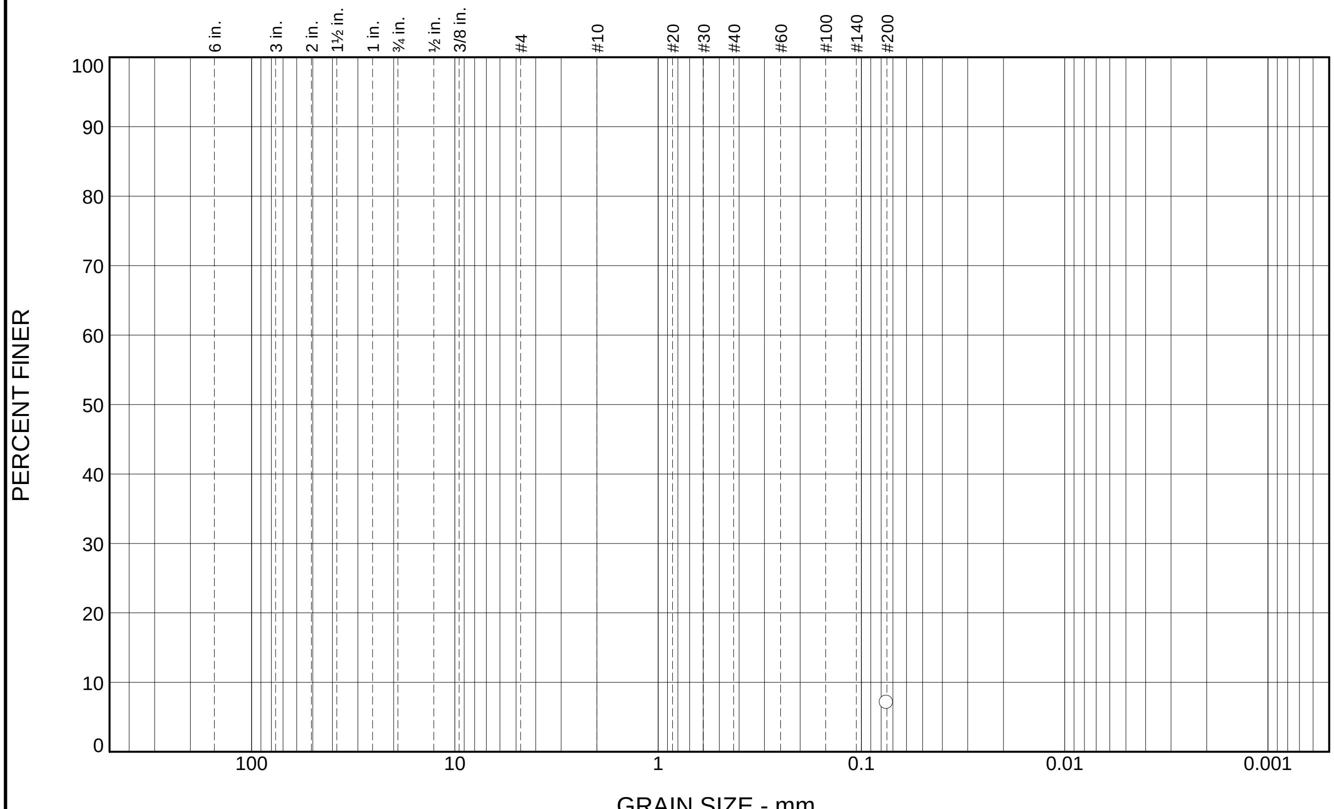
Source of Sample: P-11 **Depth:** 11-11.5'
Sample Number: 3C **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						7.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	7.1		

* (no specification provided)

Soil Description

Poorly-graded SAND with SILT, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Sandy Portion of Sample

Source of Sample: P-13 **Depth:** 16.25-16.5'
Sample Number: 4C **Date:**

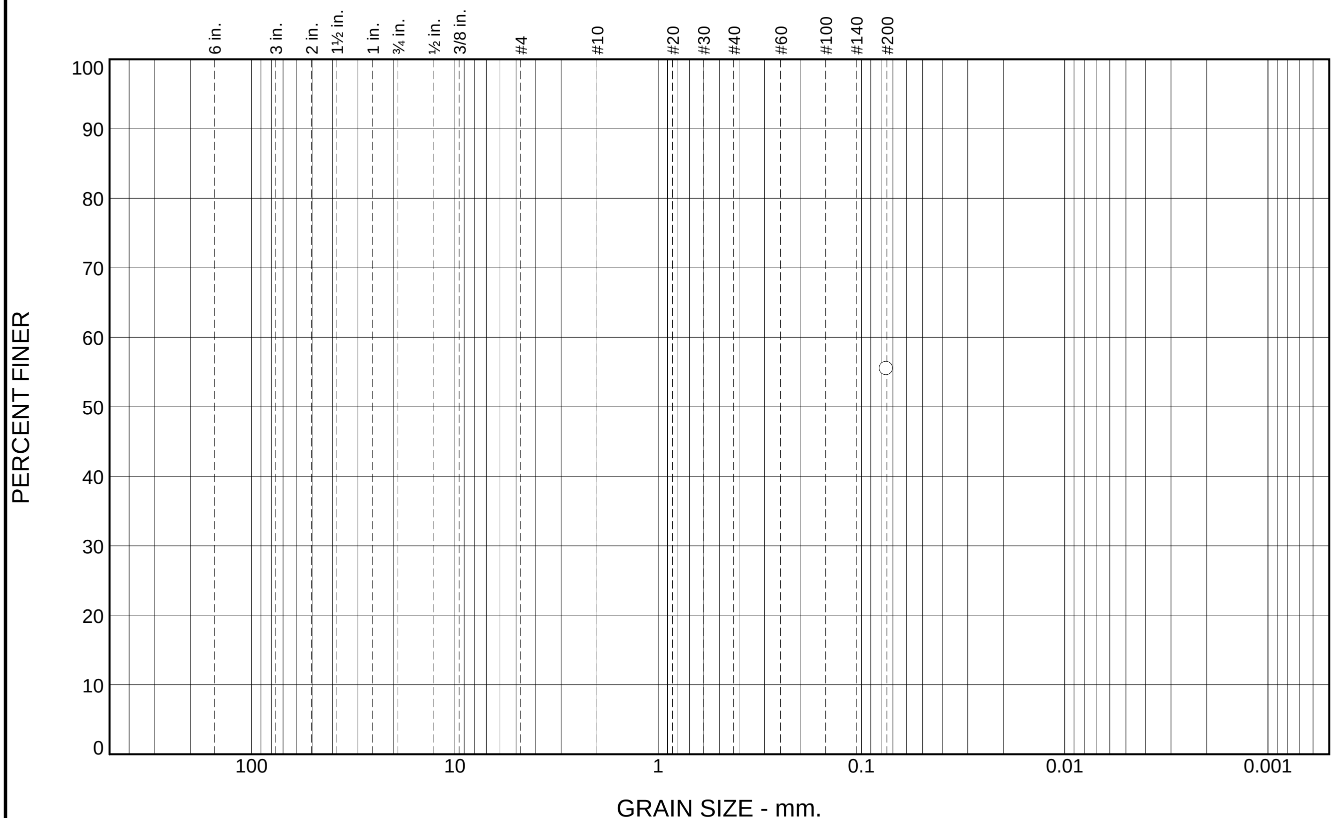
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						55.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	55.5		

* (no specification provided)

Soil Description

SANDY lean CLAY, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

Source of Sample: P-14 **Depth:** 6-6.5'
Sample Number: 2C **Date:**

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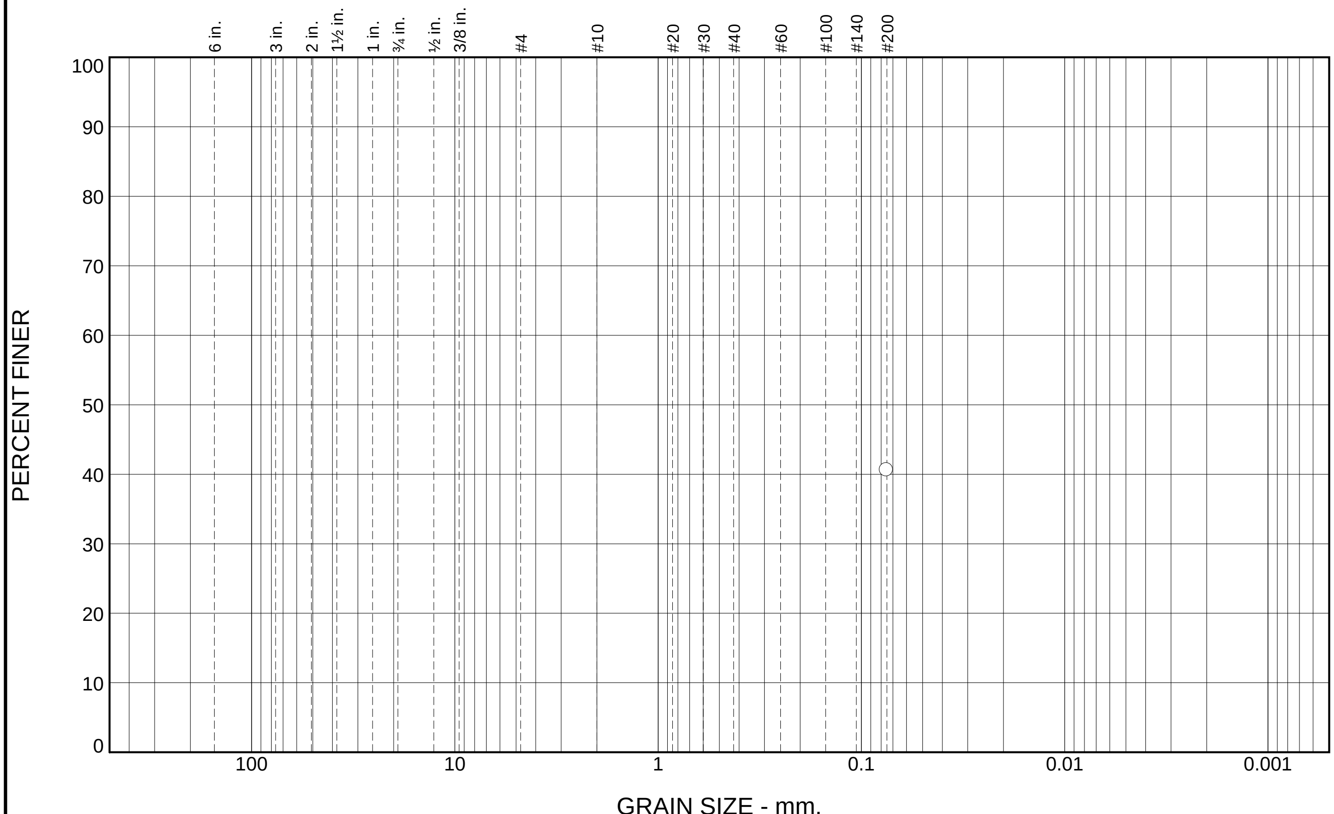
Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						40.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	40.6		

* (no specification provided)

Soil Description

CLAYEY SAND, dark reddish brown

Atterberg Limits

PL= 14 LL= 30 PI= 16

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

Source of Sample: P-16 **Depth:** 6-6.5'
Sample Number: 1C **Date:**

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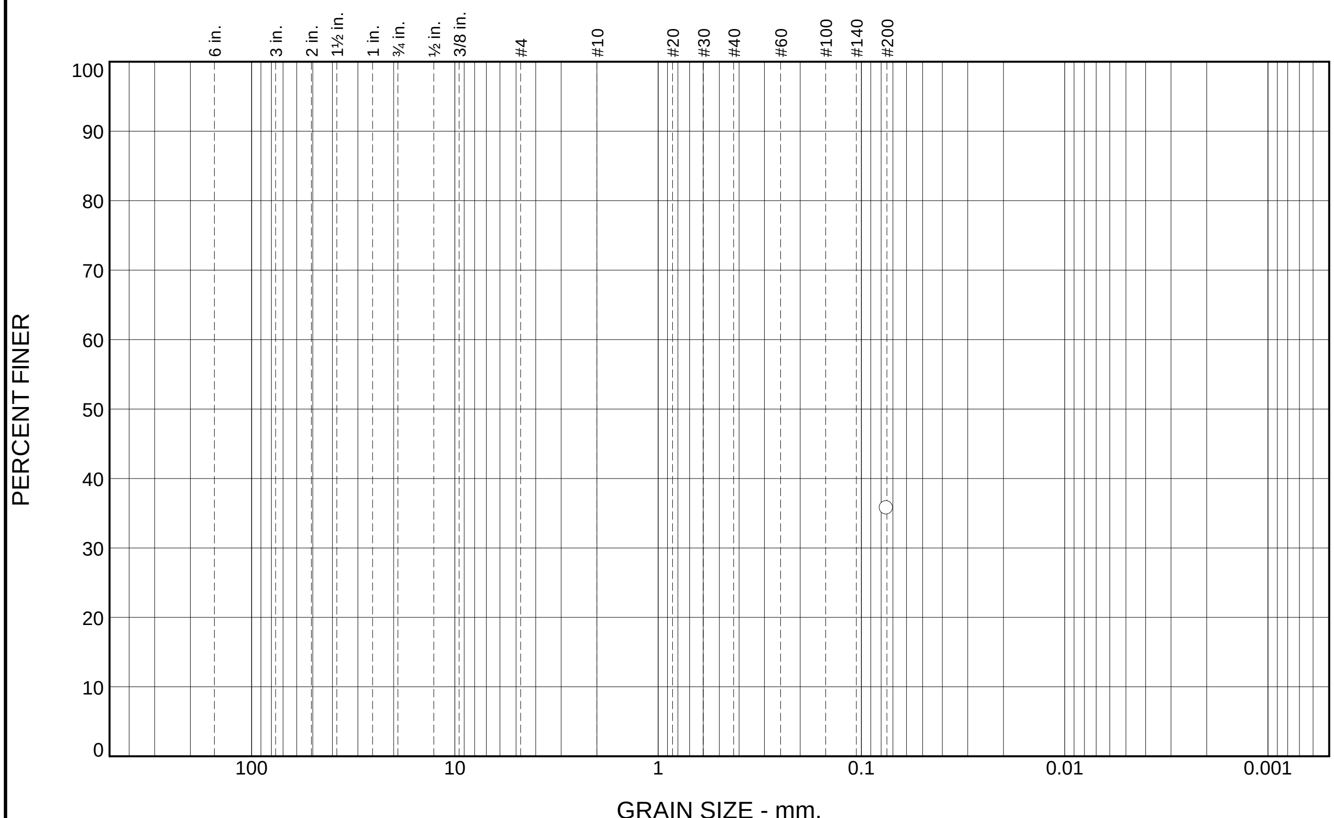
Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						35.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	35.7		

* (no specification provided)

Soil Description

CLAYEY SAND, dark reddish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

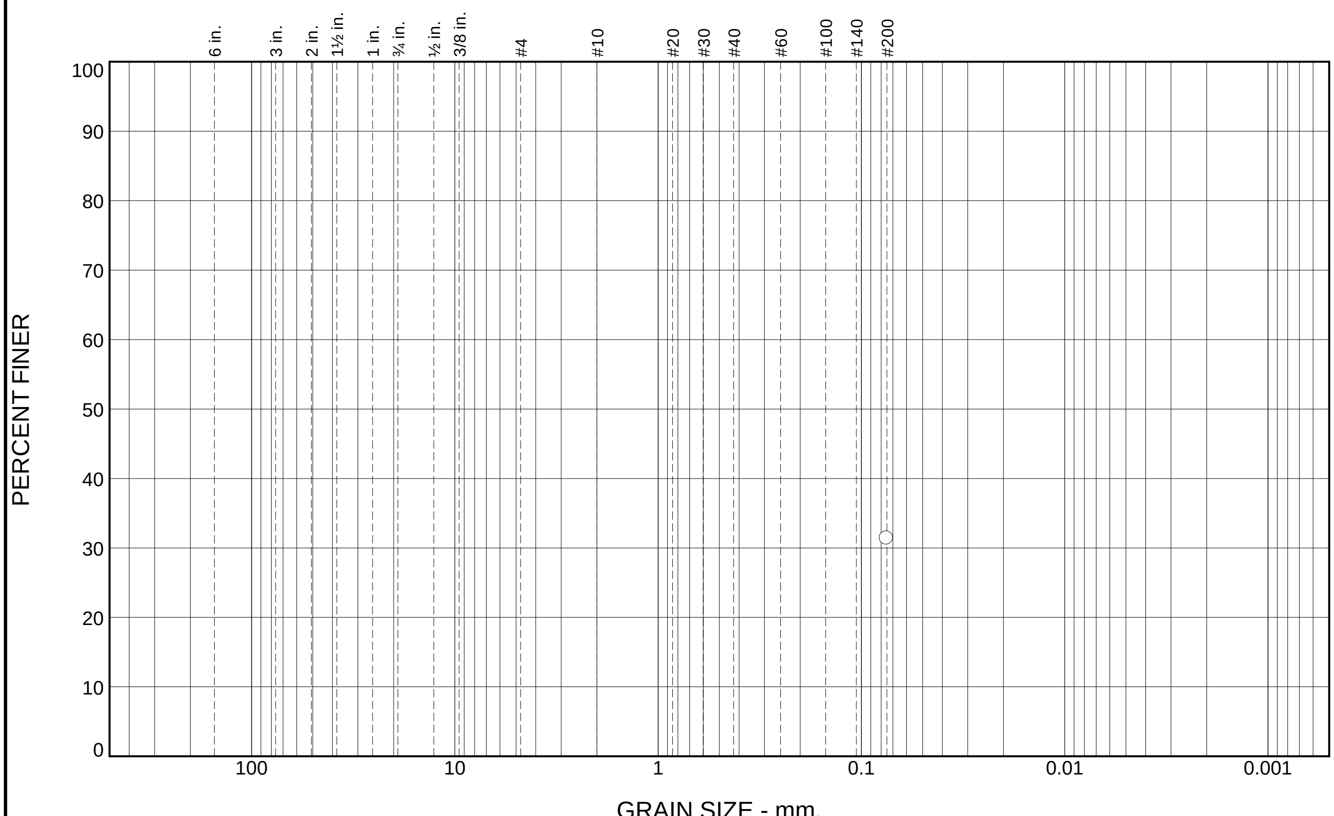
USCS= AASHTO=

Remarks

Source of Sample: P-17 **Depth:** 6-6.5'
Sample Number: 2C **Date:**

Blackburn Consulting	**Client:** Jacobs Engineering Group Inc.
	Project: OPUD South Yuba Sewer Infrastructure
W. Sacramento, CA	**Project No:** 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						31.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	31.4		

* (no specification provided)

Soil Description

CLAYEY SAND, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Source of Sample: P-17 **Depth:** 10.5-11'
Sample Number: 3B **Date:**

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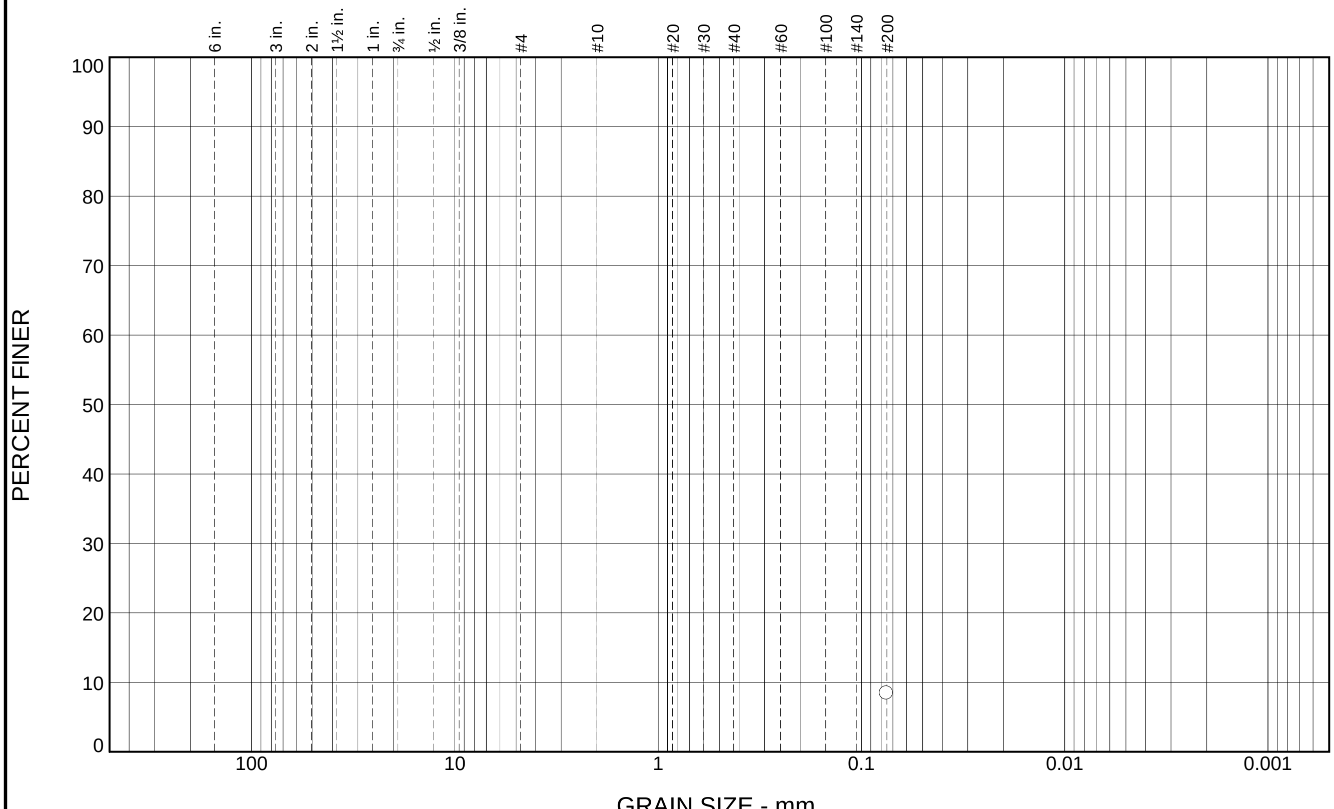
W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						8.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
# 200	8.4		

* (no specification provided)

Soil Description

Poorly-graded SAND with SILT, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Source of Sample: P-26 **Depth:** 20.5-21'
Sample Number: 5B

Date:

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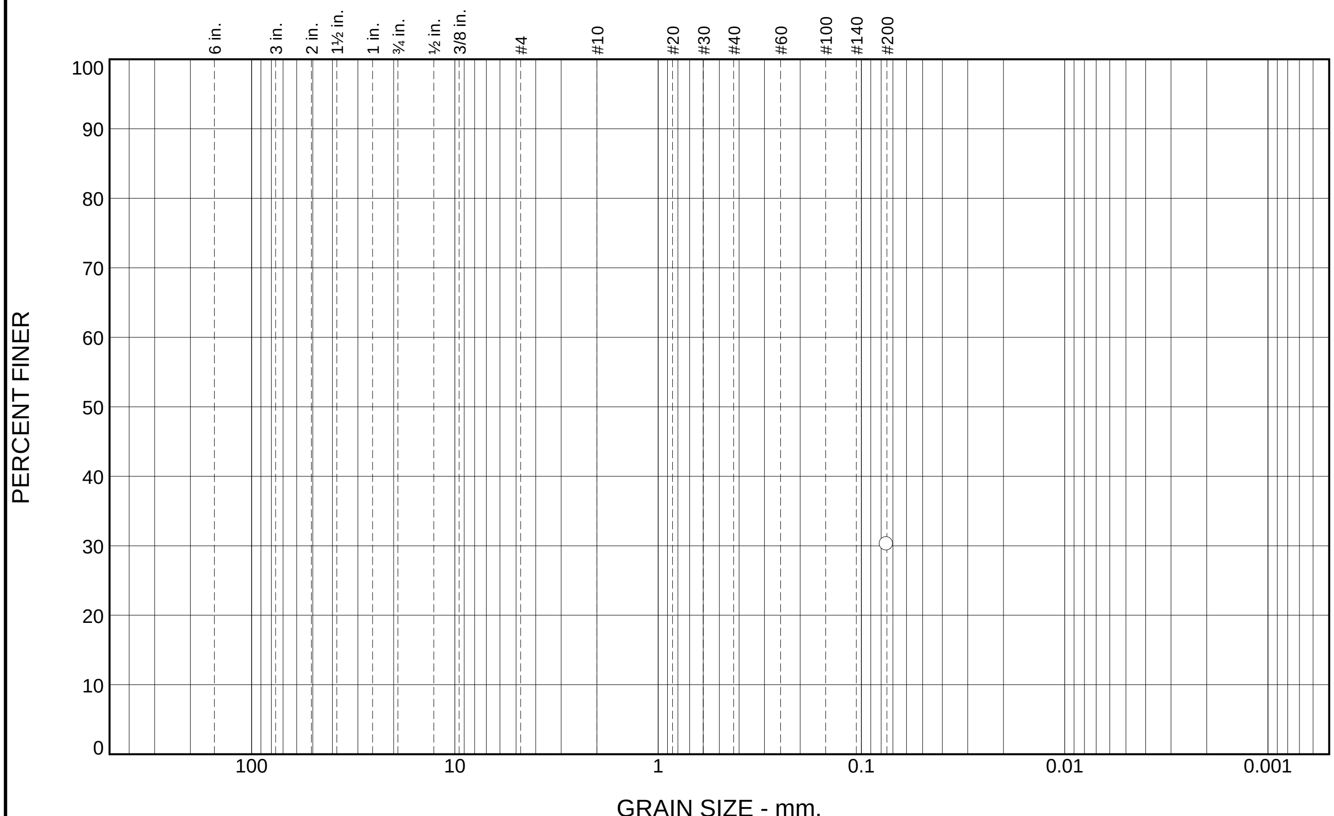
Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						30.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	30.2		

* (no specification provided)

Soil Description

CLAYEY SAND, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

Source of Sample: P-28 **Depth:** 10-10.5'
Sample Number: 3C **Date:**

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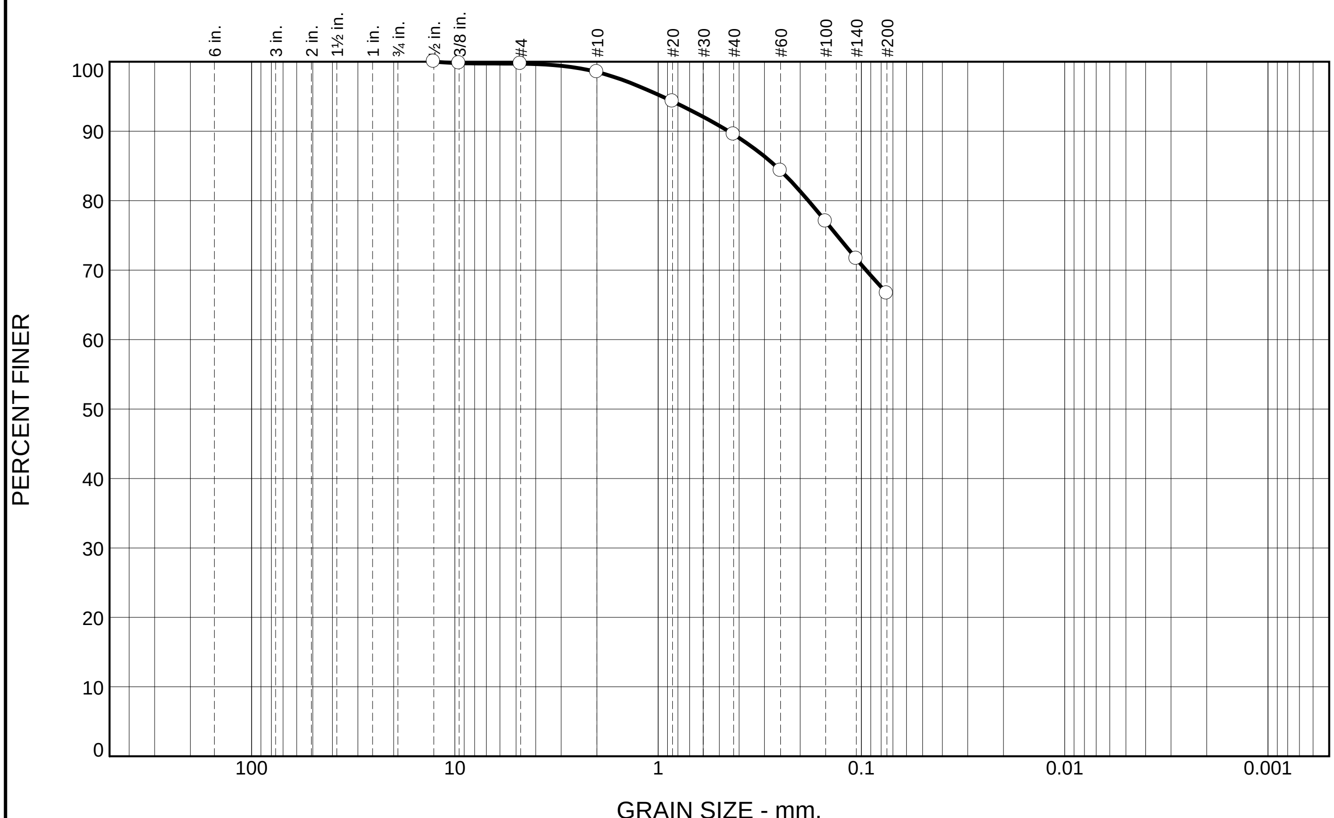
Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	1.2	9.0	22.8	66.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	99.8		
#4	99.7		
#10	98.5		
#20	94.3		
#40	89.5		
#60	84.3		
#100	77.0		
#140	71.6		
#200	66.7		

* (no specification provided)

Soil Description

SANDY lean CLAY, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4511 D_{85}= 0.2648 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

Source of Sample: P-30 **Depth:** 10.5-11.5'
Sample Number: 3 **Date:**

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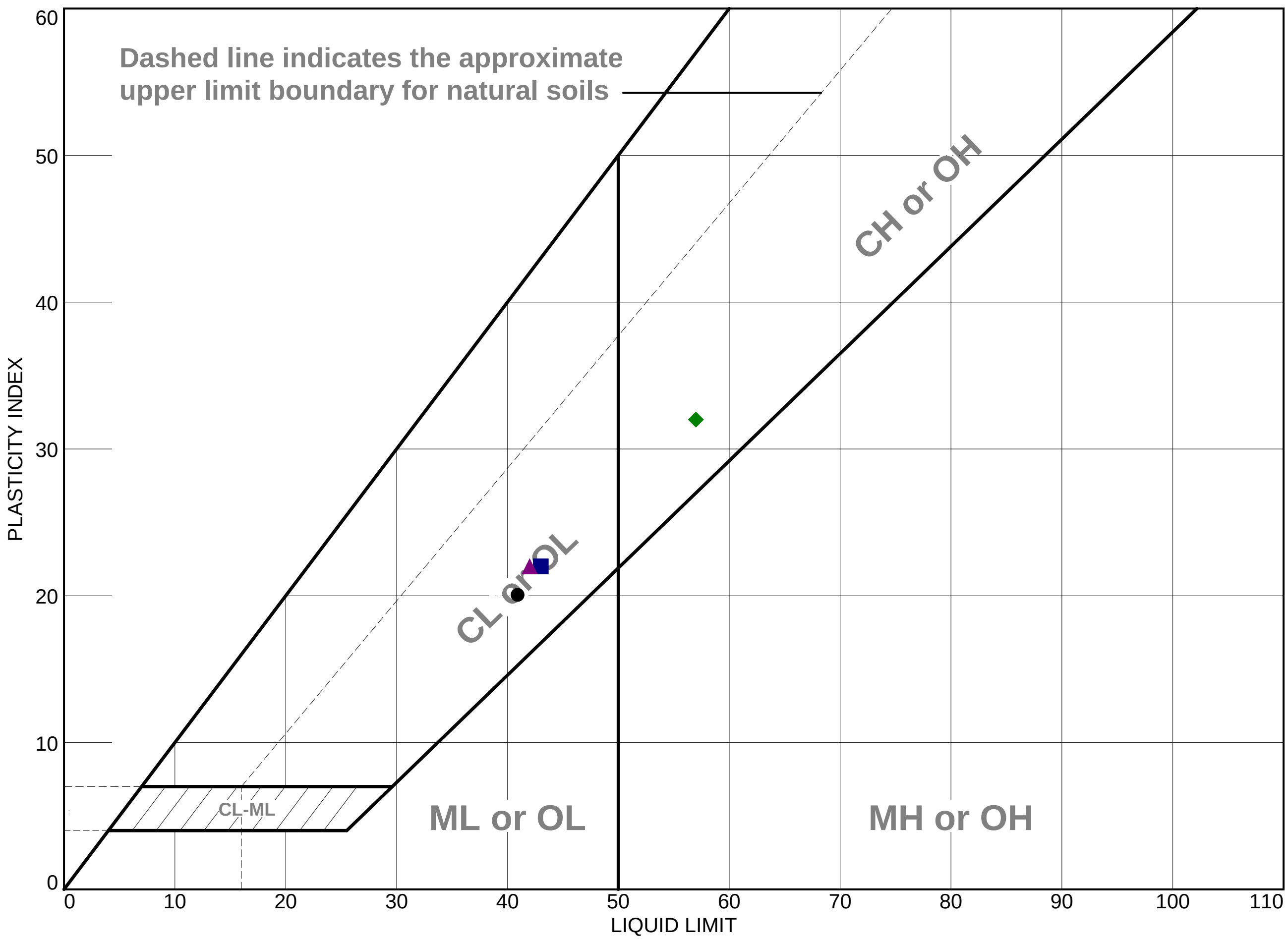
Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY with SAND, yellowish brown	41	21	20			CL
■	Lean CLAY, dark yellowish brown	43	21	22			CL
▲	Lean CLAY, yellowish brown	42	20	22			CL
◆	Fat CLAY, yellowish brown	57	25	32			CH

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-6A **Depth:** 10.5-11' **Sample Number:** 2B

■**Source of Sample:** TC-6A **Depth:** 16-16.5' **Sample Number:** 3C

▲**Source of Sample:** TC-6A **Depth:** 21-21.5' **Sample Number:** 4C

◆**Source of Sample:** TC-6A **Depth:** 26-26.5' **Sample Number:** 5C

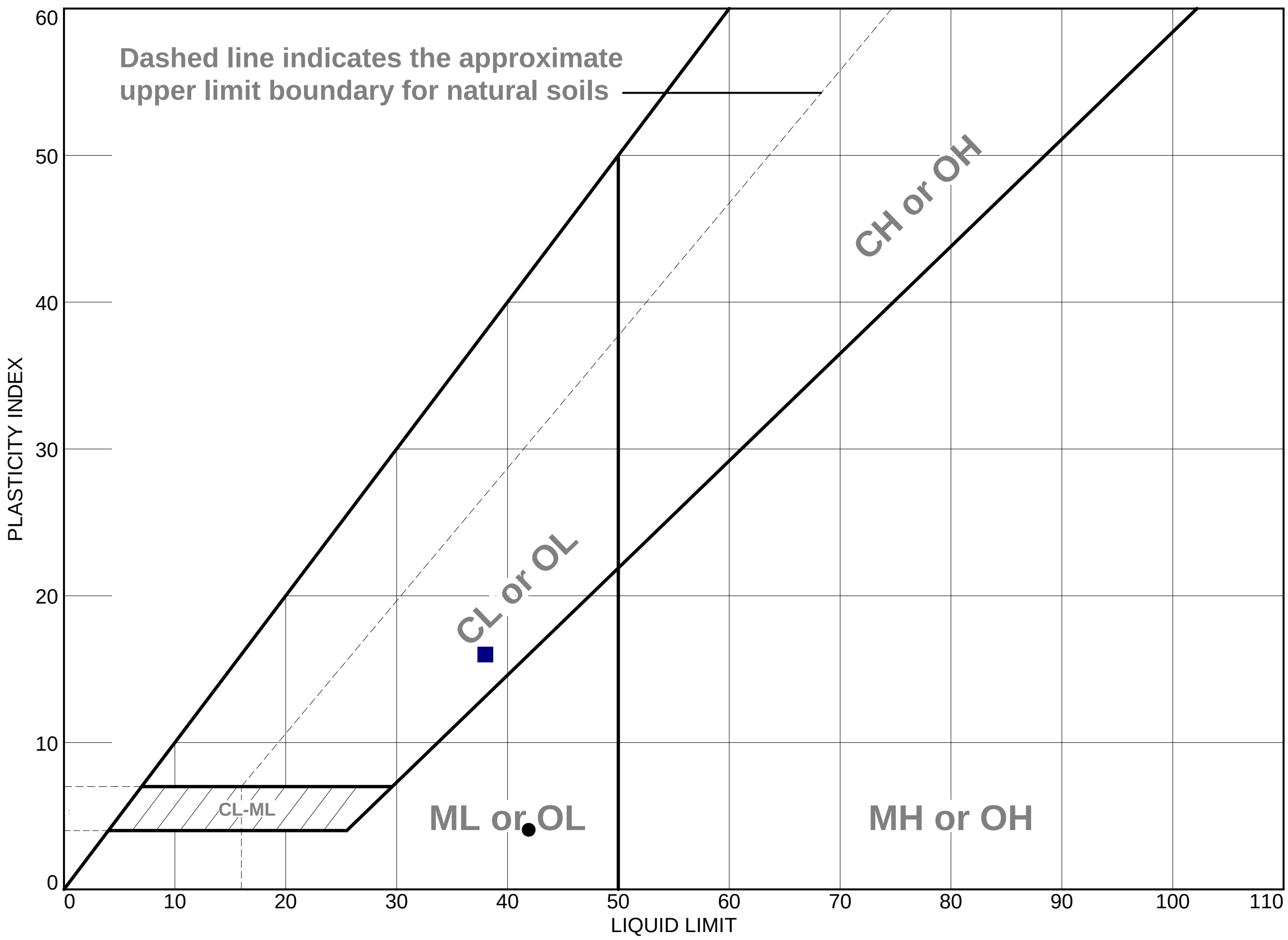
Remarks:

Blackburn Consulting

W. Sacramento, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILT, yellowish brown	42	38	4			ML
■	Lean CLAY, yellowish brown	38	22	16			CL
▲	SANDY SILT, dark yellowish brown	NP	NP	NP		57.0	ML

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-7A **Depth:** 15.5-16.5' **Sample Number:** 4
■**Source of Sample:** TC-7A **Depth:** 20.5-21.5' **Sample Number:** 5
▲**Source of Sample:** TC-7A **Depth:** 25.5-26.5' **Sample Number:** 6

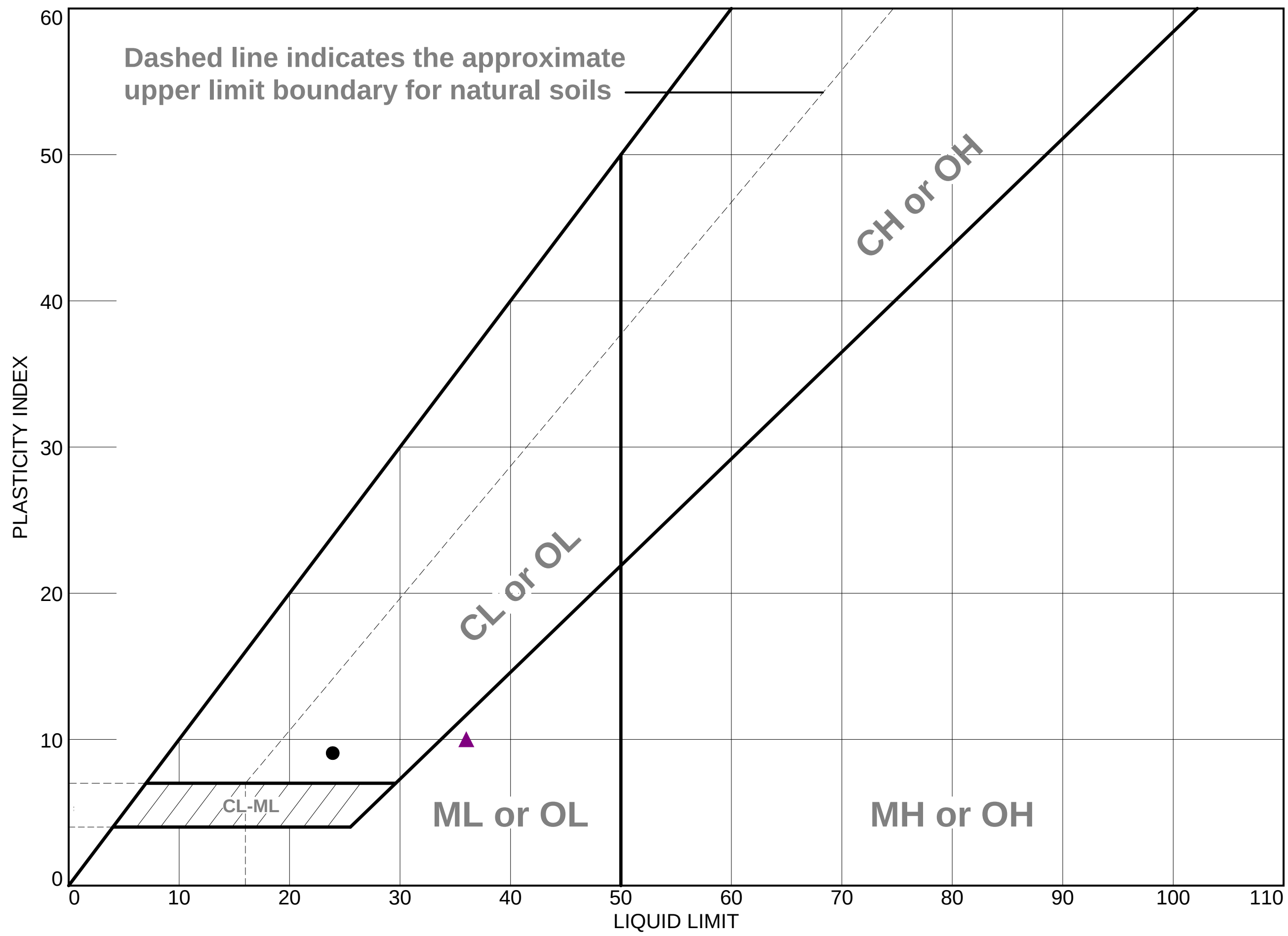
Remarks:

Blackburn Consulting

W. Sacramento, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY, dark brown	24	15	9			CL
■	SANDY SILT, dark brown	NP	NP	NP		51.2	ML
▲	SANDY SILT, brown	36	26	10			ML

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-7B **Depth:** 5.5-6.5' **Sample Number:** 2

■**Source of Sample:** TC-7B **Depth:** 15.5-16.5' **Sample Number:** 4

▲**Source of Sample:** TC-7B **Depth:** 25.5-26.5' **Sample Number:** 6

Remarks:

Blackburn Consulting

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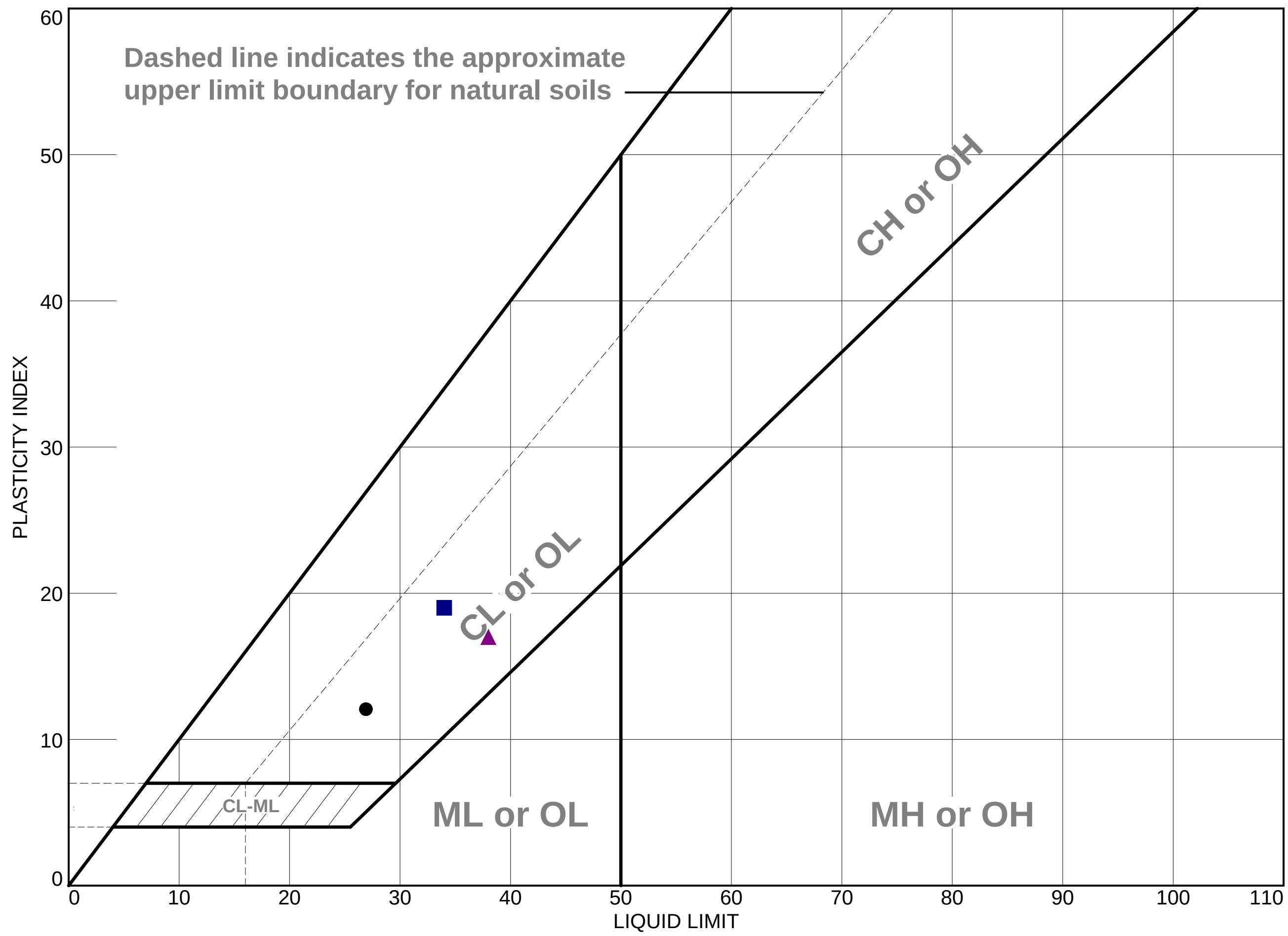
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	CLAYEY SAND, dark reddish brown	27	15	12		45.9	SC
■	Lean CLAY, reddish brown	34	15	19			CL
▲	Interbedded lenses of lean CLAY and CLAYEY SAND, yellowish brown	38	21	17		56.3	CL,SC
◆	Interbedded lenses of SILTY SAND and SANDY SILT, dark yellowish brown	NP	NP	NP		34.0	SM,ML

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-9A **Depth:** 10.5-11.5' **Sample Number:** 2
■ **Source of Sample:** TC-9A **Depth:** 15.5-16.5' **Sample Number:** 3
▲ **Source of Sample:** TC-9A **Depth:** 25.5-26.5 **Sample Number:** 5
◆ **Source of Sample:** TC-9A **Depth:** 35.5-36.5' **Sample Number:** 7

Remarks:

Blackburn Consulting

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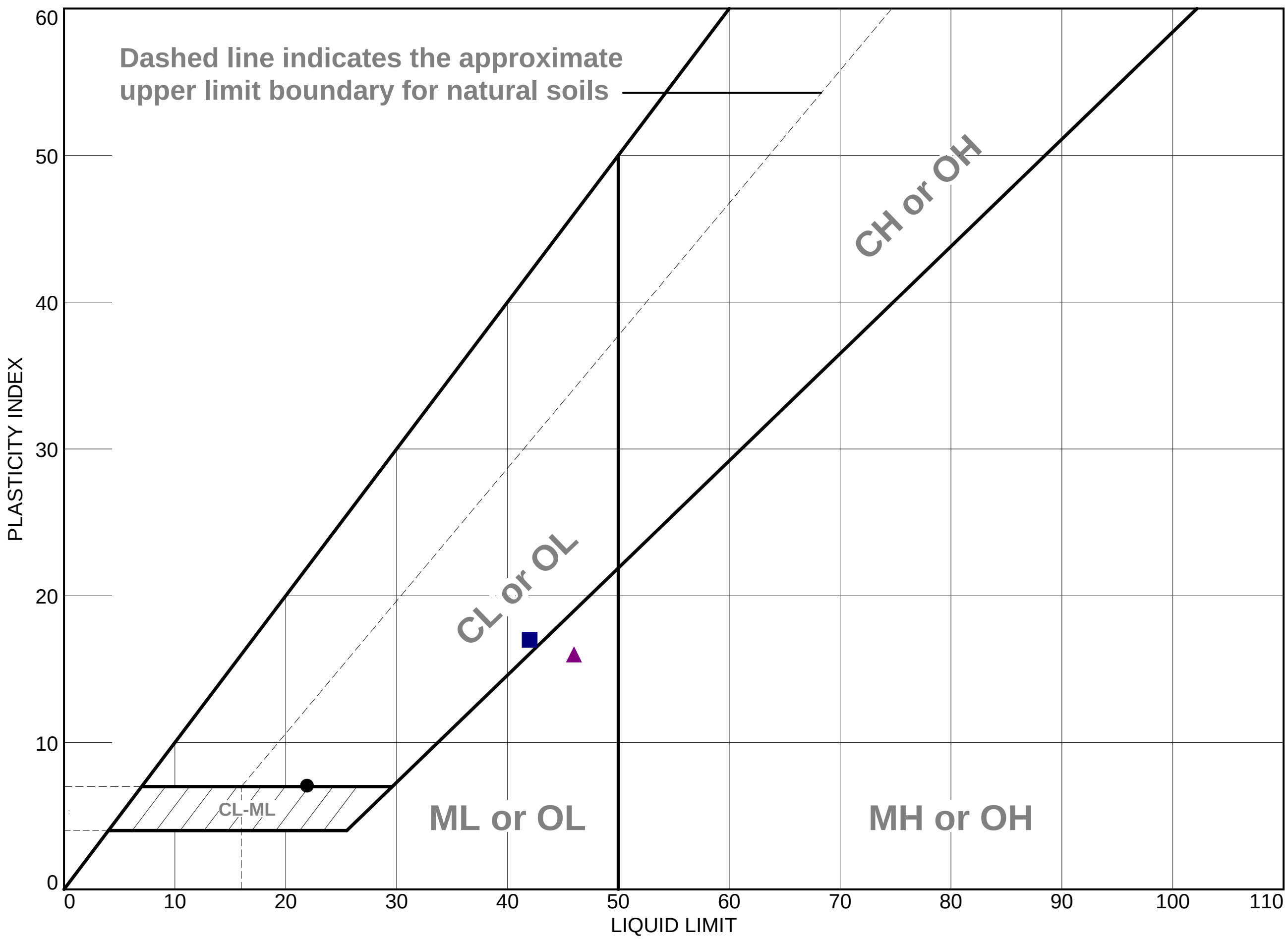
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILTY CLAY, dark reddish brown	22	15	7			CL-ML
■	Lean CLAY with SAND, strong brown	42	25	17			CL
▲	SILT, dark yellowish brown	46	30	16			ML

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-9B **Depth:** 5.5-6.5' **Sample Number:** 2

■**Source of Sample:** TC-9B **Depth:** 25.5-26' **Sample Number:** 6B

▲**Source of Sample:** TC-9B **Depth:** 31-31.5' **Sample Number:** 7C

Remarks:

Blackburn Consulting

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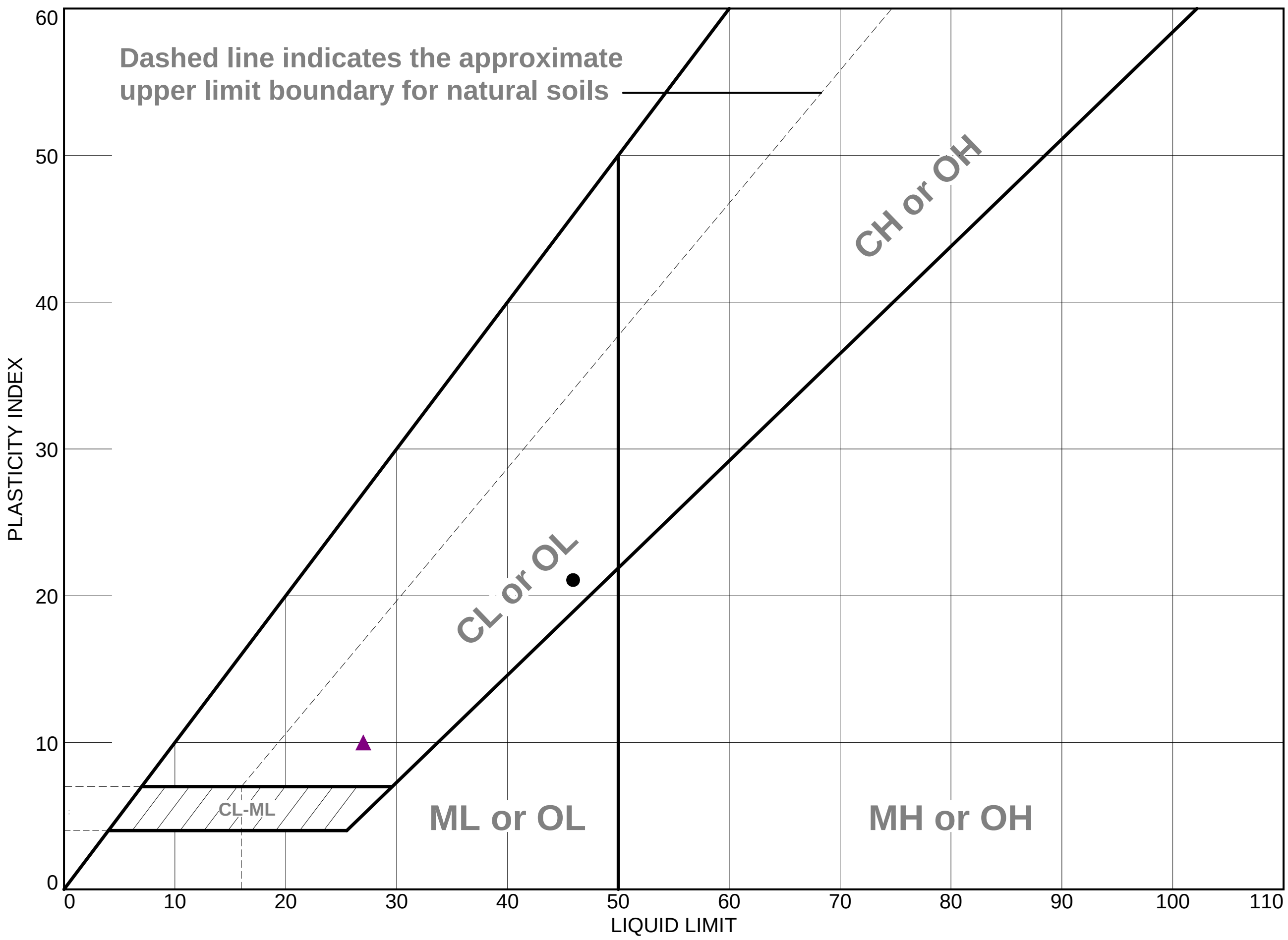
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY with SAND, yellowish brown	46	25	21			CL
■	SILTY SAND, dark olive brown	NP	NP	NP		18.6	SM
▲	Lean CLAY, dark yellowish brown	27	17	10			CL

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-10B **Depth:** 20.5-21' **Sample Number:** 5B

■**Source of Sample:** TC-10B **Depth:** 25.5-26.5' **Sample Number:** 6

▲**Source of Sample:** TC-10B **Depth:** 31-31.5' **Sample Number:** 7C

Remarks:

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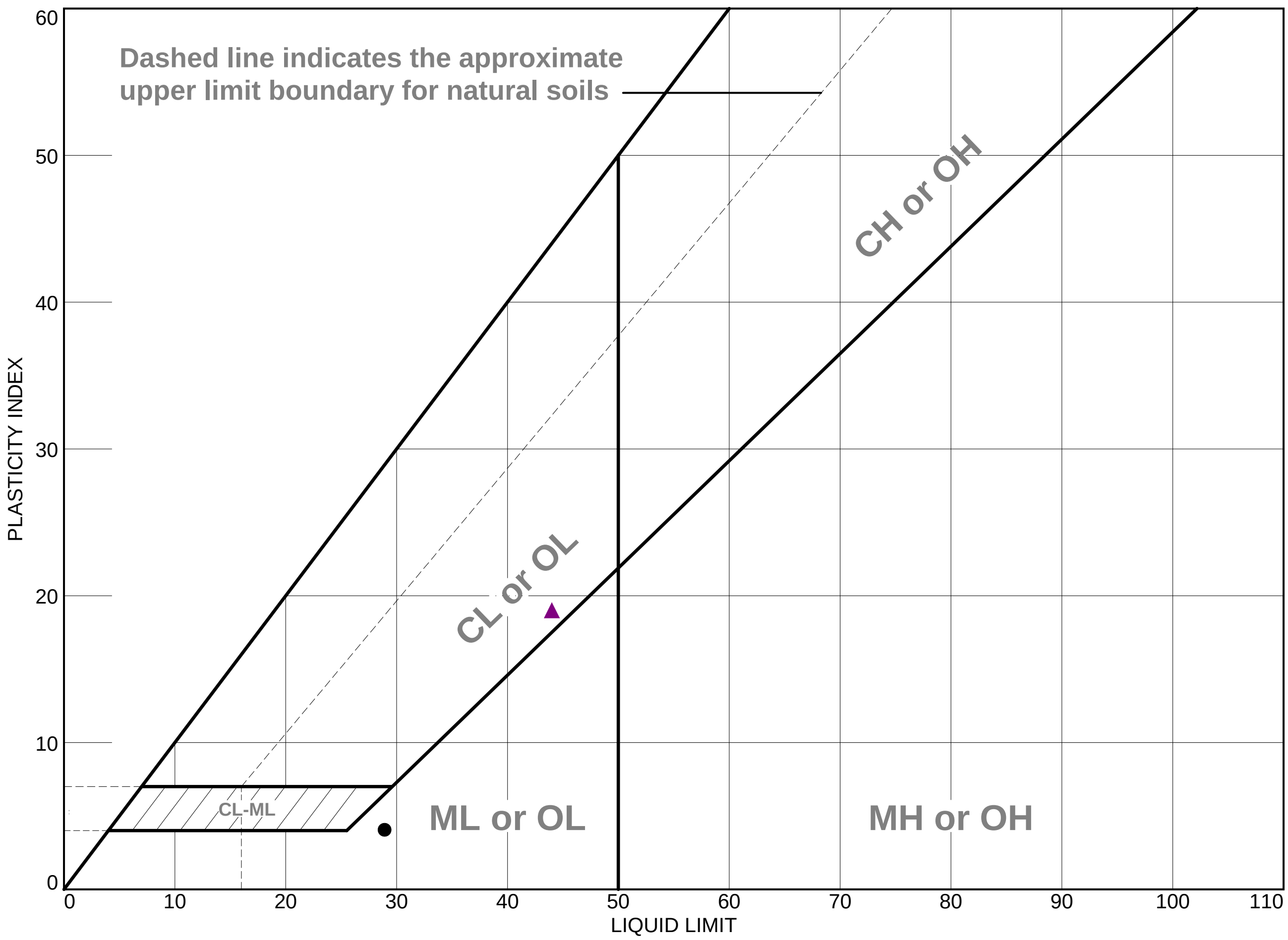
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILT, yellowish brown	29	25	4			ML
■	SILTY SAND, dark yellowish brown	NP	NP	NP	62.2	19.9	SM
▲	Lean CLAY, yellowish brown	44	25	19			CL

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-2C **Depth:** 3-3.5' **Sample Number:** 1B

■**Source of Sample:** TC-2C **Depth:** 30.5-31' **Sample Number:** 8B

▲**Source of Sample:** TC-2C **Depth:** 40.5-41.5' **Sample Number:** 10

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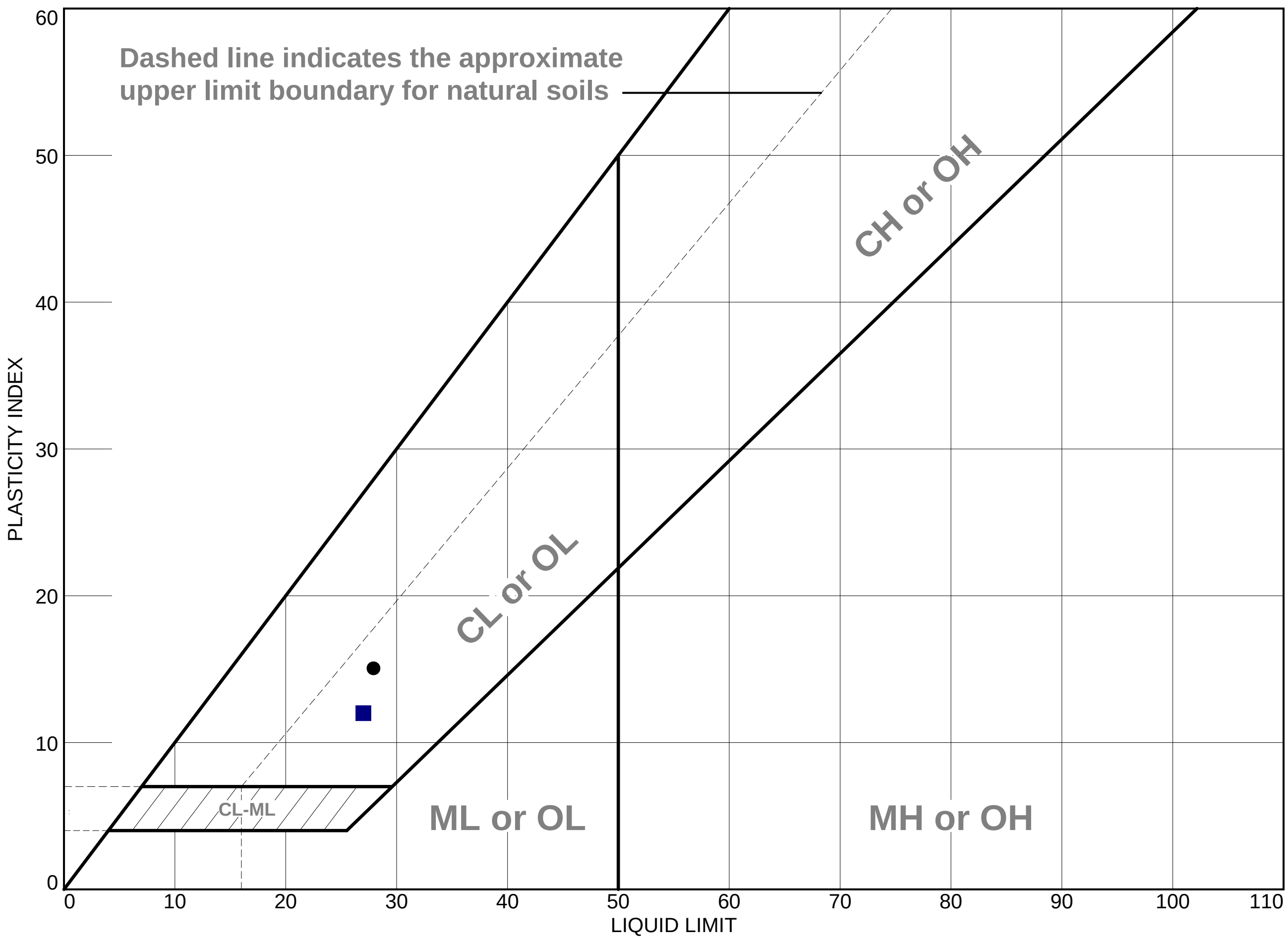
Remarks:

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	CLAYEY SAND, dark brown	28	13	15	72.5	17.4	SC
■	Lean CLAY, dark gray	27	15	12			CL

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-8A **Depth:** 15.5-16.5' **Sample Number:** 3

■ **Source of Sample:** TC-8A **Depth:** 35.5-36' **Sample Number:** 7B

Remarks:

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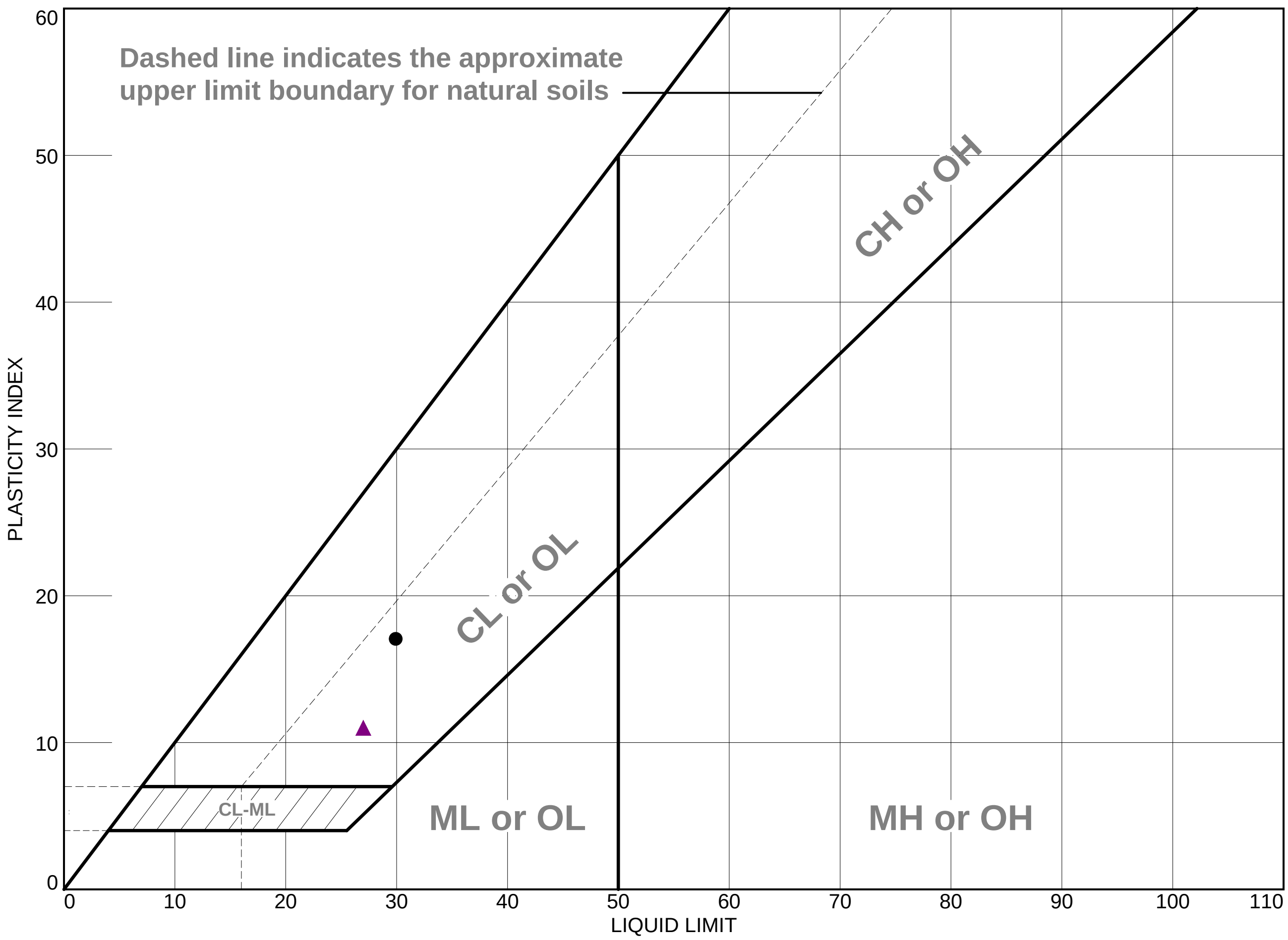
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY with SAND, brown	30	13	17			CL
■	SILTY SAND, dark yellowish brown	NP	NP	NP		42.6	SM
▲	CLAYEY SAND, dark yellowish brown	27	16	11		48.6	SC

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-8B **Depth:** 10.5-11' **Sample Number:** 3B

■**Source of Sample:** TC-8B **Depth:** 30.5-31' **Sample Number:** 7B

▲**Source of Sample:** TC-8B **Depth:** 35.5-36' **Sample Number:** 8B

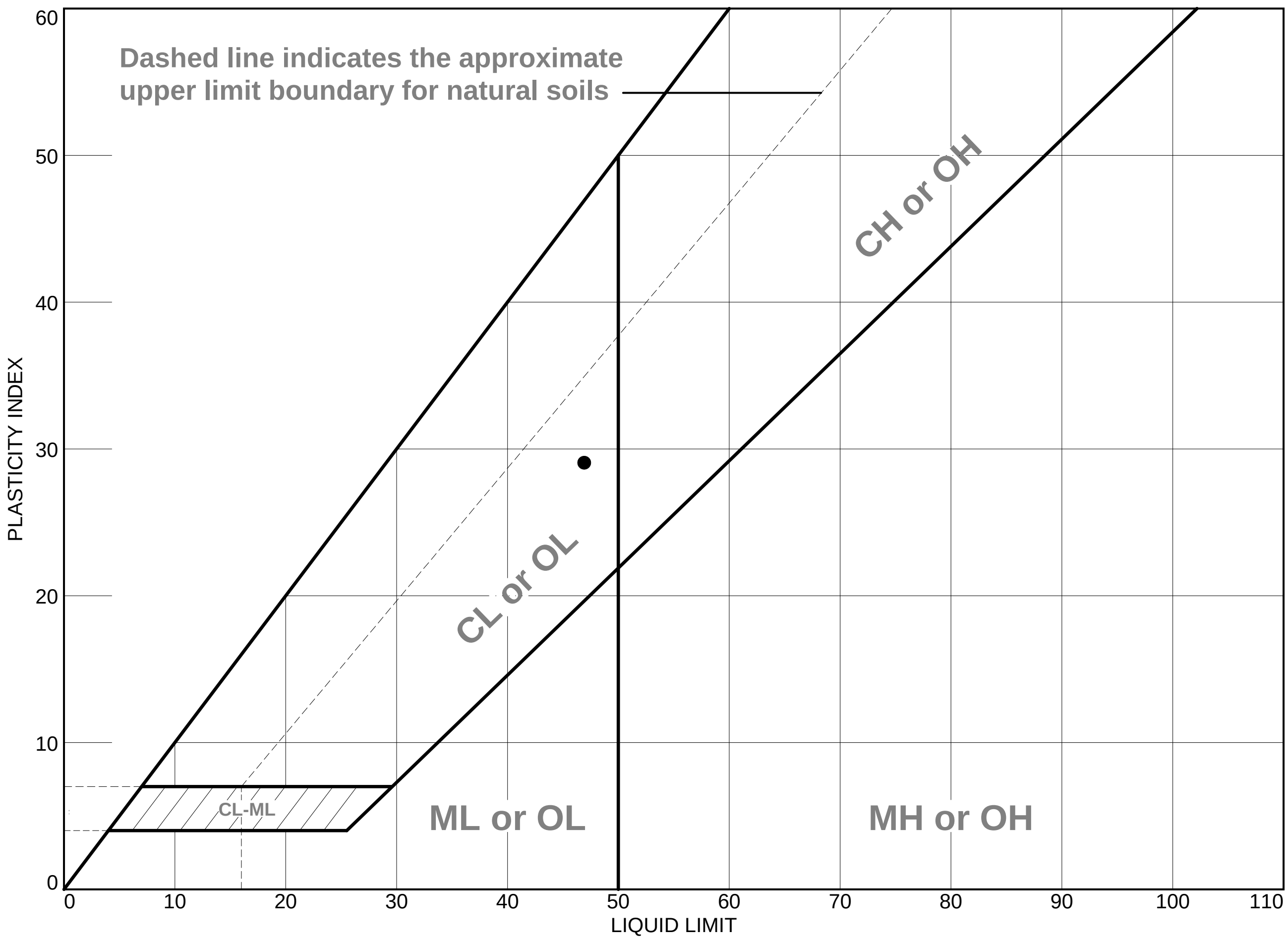
Remarks:

Blackburn Consulting

W. Sacramento, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY, reddish brown	47	18	29			CL
■	SILTY SAND, strong brown	NP	NP	NP			SM

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-10A **Depth:** 10.5-11' **Sample Number:** 3B

■**Source of Sample:** TC-10A **Depth:** 35.3-36' **Sample Number:** 8B

Remarks:

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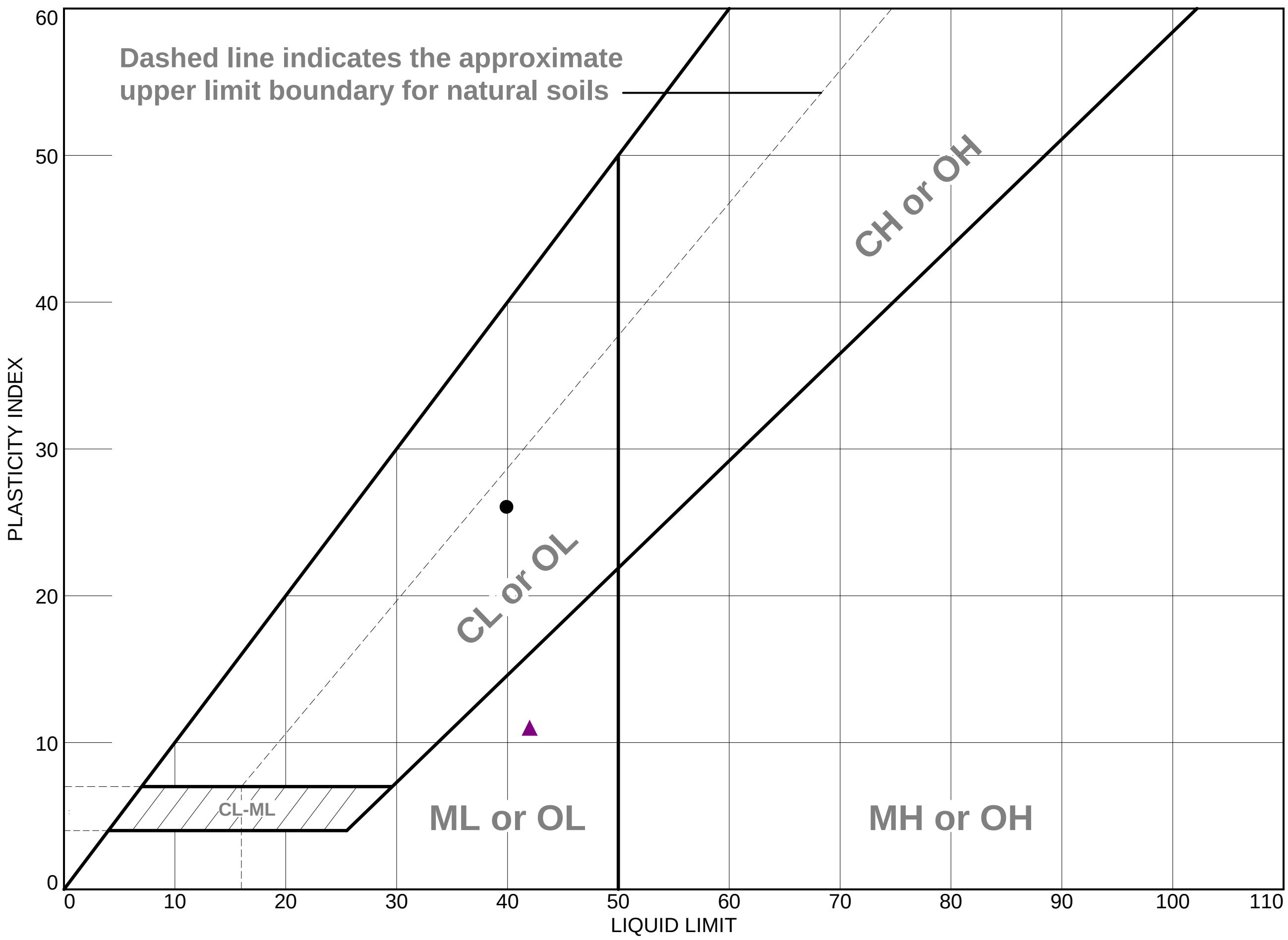
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY, dark brown	40	14	26			CL
■	Poorly-graded SAND with SILT, dark reddish brown	NP	NP	NP	73.4	9.0	SP-SM
▲	SILT, yellowish brown	42	31	11			ML

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-12A **Depth:** 5.5-6' **Sample Number:** 2B
■**Source of Sample:** TC-12A **Depth:** 20.5-21.5' **Sample Number:** 5
▲**Source of Sample:** TC-12A **Depth:** 31-31.5' **Sample Number:** 7C

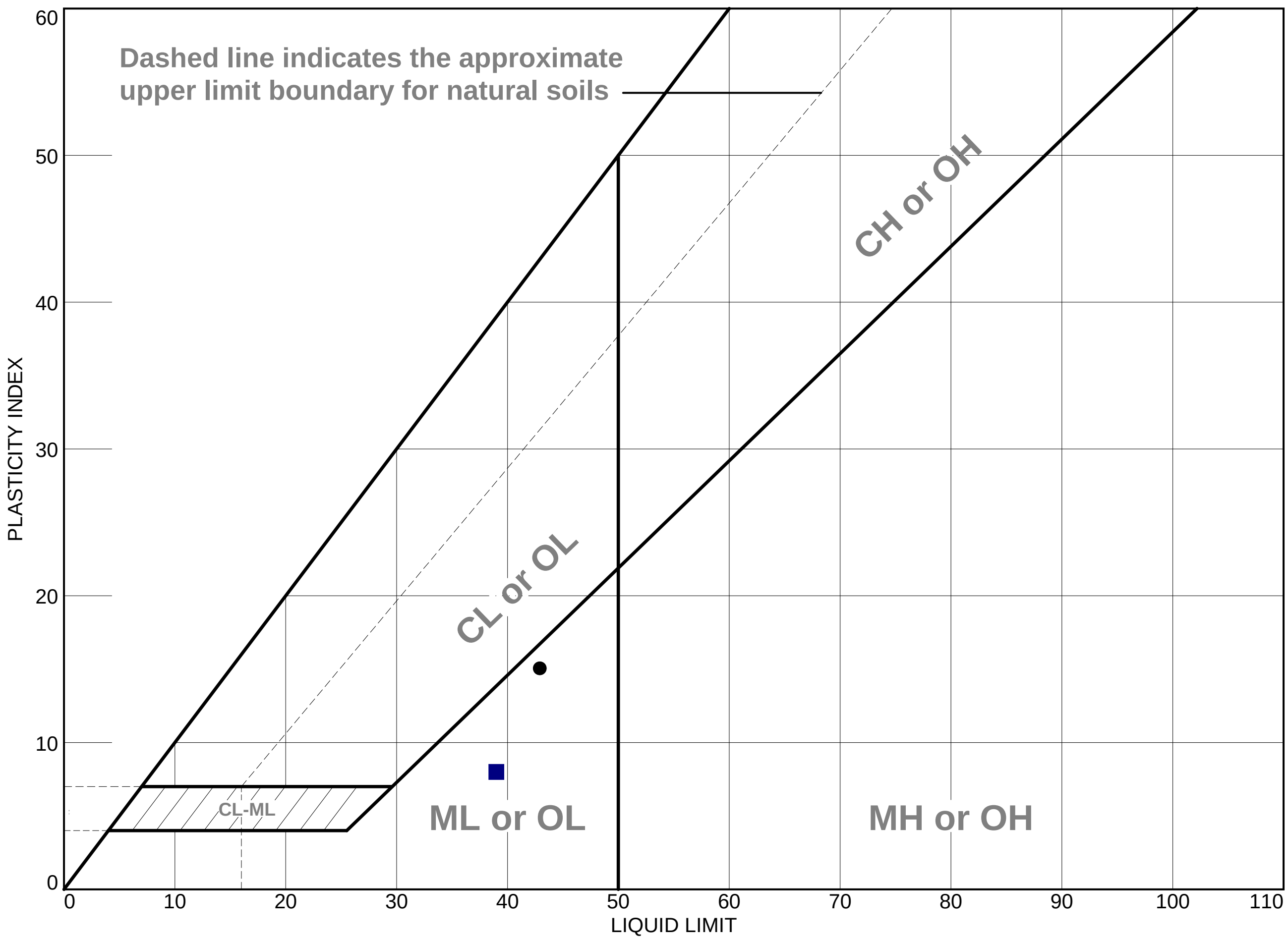
Remarks:

Blackburn Consulting

W. Sacramento, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILT with SAND, yellowish brown	43	28	15			ML
■	SILT, yellowish brown	39	31	8			ML
▲	SILTY SAND, dark yellowish brown	NP	NP	NP		46.4	SM

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-12B **Depth:** 15-16' **Sample Number:** 3

■ **Source of Sample:** TC-12B **Depth:** 31-31.5' **Sample Number:** 6C

▲ **Source of Sample:** TC-12B **Depth:** 35.5-36.5' **Sample Number:** 7

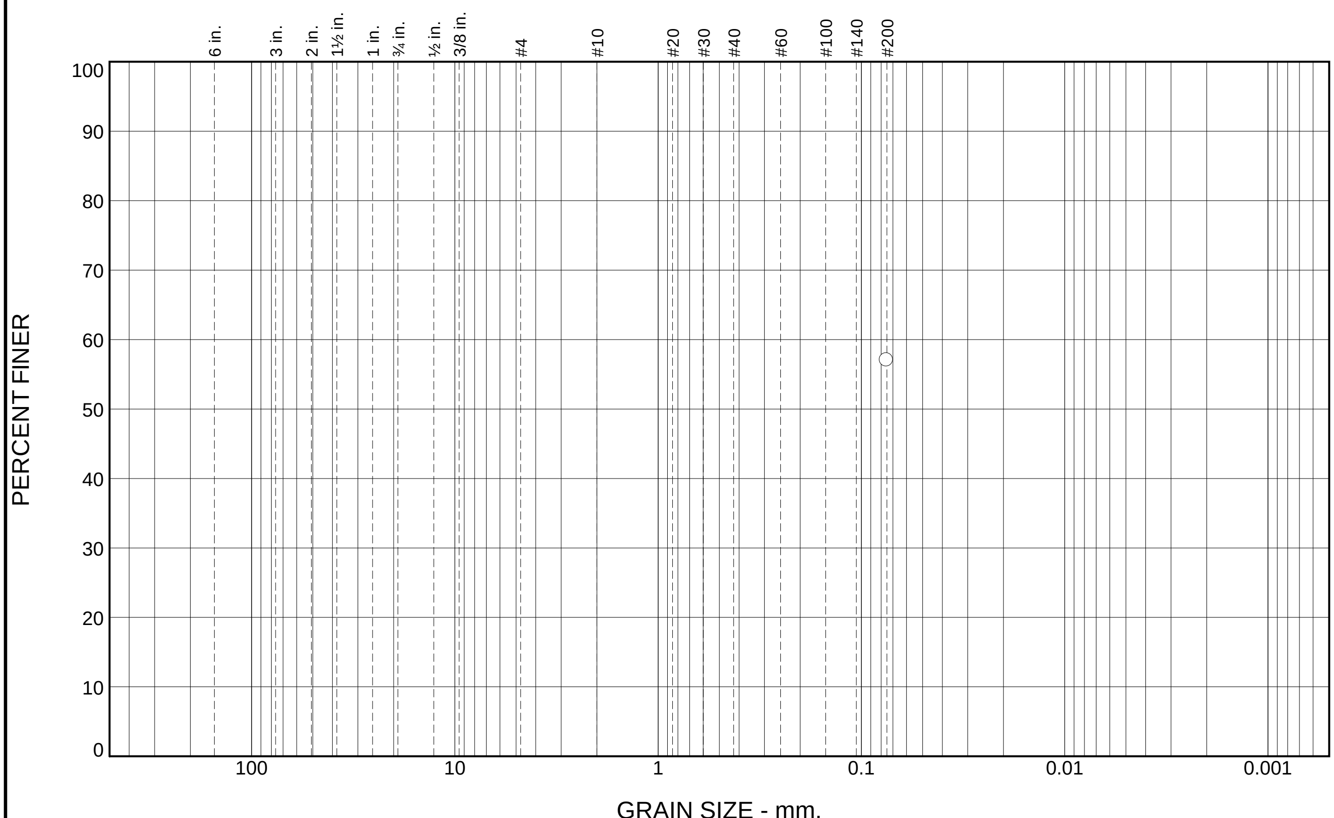
Remarks:

Blackburn Consulting

W. Sacramento, CA

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						57.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	57.0		

* (no specification provided)

Soil Description

SANDY SILT, dark yellowish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

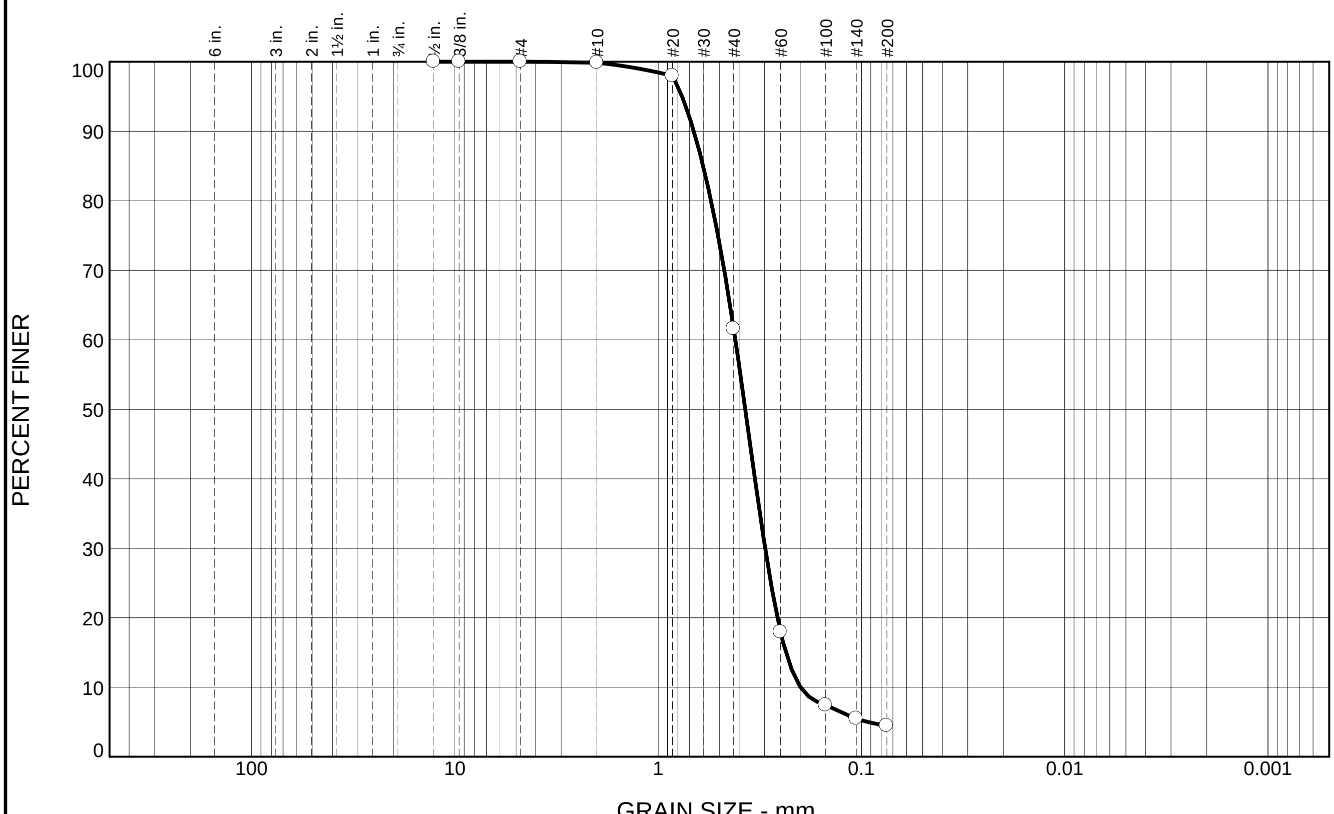
USCS= ML AASHTO=

Remarks

Source of Sample: TC-7A **Depth:** 25.5-26.5'
Sample Number: 6 **Date:**

Blackburn Consulting **W. Sacramento, CA**	**Client:** Jacobs Engineering Group Inc. **Project:** OPUD South Yuba Sewer Infrastructure **Project No:** 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	38.2	57.1	4.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	100.0		
#4	100.0		
#10	99.8		
#20	98.0		
#40	61.6		
#60	17.9		
#100	7.4		
#140	5.5		
#200	4.5		

* (no specification provided)

Soil Description

Poorly-graded SAND, dark brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6669 D_{85}= 0.6004 D_{60}= 0.4170
D_{50}= 0.3727 D_{30}= 0.2975 D_{15}= 0.2354
D_{10}= 0.1991 C_u= 2.09 C_c= 1.07

Classification

USCS= SP AASHTO=

Remarks

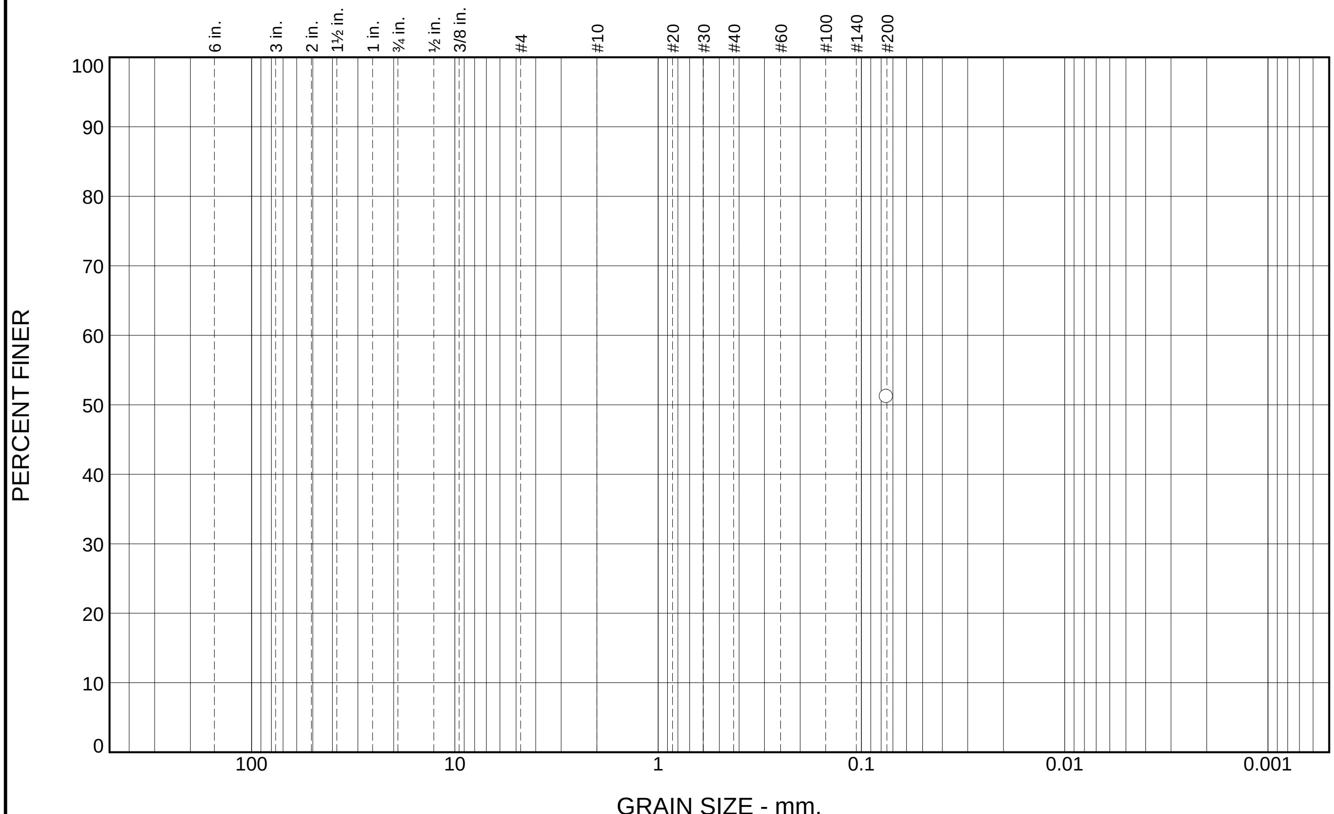
Source of Sample: TC-7A **Depth:** 35.5-36.5'
Sample Number: 8 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						51.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	51.2		

* (no specification provided)

Soil Description

SANDY SILT, dark brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Source of Sample: TC-7B **Depth:** 15.5-16.5'
Sample Number: 4 **Date:**

Blackburn Consulting

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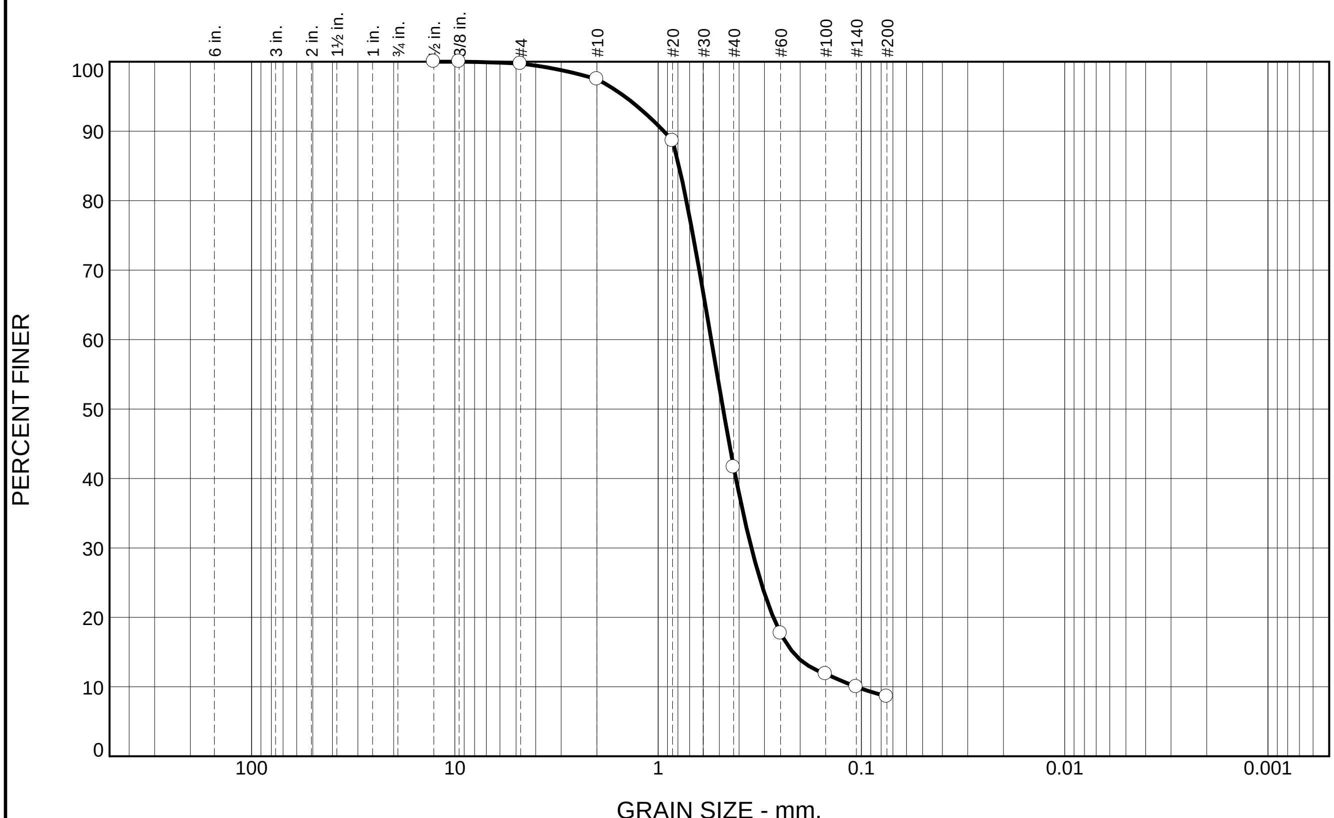
Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	2.2	55.9	33.0	8.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	100.0		
#4	99.7		
#10	97.5		
#20	88.6		
#40	41.6		
#60	17.7		
#100	11.9		
#140	10.0		
#200	8.6		

* (no specification provided)

Soil Description

Poorly-graded SAND with CLAY, dark brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.9393 D_{85}= 0.7907 D_{60}= 0.5483
D_{50}= 0.4794 D_{30}= 0.3475 D_{15}= 0.2176
D_{10}= 0.1059 C_u= 5.18 C_c= 2.08

Classification

USCS= AASHTO=

Remarks

Source of Sample: TC-7B **Depth:** 30.5-31.5'
Sample Number: 7

Date:

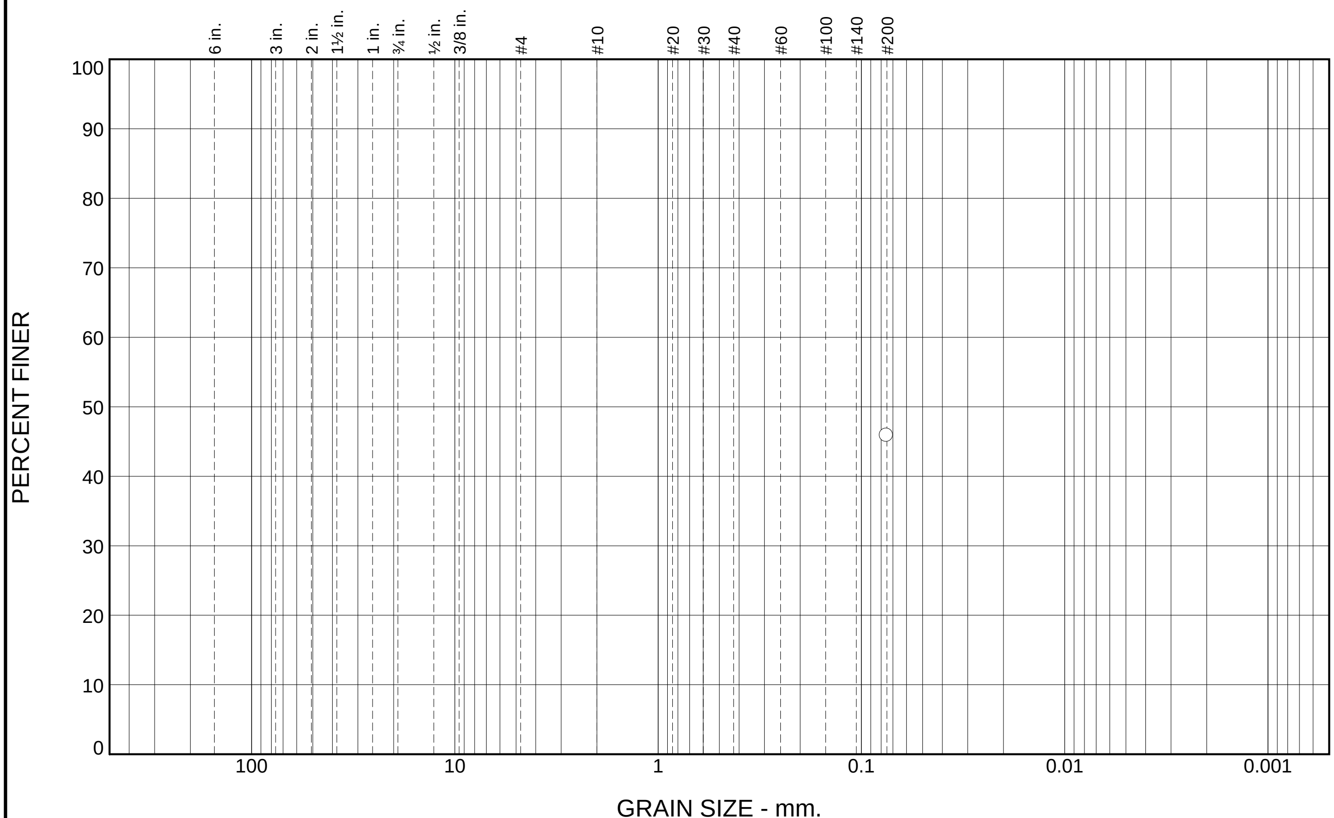
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						45.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	45.9		

* (no specification provided)

Soil Description

CLAYEY SAND, dark reddish brown

Atterberg Limits

PL= 15 LL= 27 PI= 12

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

Source of Sample: TC-9A **Depth:** 10.5-11.5'
Sample Number: 2

Date:

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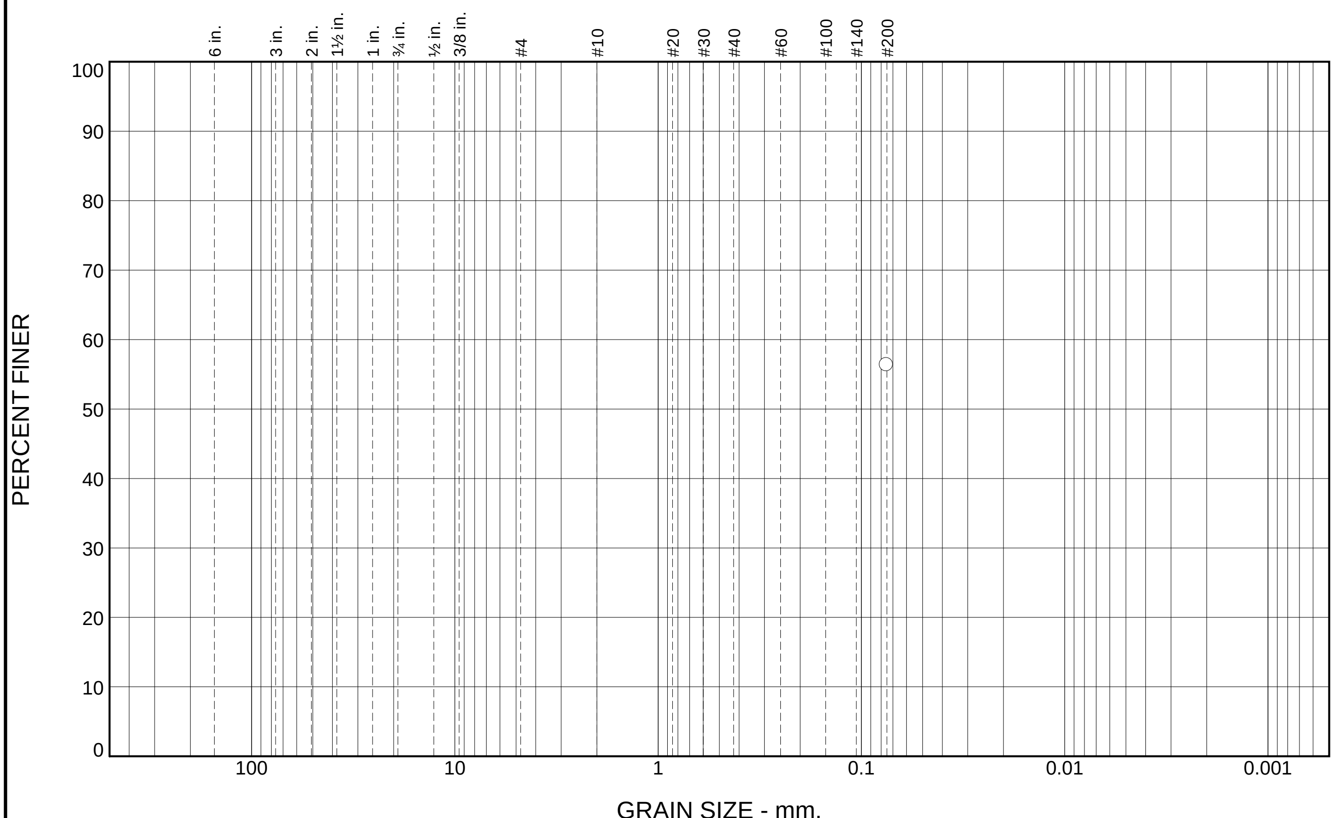
W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						56.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	56.3		

* (no specification provided)

Soil Description

Interbedded lenses of lean CLAY and CLAYEY SAND, yellowish brown

Atterberg Limits

PL= 21 LL= 38 PI= 17

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL,SC AASHTO=

Remarks

Source of Sample: TC-9A **Depth:** 25.5-26.5
Sample Number: 5 **Date:**

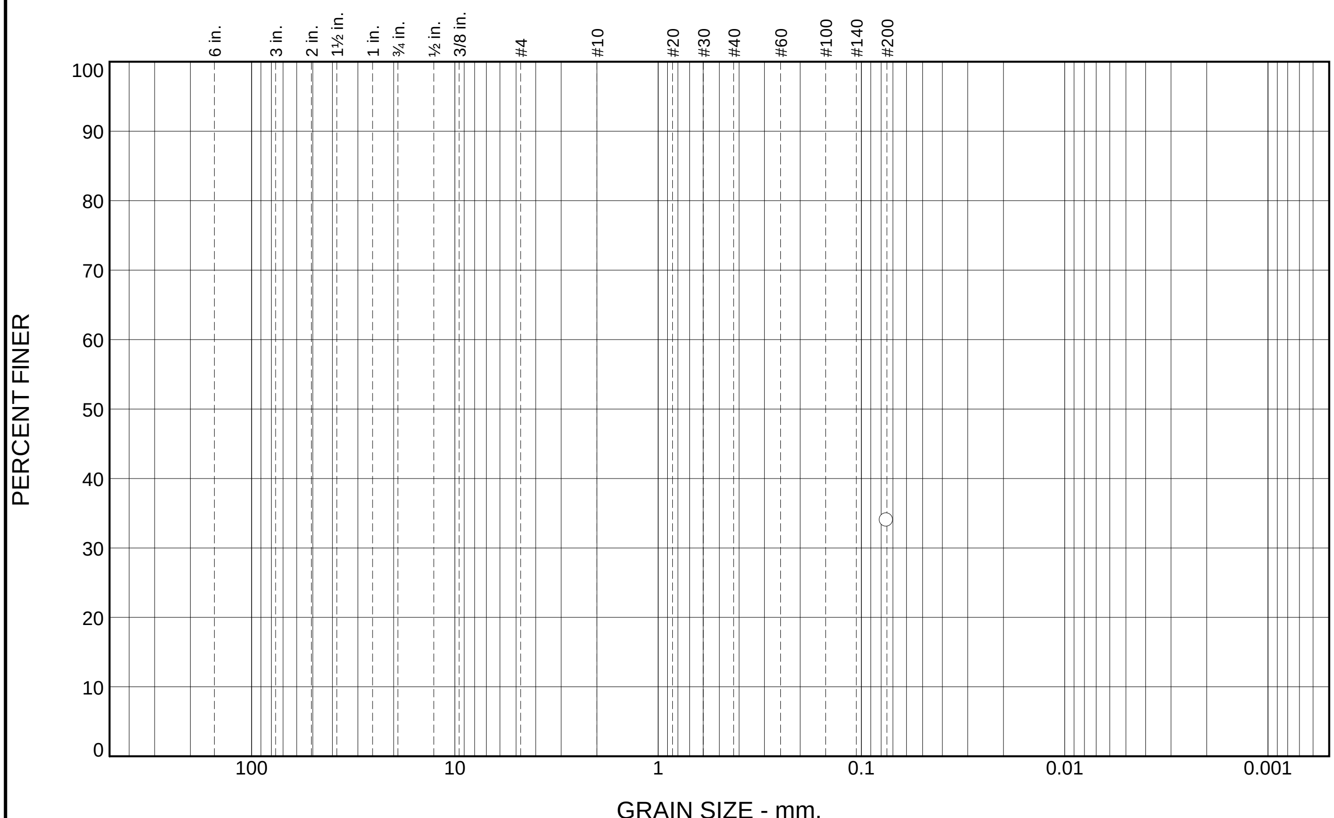
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						34.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	34.0		

* (no specification provided)

Soil Description

Interbedded lenses of SILTY SAND and SANDY SILT, dark yellowish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM,ML AASHTO=

Remarks

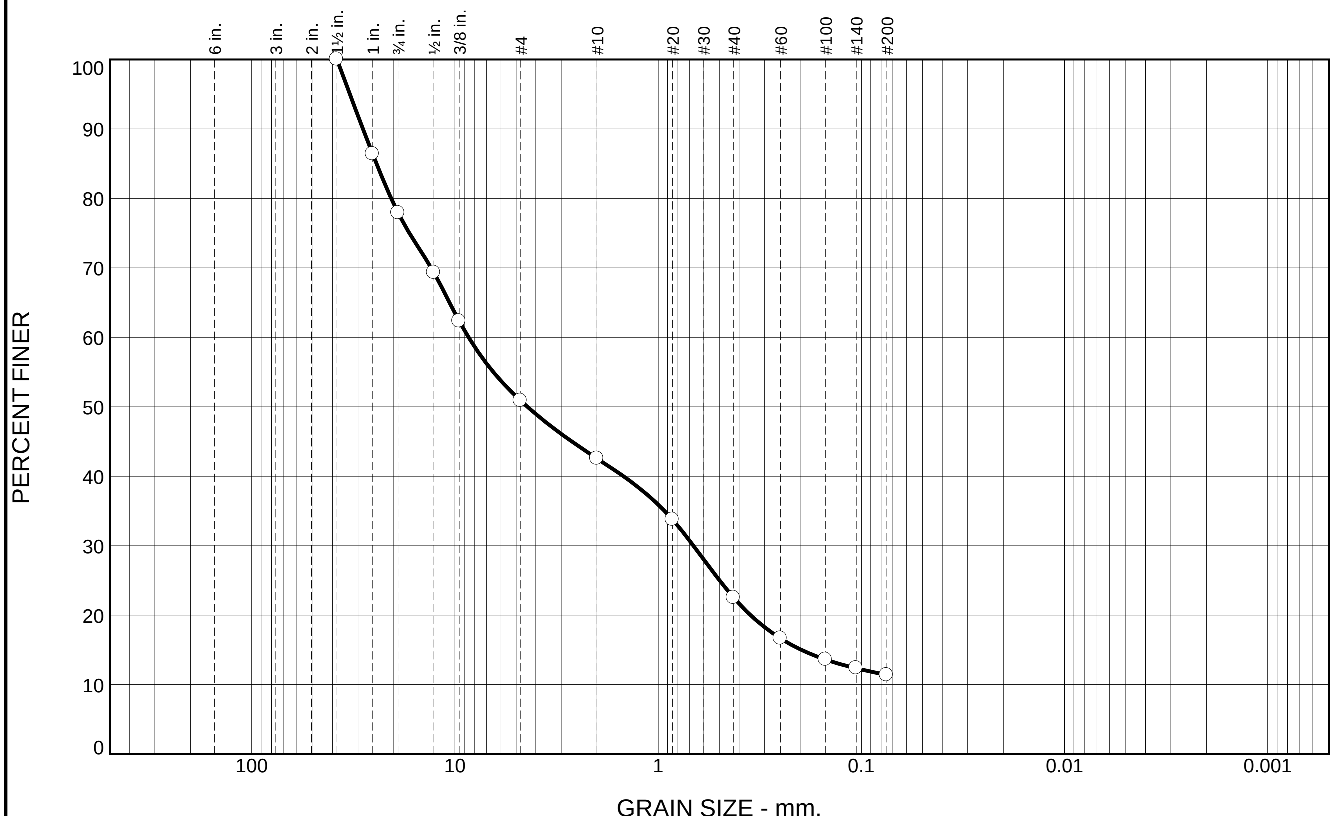
Source of Sample: TC-9A **Depth:** 35.5-36.5'
Sample Number: 7 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.1	27.0	8.4	20.0	11.1	11.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	86.4		
3/4"	77.9		
1/2"	69.3		
3/8"	62.3		
#4	50.9		
#10	42.5		
#20	33.8		
#40	22.5		
#60	16.7		
#100	13.6		
#140	12.4		
#200	11.4		

* (no specification provided)

Soil Description

Well-graded GRAVEL with CLAY and SAND, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 28.3540 D_{85}= 24.3262 D_{60}= 8.5712
D_{50}= 4.4008 D_{30}= 0.6706 D_{15}= 0.1973
D_{10}= C_u= C_c=

Classification

USCS= GW-GC AASHTO=

Remarks

Source of Sample: TC-10B **Depth:** 15.5-16.5'
Sample Number: 4 **Date:**

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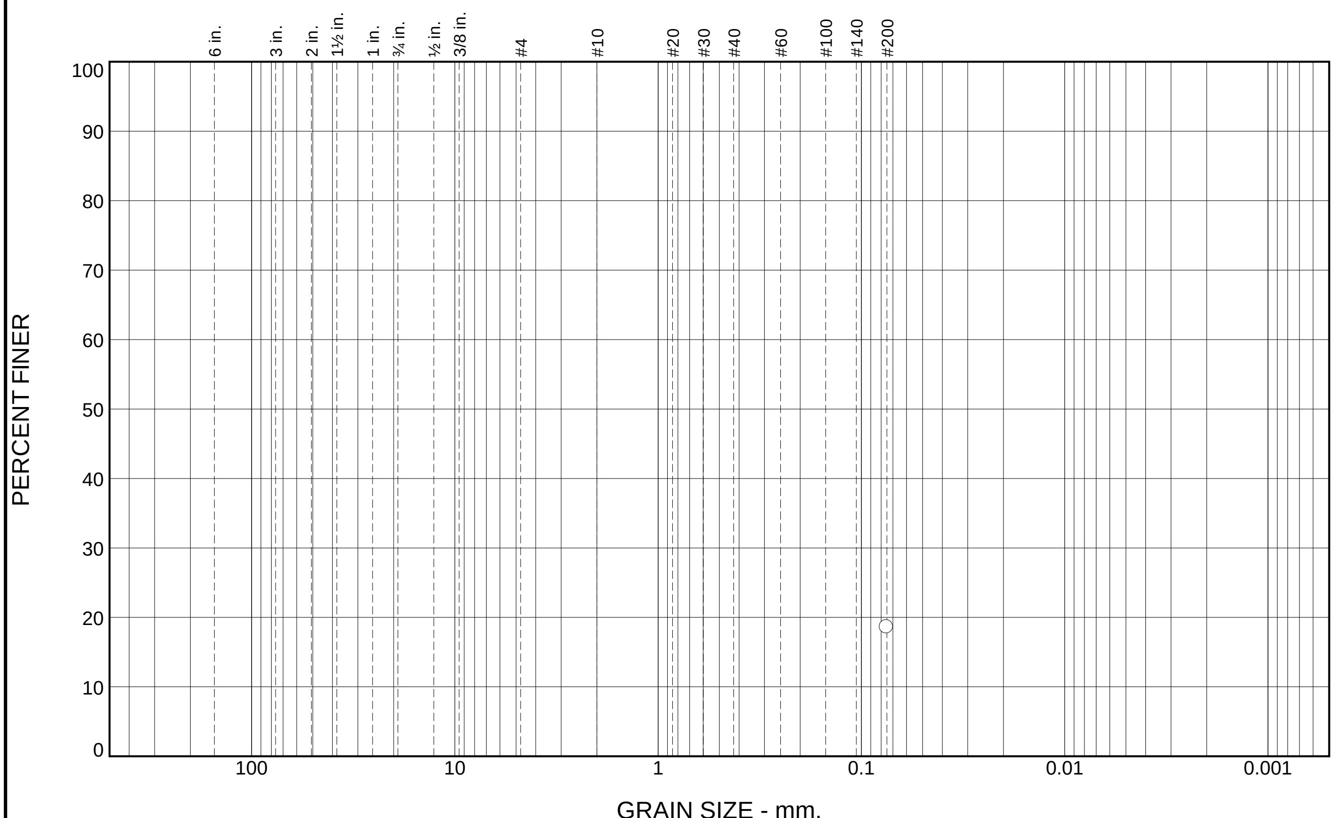
Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						18.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	18.6		

* (no specification provided)

Soil Description

SILTY SAND, dark olive brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

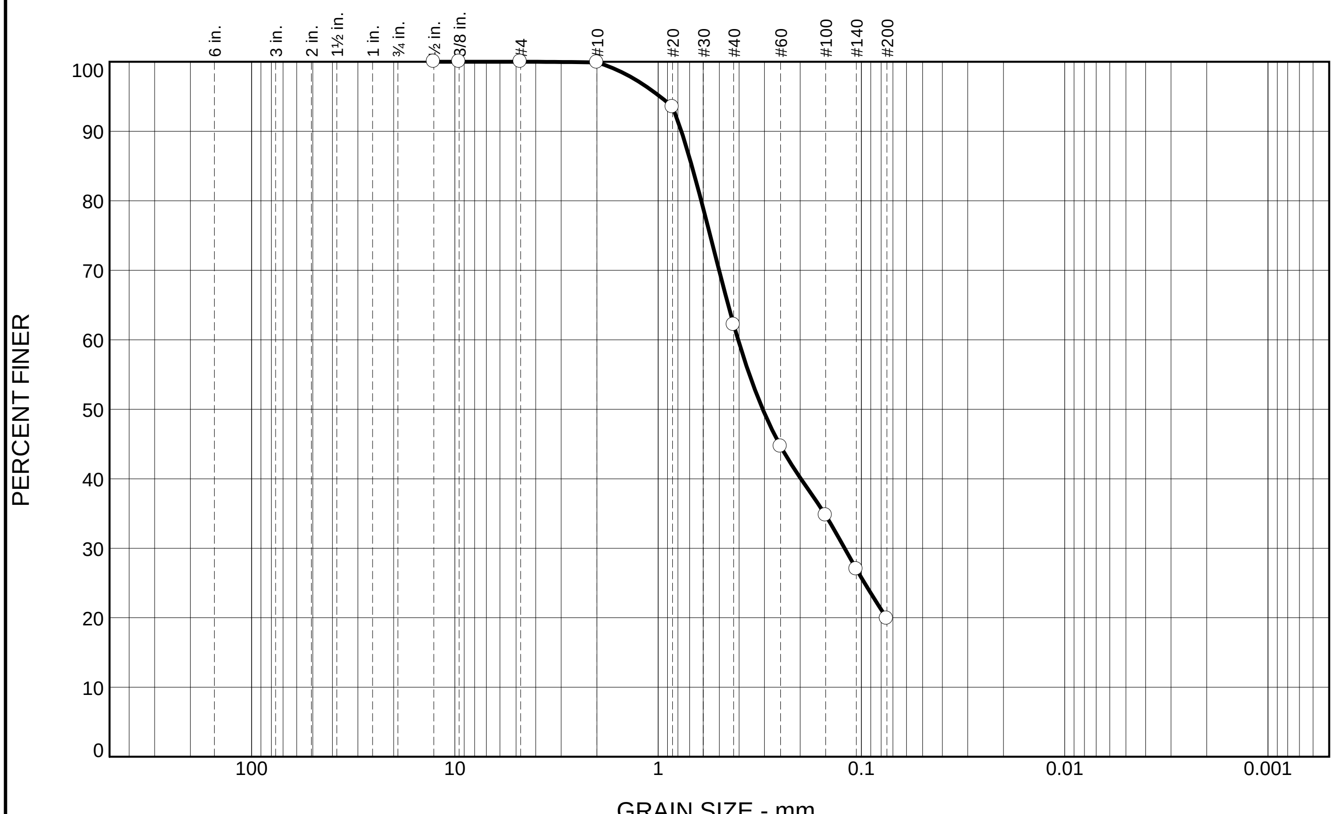
Source of Sample: TC-10B **Depth:** 25.5-26.5'
Sample Number: 6 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	37.7	42.3	19.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	100.0		
#4	100.0		
#10	99.9		
#20	93.5		
#40	62.2		
#60	44.7		
#100	34.7		
#140	27.0		
#200	19.9		

* (no specification provided)

Soil Description

SILTY SAND, dark yellowish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.7686 D_{85}= 0.6823 D_{60}= 0.4042
D_{50}= 0.3057 D_{30}= 0.1210 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

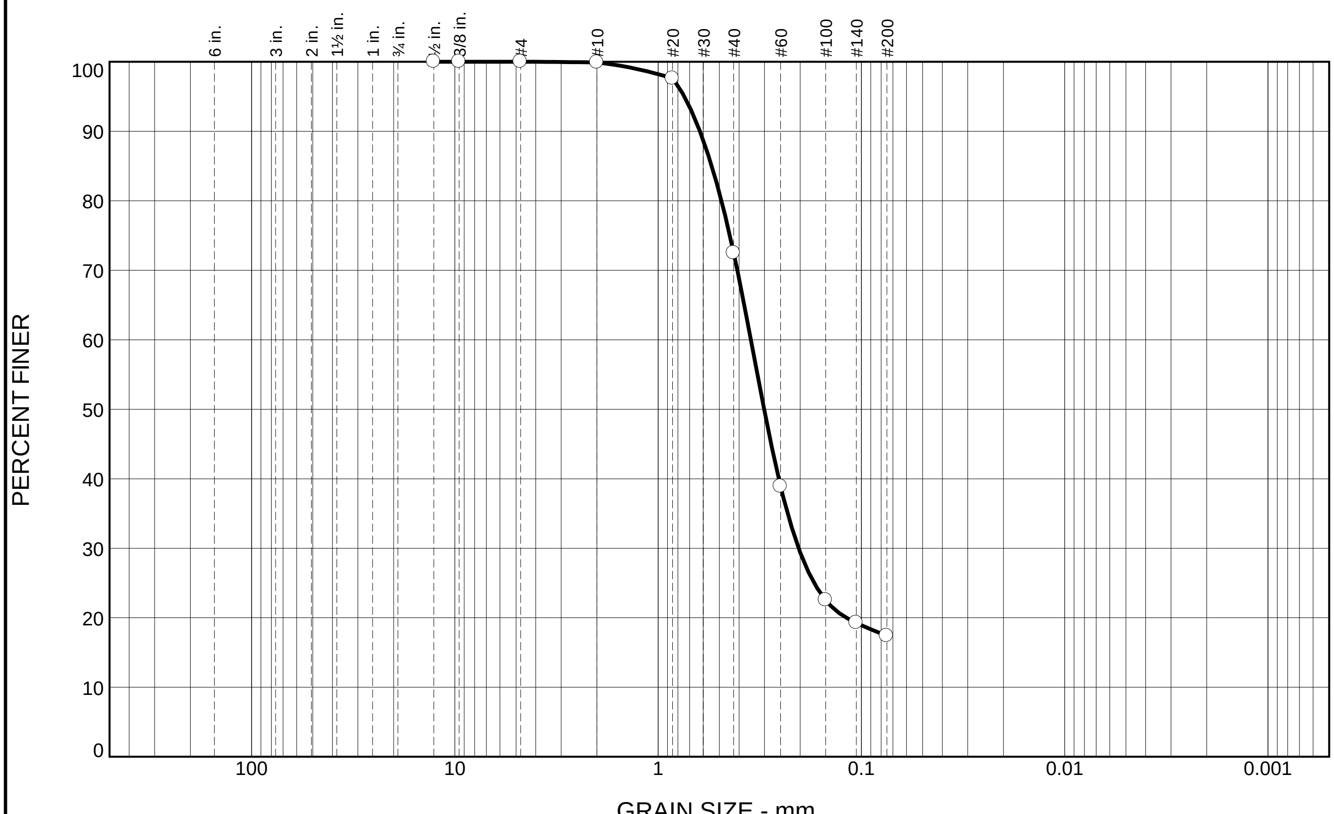
Source of Sample: TC-2C **Depth:** 30.5-31'
Sample Number: 8B **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	27.4	55.1	17.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	100.0		
#4	100.0		
#10	99.9		
#20	97.6		
#40	72.5		
#60	38.9		
#100	22.5		
#140	19.3		
#200	17.4		

* (no specification provided)

Soil Description

CLAYEY SAND, dark brown

Atterberg Limits

PL= 13 LL= 28 PI= 15

Coefficients

D_{90}= 0.6228 D_{85}= 0.5452 D_{60}= 0.3497
D_{50}= 0.3010 D_{30}= 0.2037 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

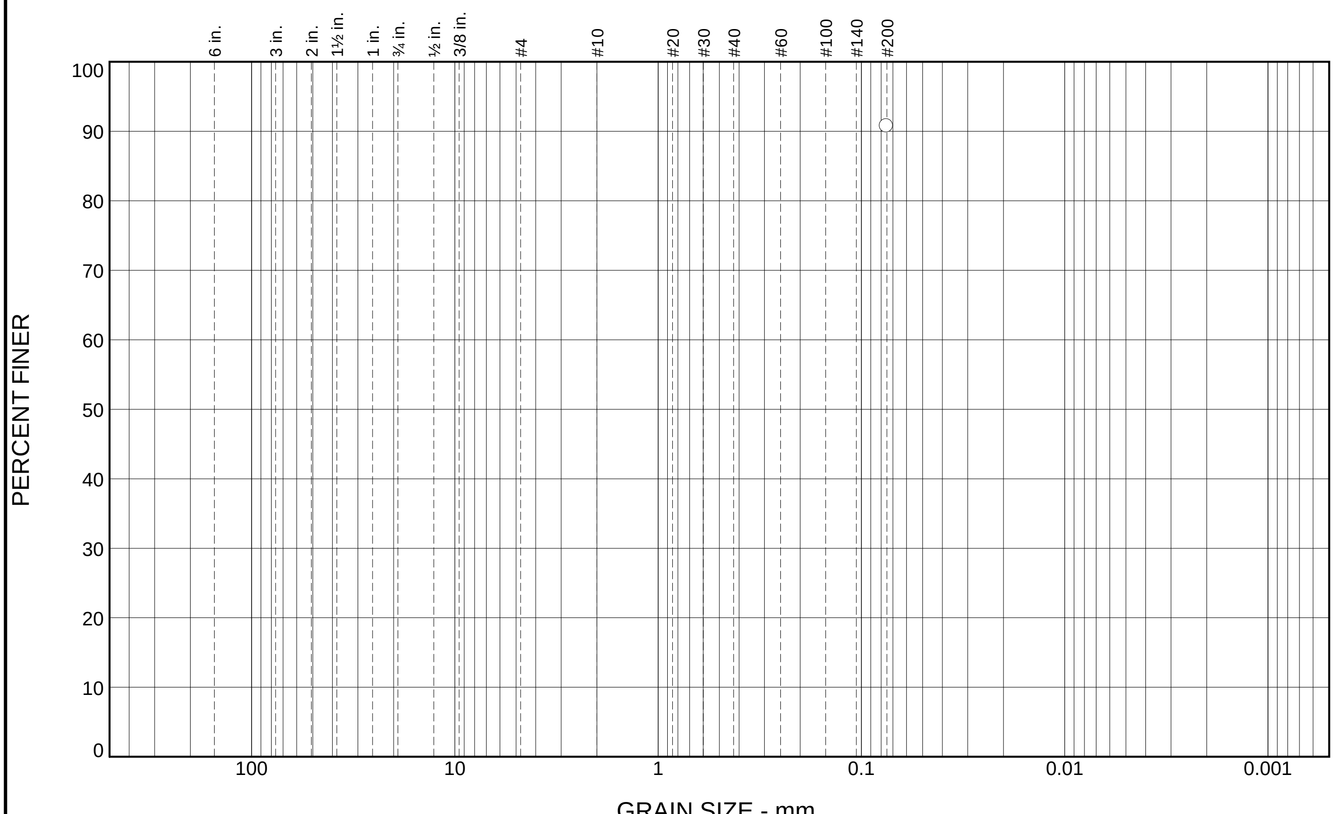
Source of Sample: TC-8A **Depth:** 15.5-16.5'
Sample Number: 3 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						90.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	90.7		

* (no specification provided)

Soil Description

Lean CLAY, dark greenish gray

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

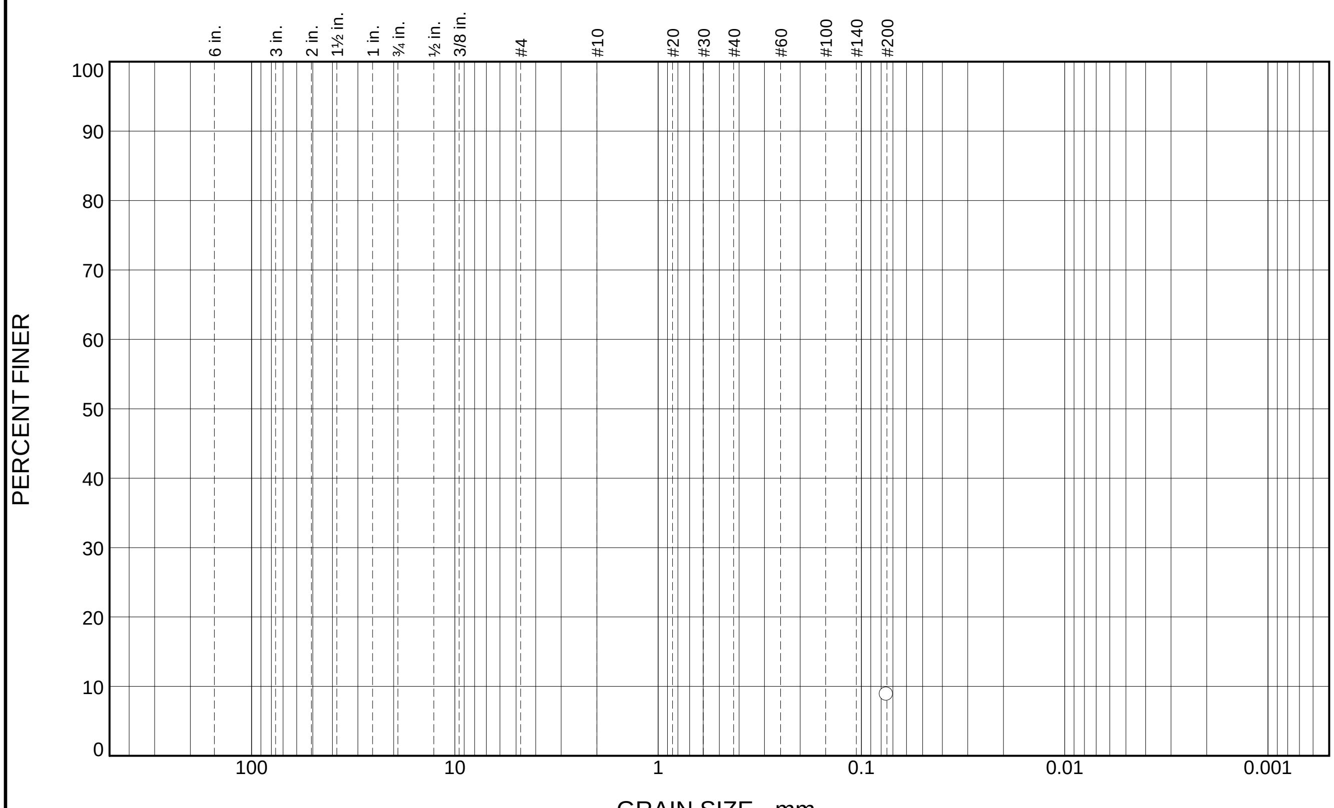
Source of Sample: TC-8A **Depth:** 25.5-26'
Sample Number: 5B **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						8.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	8.9		

* (no specification provided)

Soil Description

Poorly-graded GRAVEL with CLAY and SAND, grayish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GP-GC AASHTO=

Remarks

Source of Sample: TC-8B **Depth:** 15.5-16.5'
Sample Number: 4

Date:

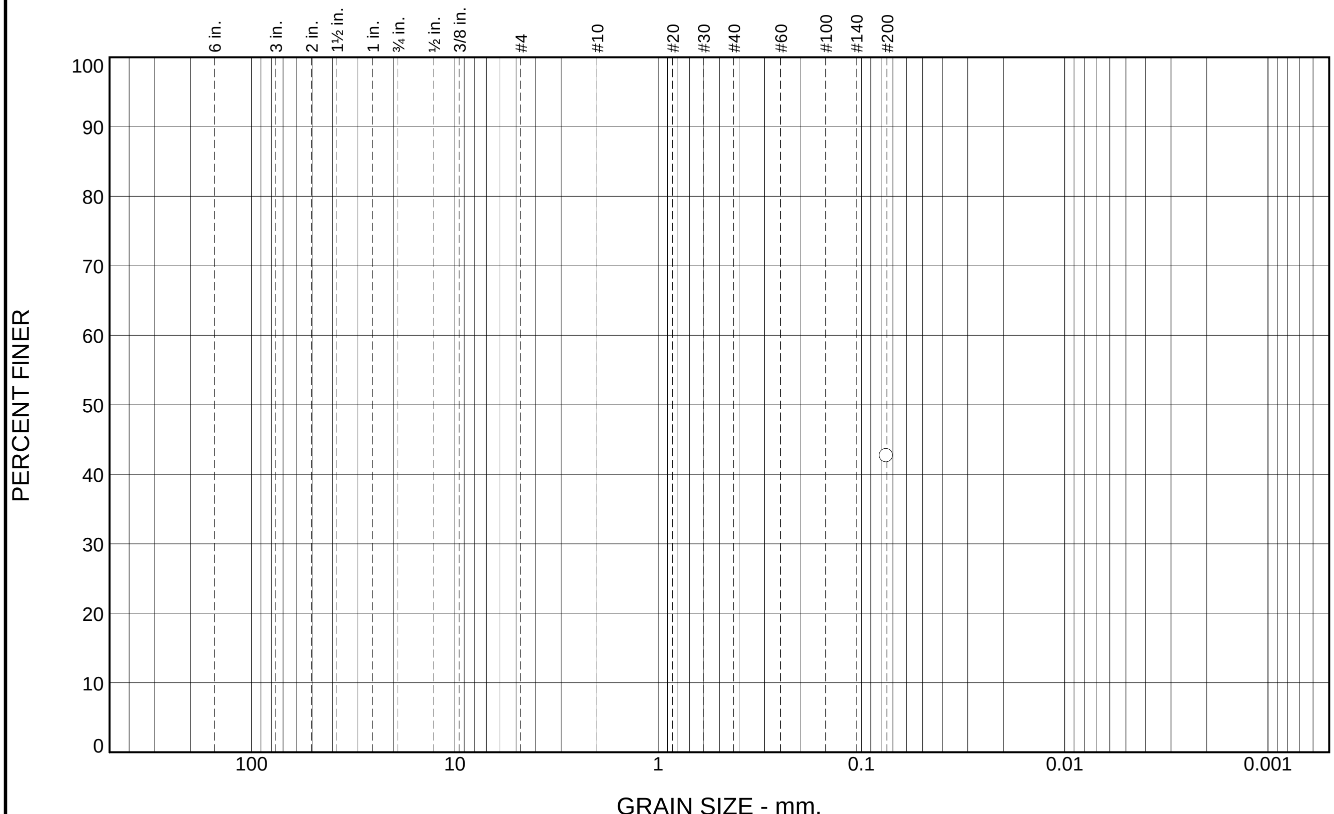
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						42.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	42.6		

* (no specification provided)

Soil Description

SILTY SAND, dark yellowish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: TC-8B **Depth:** 30.5-31'
Sample Number: 7B

Date:

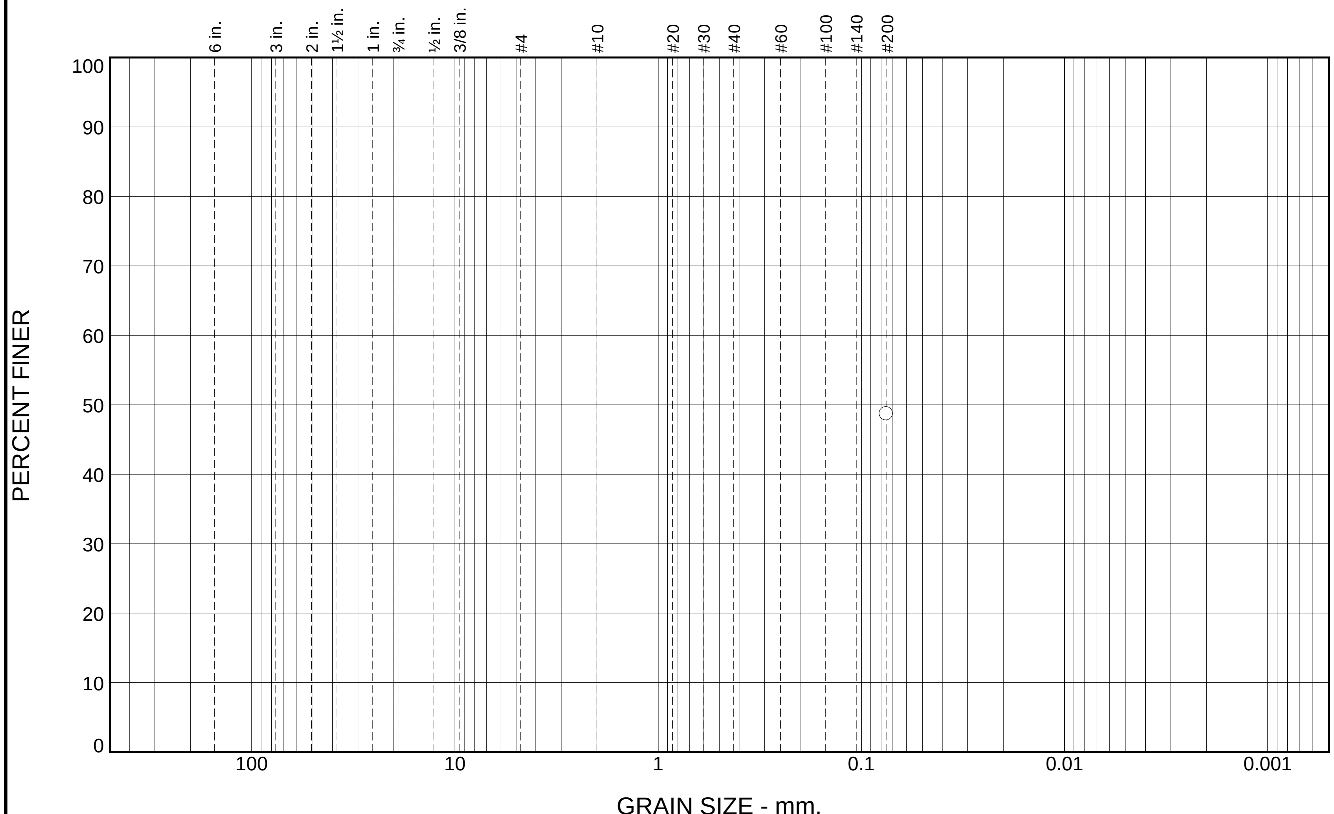
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						48.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	48.6		

* (no specification provided)

Soil Description

CLAYEY SAND, dark yellowish brown

Atterberg Limits

PL= 16 LL= 27 PI= 11

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

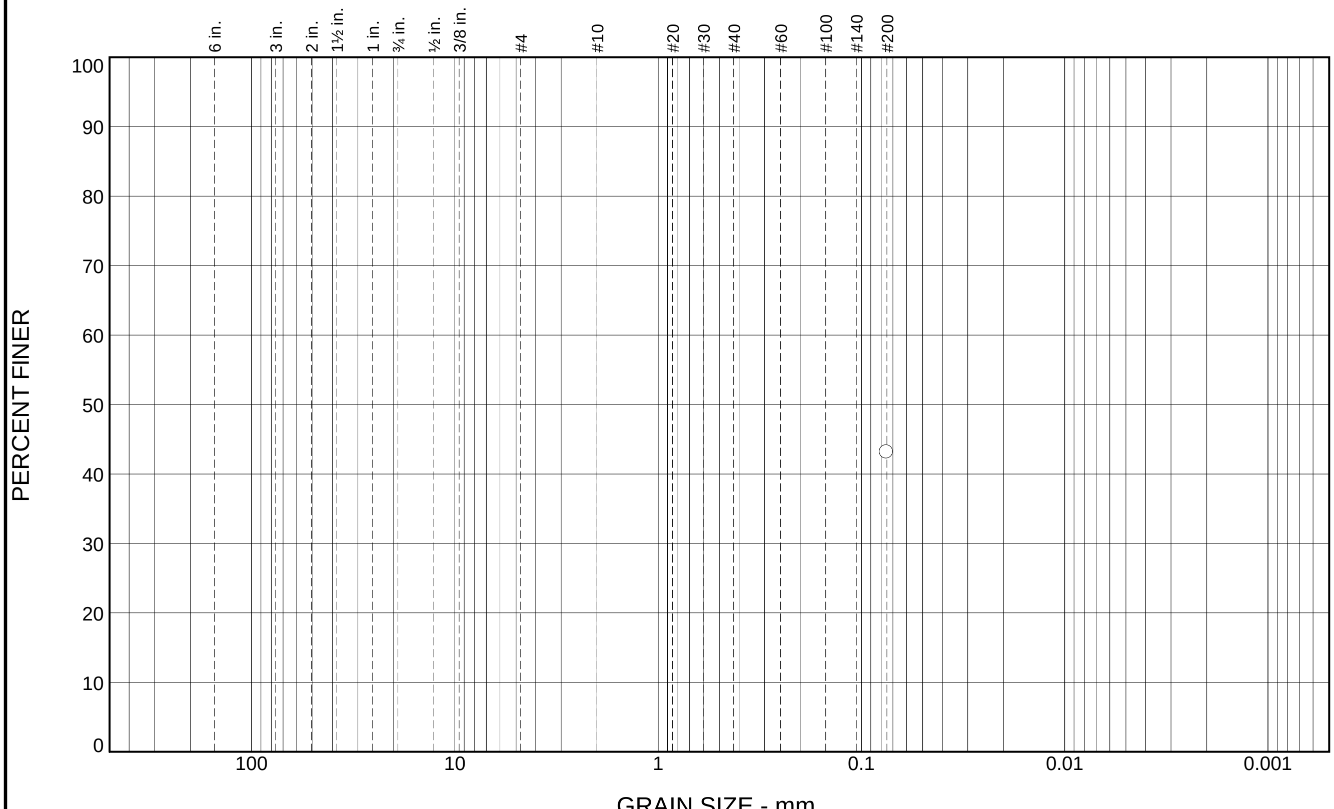
USCS= SC AASHTO=

Remarks

Source of Sample: TC-8B **Depth:** 35.5-36'
Sample Number: 8B **Date:**

Blackburn Consulting **W. Sacramento, CA**	**Client:** Jacobs Engineering Group Inc. **Project:** OPUD South Yuba Sewer Infrastructure **Project No:** 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						43.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	43.1		

* (no specification provided)

Soil Description

SILTY SAND, yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

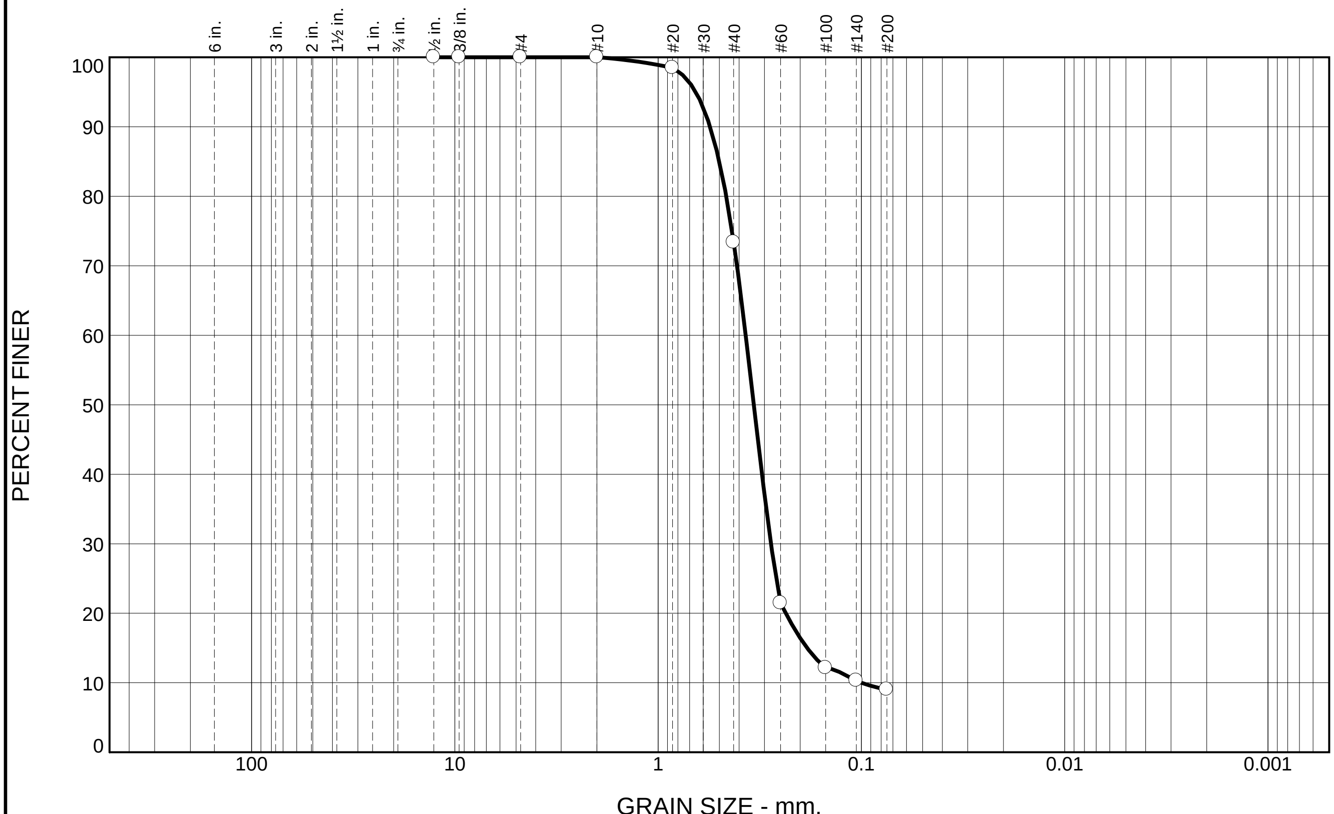
Source of Sample: TC-10A **Depth:** 30.5-31'
Sample Number: 7B **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	26.6	64.4	9.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	100.0		
#4	100.0		
#10	100.0		
#20	98.5		
#40	73.4		
#60	21.5		
#100	12.1		
#140	10.3		
#200	9.0		

* (no specification provided)

Soil Description

Poorly-graded SAND with SILT, dark reddish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.5551 D_{85}= 0.5005 D_{60}= 0.3708
D_{50}= 0.3383 D_{30}= 0.2787 D_{15}= 0.1848
D_{10}= 0.0999 C_u= 3.71 C_c= 2.10

Classification

USCS= SP-SM AASHTO= A-3

Remarks

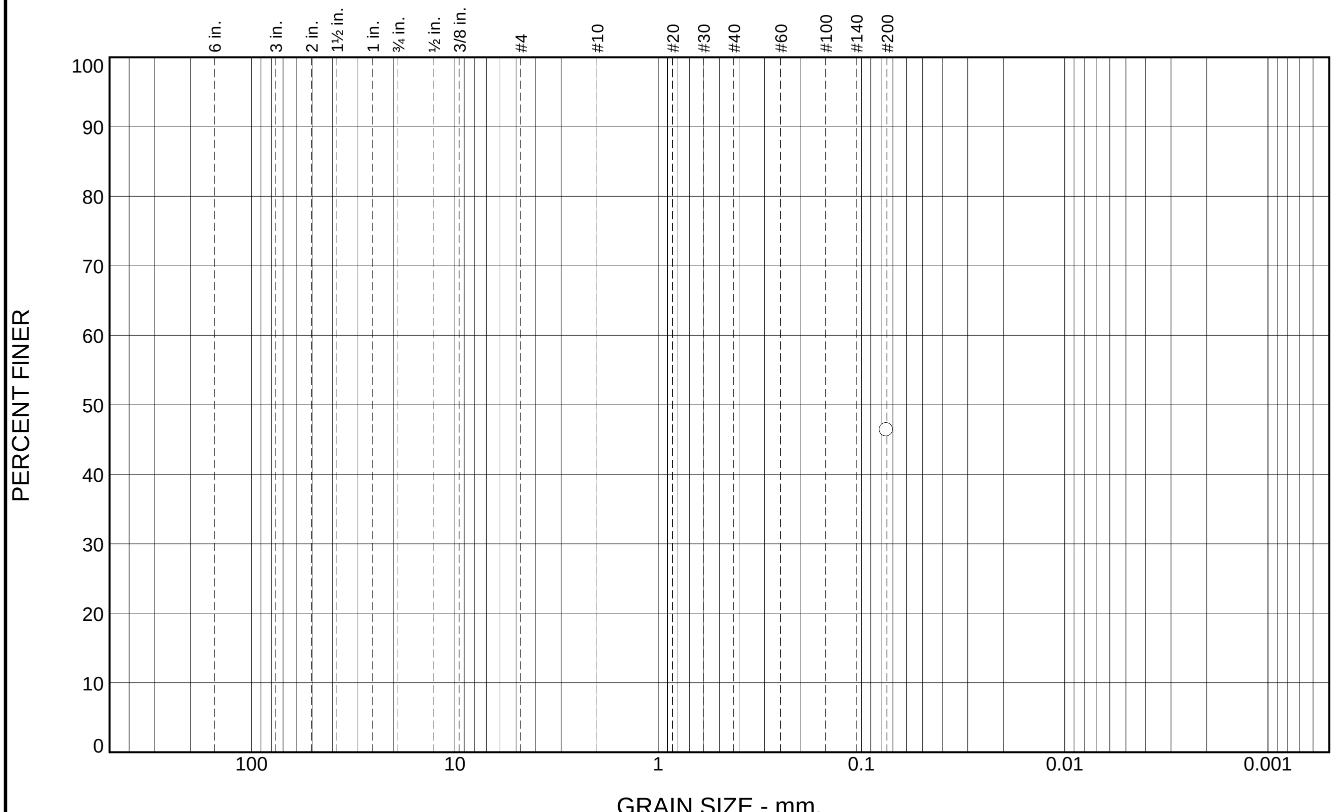
Source of Sample: TC-12A **Depth:** 20.5-21.5'
Sample Number: 5 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						46.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	46.4		

* (no specification provided)

Soil Description

SILTY SAND, dark yellowish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: TC-12B **Depth:** 35.5-36.5'
Sample Number: 7 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-2C, 6B
Type of Sample:	2.4" Cal Mod
Sample Description:	Lean CLAY with SAND, yellowish brown
Depth:	20.5-21'

Sample Data

Sample Length:	5.27	in	Sample + Tube:	692	g
Diameter:	2.40	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.19		Sample Weight:	692	g
Sample Area:	4.54	in^2	Wet Density:	110.2	pcf
Sample Volume:	23.9	in^3	Moisture:	41.3	%
Specific Gravity:	2.65	(assumed)	Dry Density:	78.0	pcf
			Saturation:	97.6	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0200	in/min
Deflection at Max. Load:	0.140	in
Maximum Load:	152	lbs
Strain at Failure:	2.66	%
Average cross-sectional area at failure:	4.66	in^2
Compressive Strength:	**2.35**	**tsf**
	32.7	**psi**

Strain Information

Rate of Strain ½%:	0.026	in/min
Rate of Strain 2%:	0.105	in/min
Strain Rate:	0.020	in/min
15% Strain:	0.791	in

Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-6A-5C
Type of Sample:	2.4" Cal Mod
Sample Description:	Fat CLAY, yellowish brown
Depth:	26-26.5’

Sample Data

Sample Length:	5.26	in	Sample + Tube:	738	g
Diameter:	2.39	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.20		Sample Weight:	738	g
Sample Area:	4.47	in^2	Wet Density:	119.7	pcf
Sample Volume:	23.5	in^3	Moisture:	29	%
Specific Gravity:	2.65	(assumed)	Dry Density:	93.0	pcf
			Saturation:	97.7	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0500	in/min
Deflection at Max. Load:	0.135	in
Maximum Load:	112	lbs
Strain at Failure:	2.56	%
Average cross-sectional area at failure:	4.58	in^2
Compressive Strength:	**1.75**	**tsf**
	24.4	**psi**

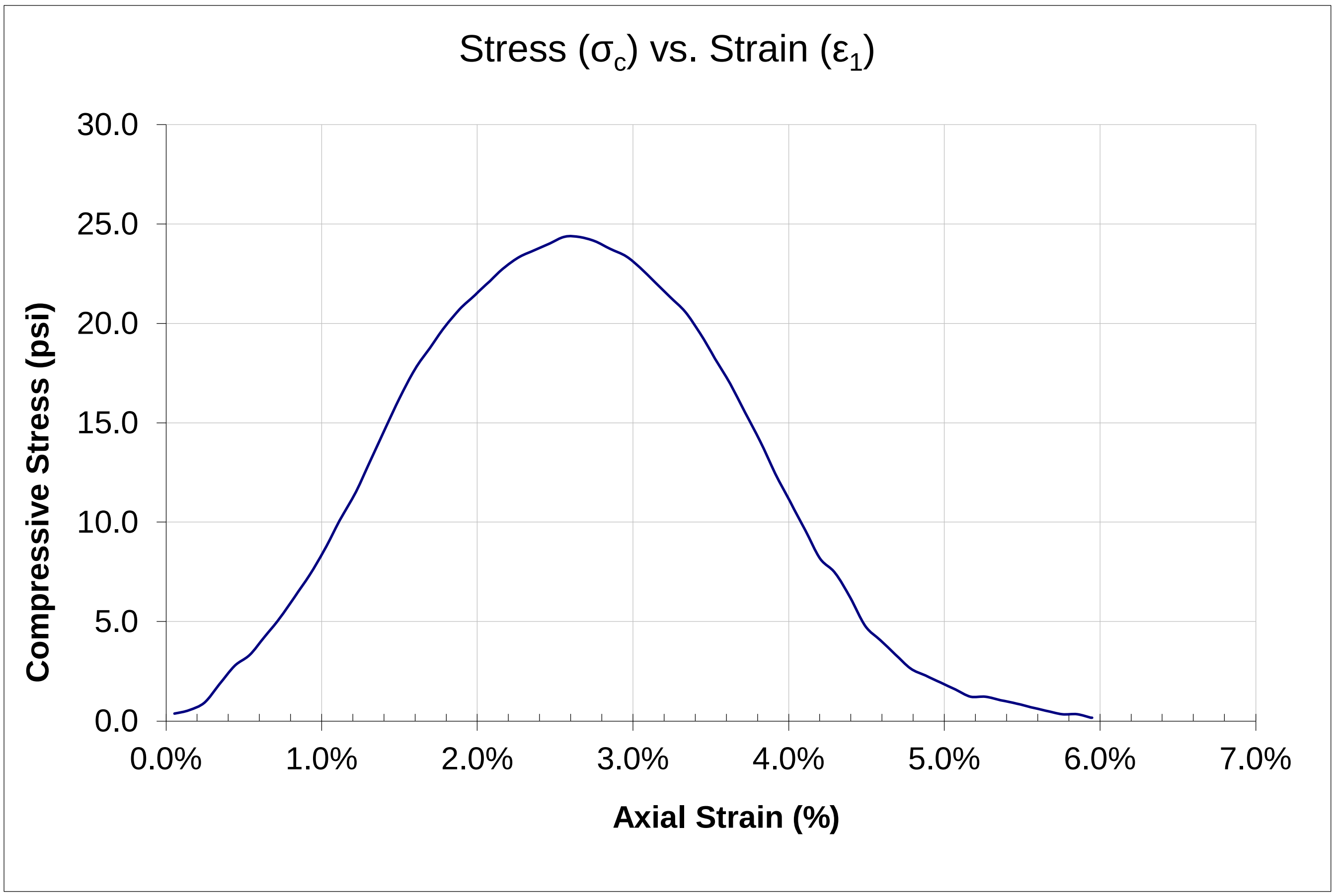
Strain Information

Rate of Strain ½%:	0.026	in/min
Rate of Strain 2%:	0.105	in/min
Strain Rate:	0.050	in/min
15% Strain:	0.788	in

Unconfined Compression
ASTM D 2166

Project Name: OPUD
Project Number: 3842.X
Sample ID: TC-6A-5C
Type of Sample: 2.4" Cal Mod
Sample Description: Fat CLAY, yellowish brown
Depth: 26-26.5’

Compressive Strength:	**1.75**	**tsf**
	24.4	**psi**



Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-9B-6B
Type of Sample:	2.4" Cal Mod
Sample Description:	Lean CLAY with SAND, strong brown
Depth:	25.5-26’

Sample Data

Sample Length:	5.02	in	Sample + Tube:	672	g
Diameter:	2.39	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.10		Sample Weight:	672	g
Sample Area:	4.49	in^2	Wet Density:	113.4	pcf
Sample Volume:	22.6	in^3	Moisture:	40	%
Specific Gravity:	2.65	(assumed)	Dry Density:	81.3	pcf
			Saturation:	101.4	%

**Moisture content taken after test*

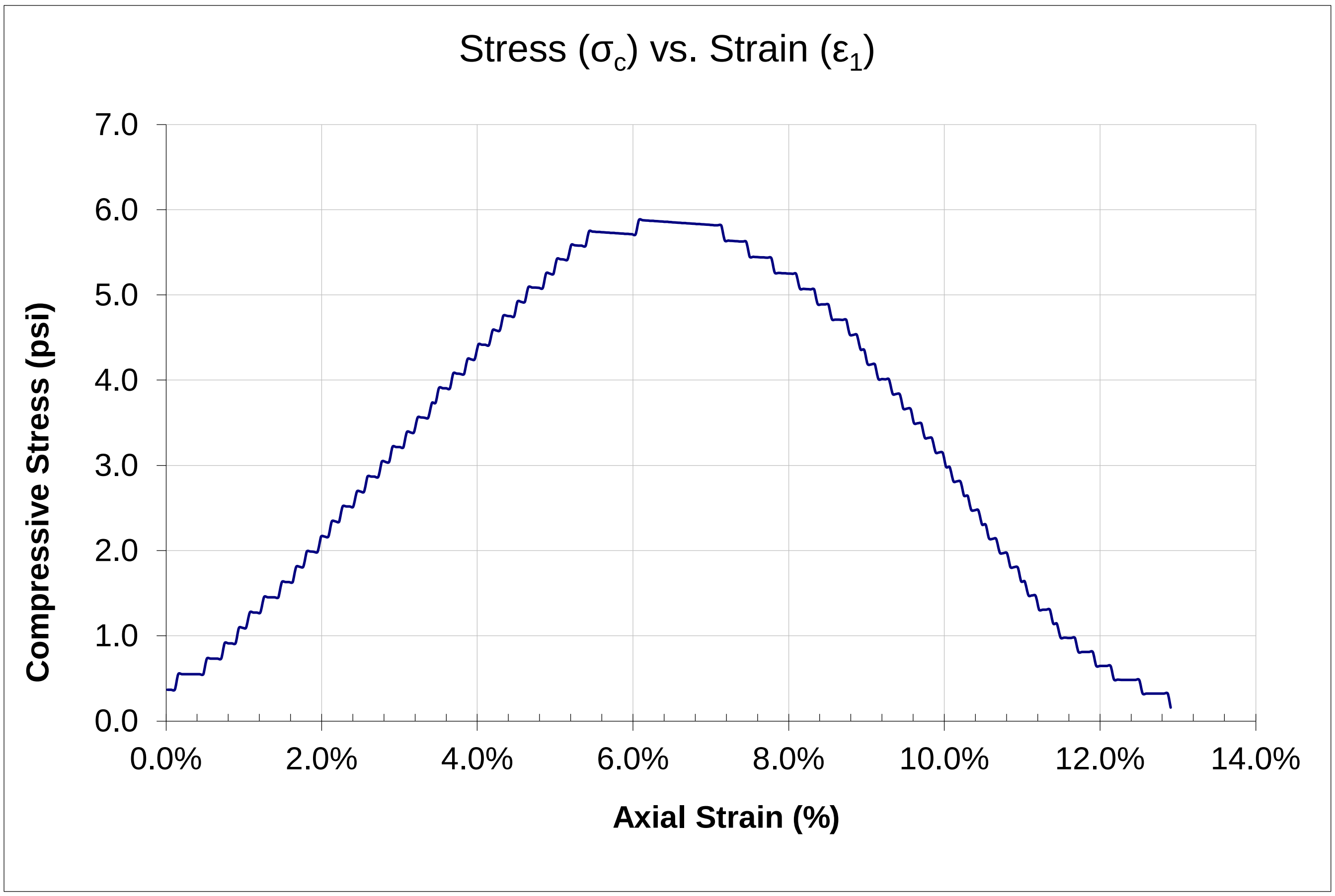
Test Results			**Strain Information**		
Rate of Strain:	0.0200	in/min	Rate of Strain ½%:	0.025	in/min
Deflection at Max. Load:	0.195	in	Rate of Strain 2%:	0.100	in/min
Maximum Load:	20	lbs	Strain Rate:	0.020	in/min
Strain at Failure:	6.08	%	15% Strain:	0.753	in
Average cross-sectional area at failure:	4.78	in^2			
Compressive Strength:	**0.42**	**tsf**			
	5.9	**psi**			

Unconfined Compression
ASTM D 2166

blackburn consulting

Project Name: OPUD
Project Number: 3842.X
Sample ID: TC-9B-6B
Type of Sample: 2.4" Cal Mod
Sample Description: Lean CLAY with SAND, strong brown
Depth: 25.5-26'

Compressive Strength:	**0.42**	**tsf**
	5.9	**psi**



Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-9B-7C
Type of Sample:	2.4" Cal Mod
Sample Description:	SILT, dark yellowish brown
Depth:	31-31.5’

Sample Data

Sample Length:	5.19	in	Sample + Tube:	694	g
Diameter:	2.40	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.16		Sample Weight:	694	g
Sample Area:	4.52	in^2	Wet Density:	112.5	pcf
Sample Volume:	23.5	in^3	Moisture:	43	%
Specific Gravity:	2.65	(assumed)	Dry Density:	78.9	pcf
			Saturation:	103.0	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0200	in/min
Deflection at Max. Load:	0.242	in
Maximum Load:	56	lbs
Strain at Failure:	4.65	%
Average cross-sectional area at failure:	4.74	in^2
Compressive Strength:	**0.85**	**tsf**
	11.9	**psi**

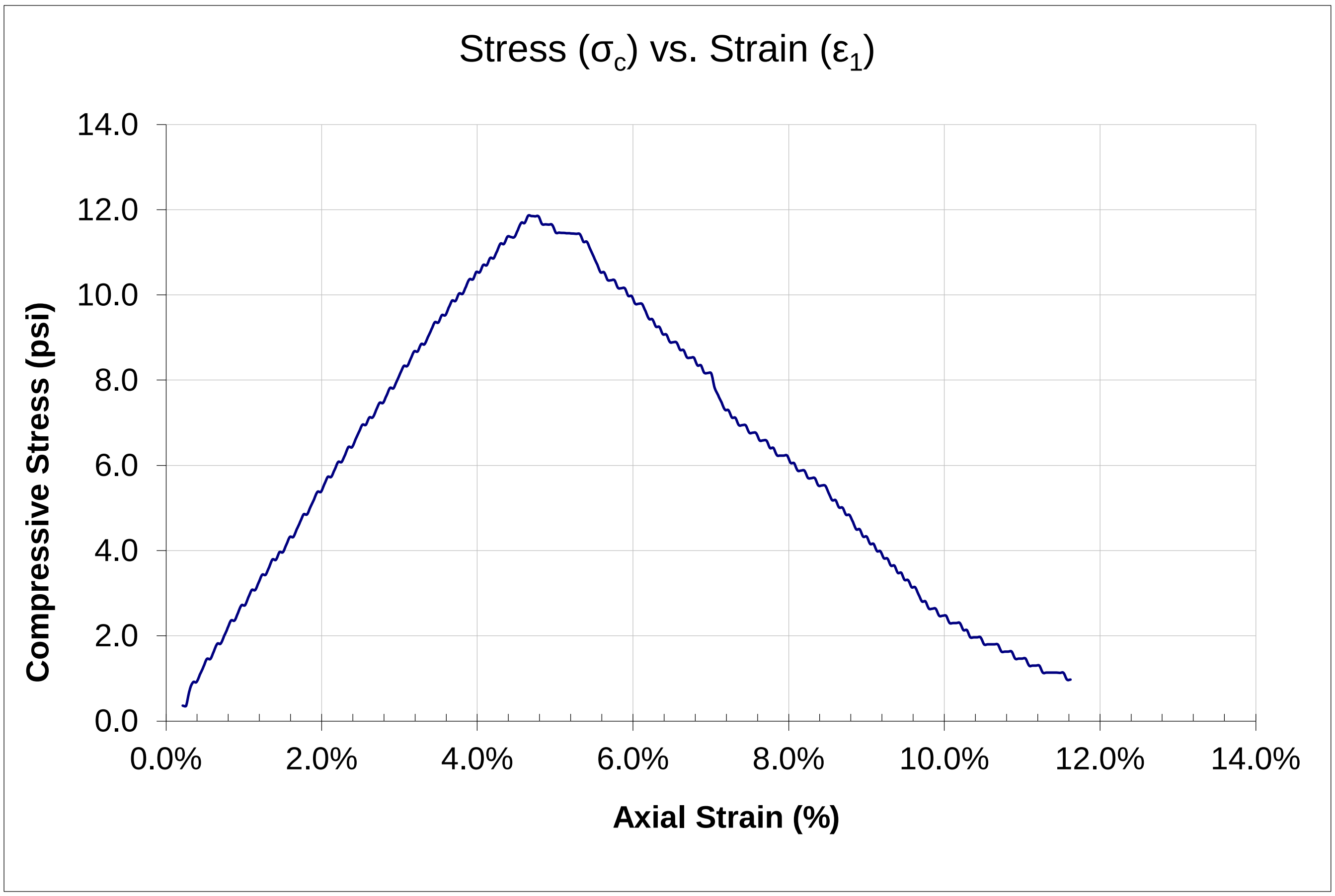
Strain Information

Rate of Strain ½%:	0.026	in/min
Rate of Strain 2%:	0.104	in/min
Strain Rate:	0.020	in/min
15% Strain:	0.779	in

Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-9B-7C
Type of Sample:	2.4" Cal Mod
Sample Description:	SILT, dark yellowish brown
Depth:	31-31.5'

Compressive Strength:	**0.85**	**tsf**
	11.9	**psi**



Unconfined Compression
ASTM D 2166

blackburn consulting

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-10A, 8B
Type of Sample:	2.4" Cal Mod
Sample Description:	SILTY SAND, strong brown
Depth:	35.5-36'

Sample Data

Sample Length:	5.00	in	Sample + Tube:	768	g
Diameter:	2.41	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.08		Sample Weight:	768	g
Sample Area:	4.56	in^2	Wet Density:	128.3	pcf
Sample Volume:	22.8	in^3	Moisture:	22.2	%
Specific Gravity:	2.65	(assumed)	Dry Density:	105.0	pcf
			Saturation:	102.2	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0300	in/min
Deflection at Max. Load:	0.083	in
Maximum Load:	26	lbs
Strain at Failure:	1.67	%
Average cross-sectional area at failure:	4.64	in^2
Compressive Strength:	**0.41**	**tsf**
	5.7	**psi**

Strain Information

Rate of Strain ½%:	0.025	in/min
Rate of Strain 2%:	0.100	in/min
Strain Rate:	0.030	in/min
15% Strain:	0.750	in

Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-12B-6C
Type of Sample:	2.4" Cal Mod
Sample Description:	SILT, yellowish brown
Depth:	31-31.5

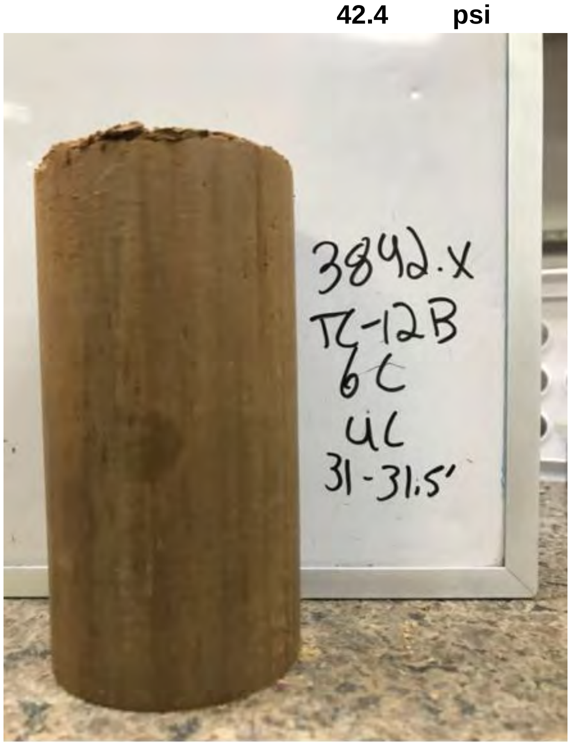
Sample Data

Sample Length:	4.87	in	Sample + Tube:	682	g
Diameter:	2.39	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.04		Sample Weight:	682	g
Sample Area:	4.47	in^2	Wet Density:	119.4	pcf
Sample Volume:	21.7	in^3	Moisture:	34	%
Specific Gravity:	2.65	(assumed)	Dry Density:	89.2	pcf
			Saturation:	105.2	%

**Moisture content taken after test*

Test Results			**Strain Information**		
Rate of Strain:	0.0200	in/min	Rate of Strain ½%:	0.024	in/min
Deflection at Max. Load:	0.191	in	Rate of Strain 2%:	0.097	in/min
Maximum Load:	197	lbs	Strain Rate:	0.020	in/min
Strain at Failure:	3.93	%	15% Strain:	0.730	in
Average cross-sectional area at failure:	4.65	in^2			

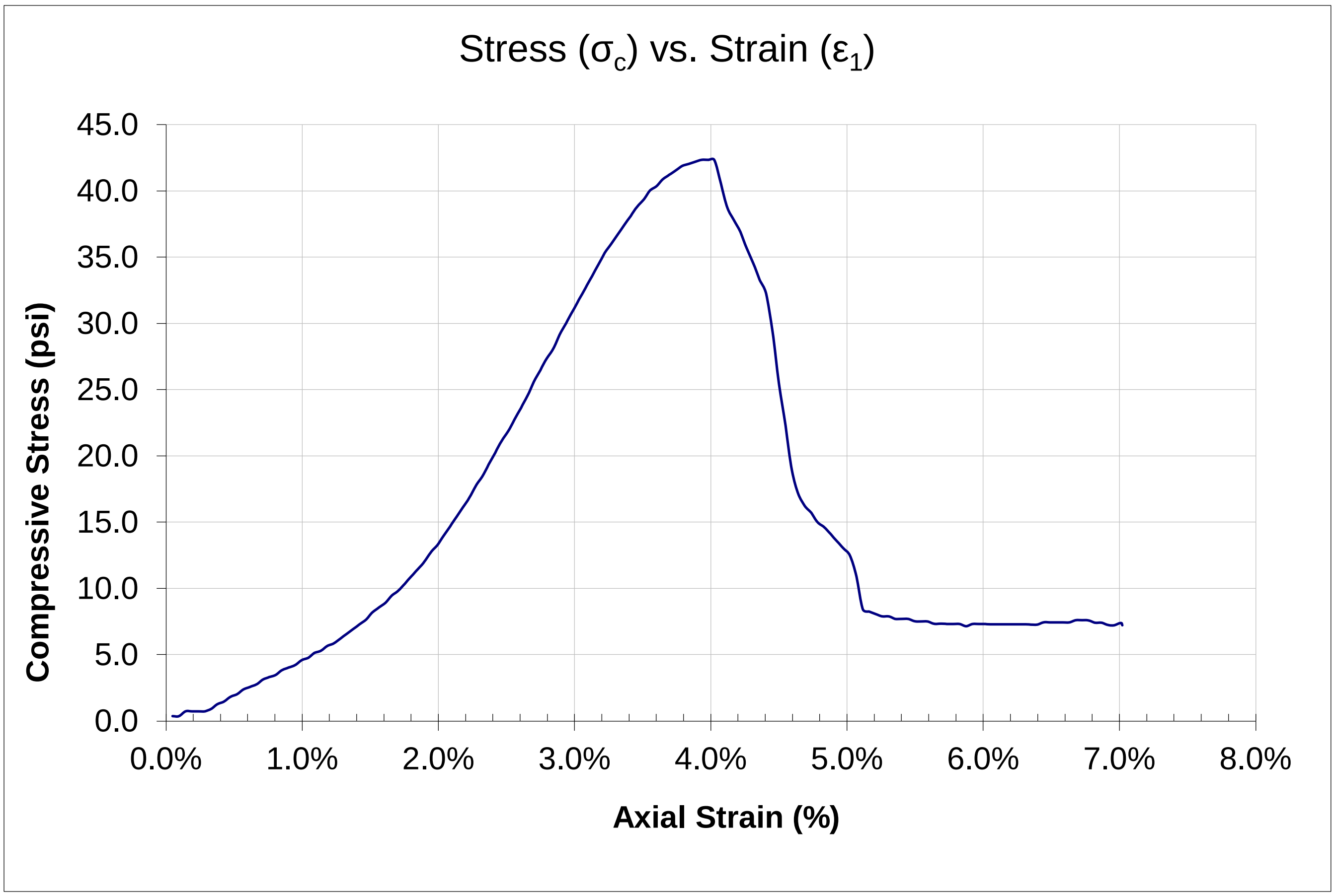
Compressive Strength:	**3.05**	**tsf**
	42.4	**psi**



Unconfined Compression
ASTM D 2166

Project Name: OPUD
Project Number: 3842.X
Sample ID: TC-12B-6C
Type of Sample: 2.4" Cal Mod
Sample Description: SILT, yellowish brown
Depth: 31-31.5

Compressive Strength:	**3.05**	**tsf**
	42.4	**psi**



UPDATED DRAFT PRELIMINARY GEOTECHNICAL BASIS OF DESIGN REPORT

Olivehurst Public Utilities District

South Yuba Sewer and Water Infrastructure Project

Olivehurst, CA

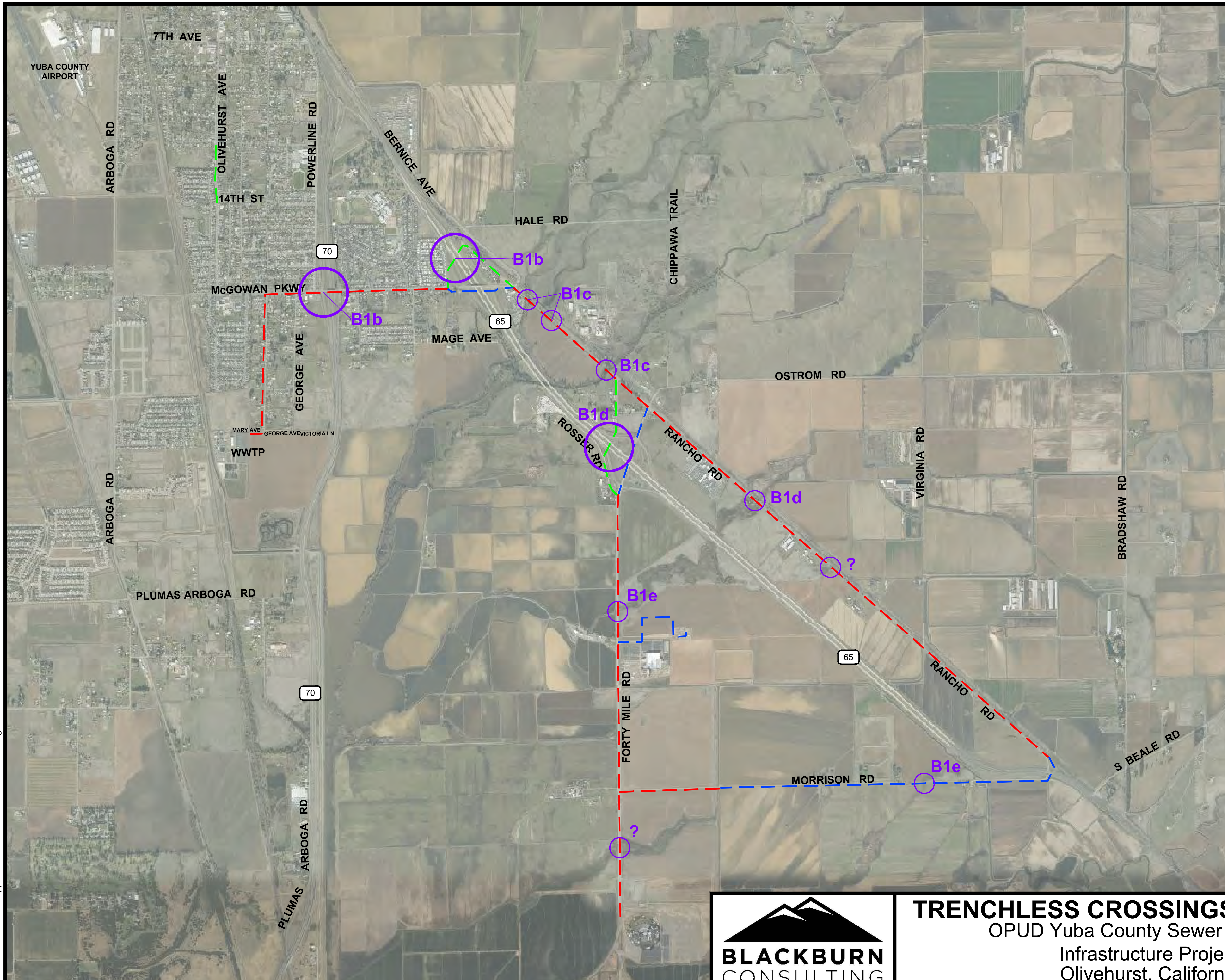
APPENDIX B: Trenchless Pipeline Crossings

B1: Site Plan

B2: Boring and Test Pit Logs Legend

Boring and Test Pit Logs

B3: Laboratory Test Results



N

SCALE 1" = 2,500'

LEGEND

- Approximate Pipeline Water Only
- Approximate Pipeline Sewer Only
- Approximate Pipeline Sewer and Water
- Trenchless Crossing Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

BLACKBURN CONSULTING

TRENCHLESS CROSSINGS LOCATIONS

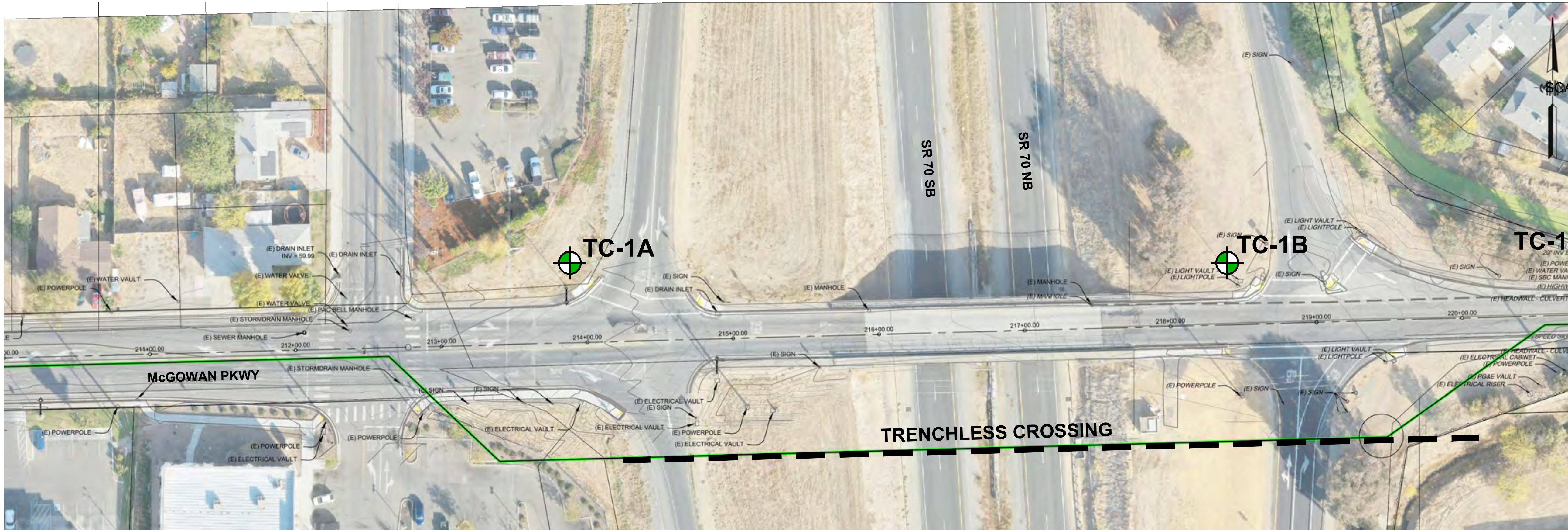
OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

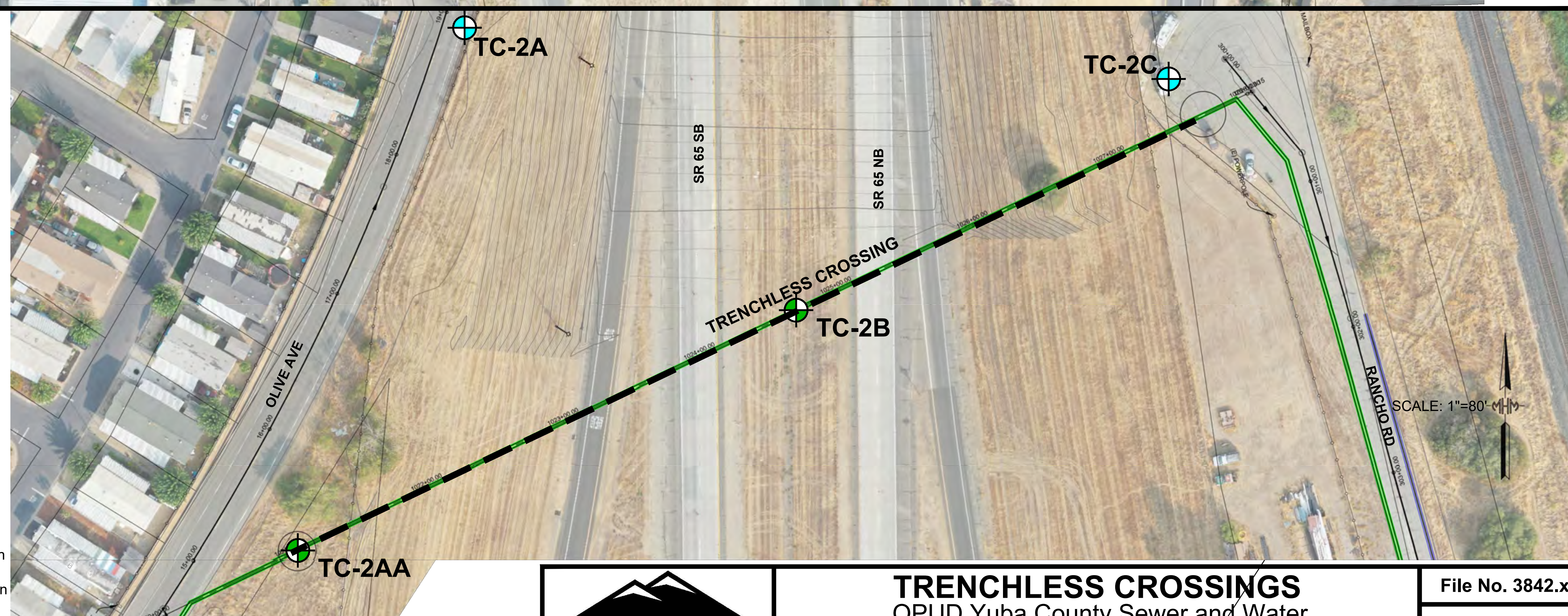
File No. 3842.x

April 2021

Appendix B1a

4/30/2021 3842.x AppB1 OPUD South Yuba Sewer.dwg





LEGEND

- Approximate Water Pipeline Location
- Approximate Sewer Pipeline Location
- TC-X Trenchless Crossing Boring Location
- TC-X Planned Trenchless Crossing Boring Location

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TRENCHLESS CROSSINGS

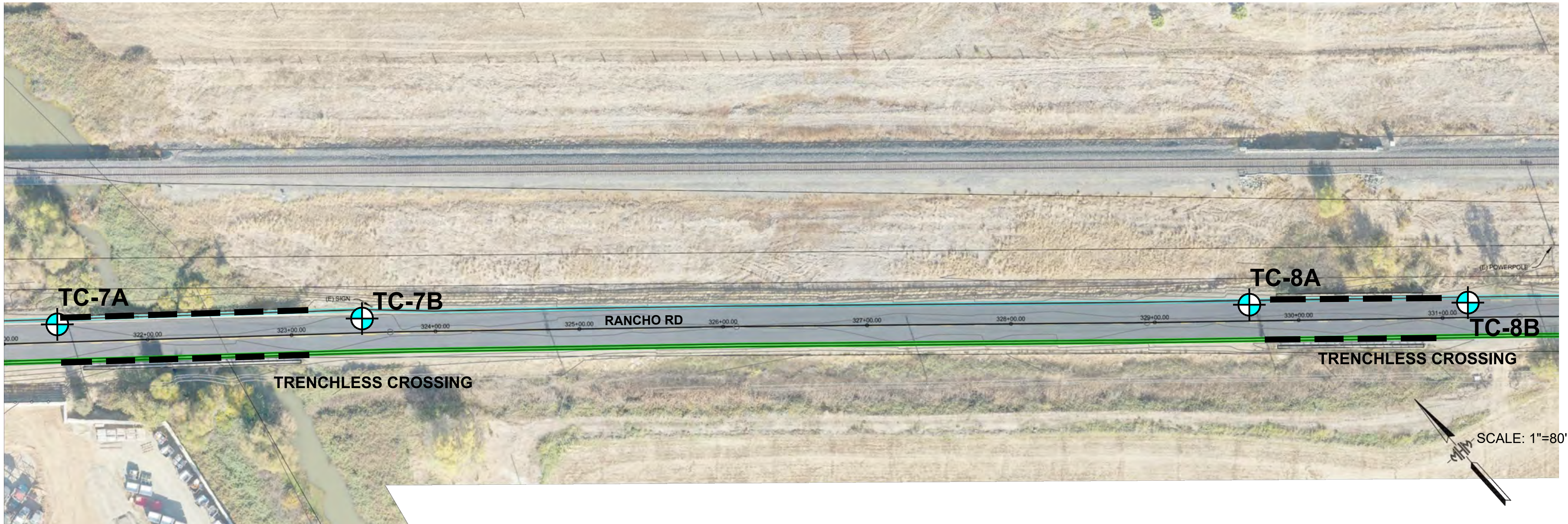
OPUD Yuba County Sewer and Water
Infrastructure Project
Olivehurst, California

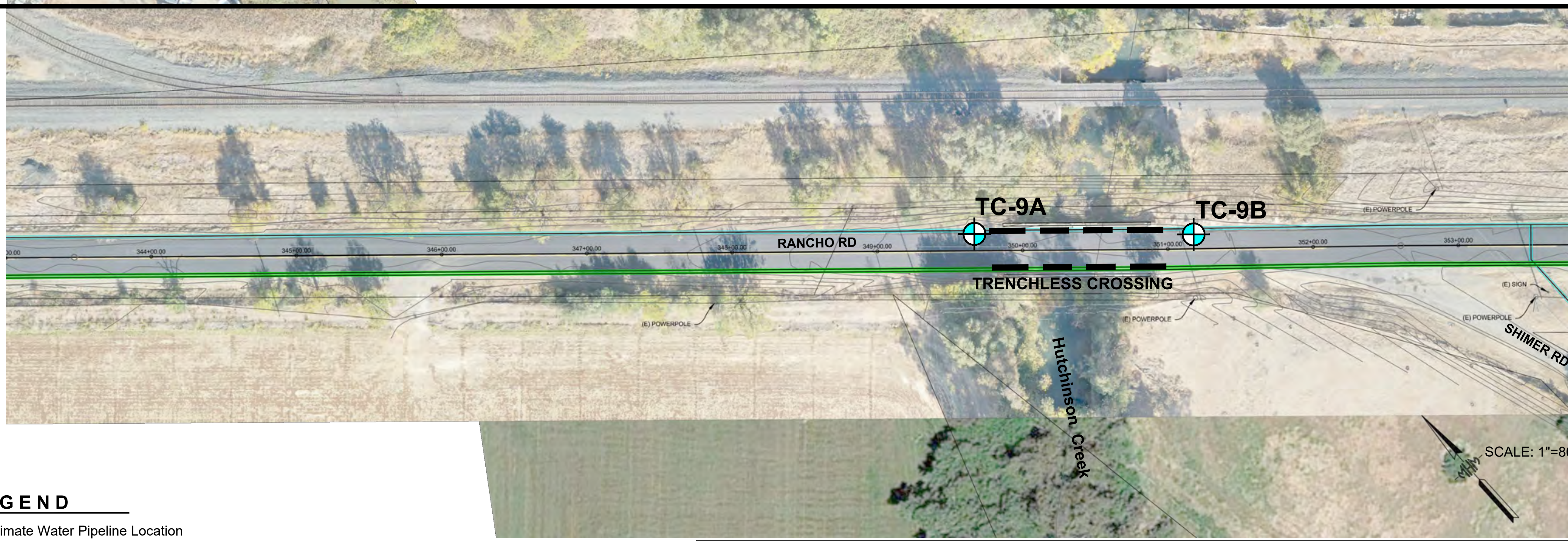
File No. 3842.x

April 2021

Appendix B1b

4/30/2021 3842.x AppB1 OPUD South Yuba Sewer.dwg





LEGEND

- Approximate Water Pipeline Location
- Approximate Sewer Pipeline Location
- TC-X Trenchless Crossing Boring Location
- TC-X Planned Trenchless Crossing Boring Location

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TRENCHLESS CROSSINGS

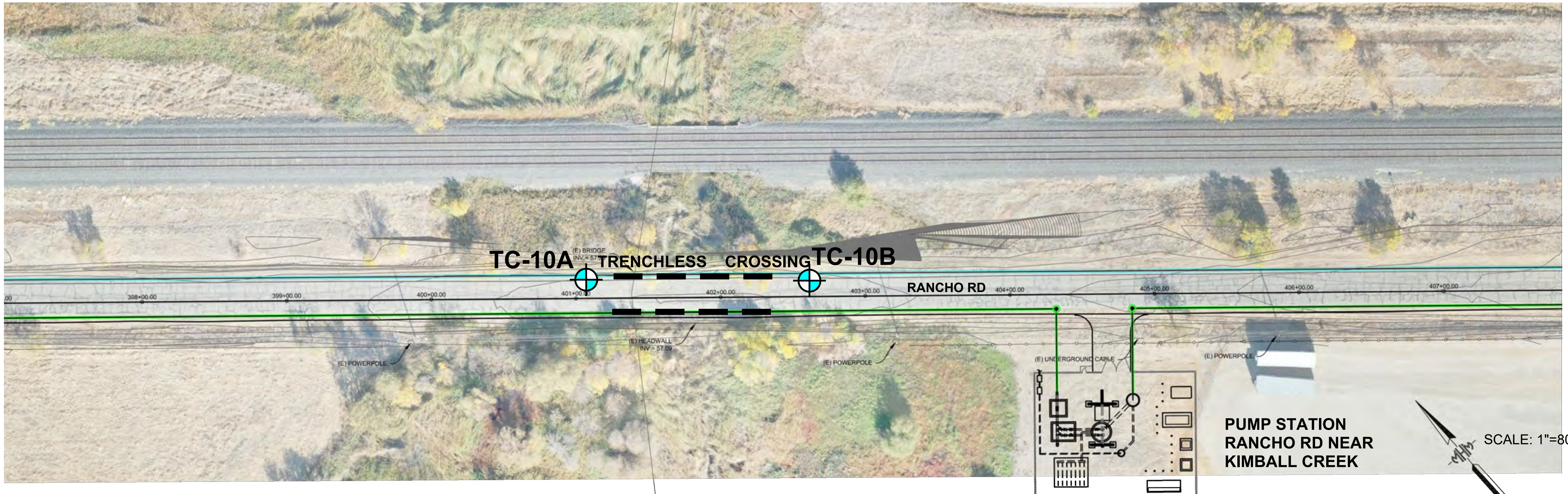
OPUD Yuba County Sewer and Water
Infrastructure Project
Olivehurst, California

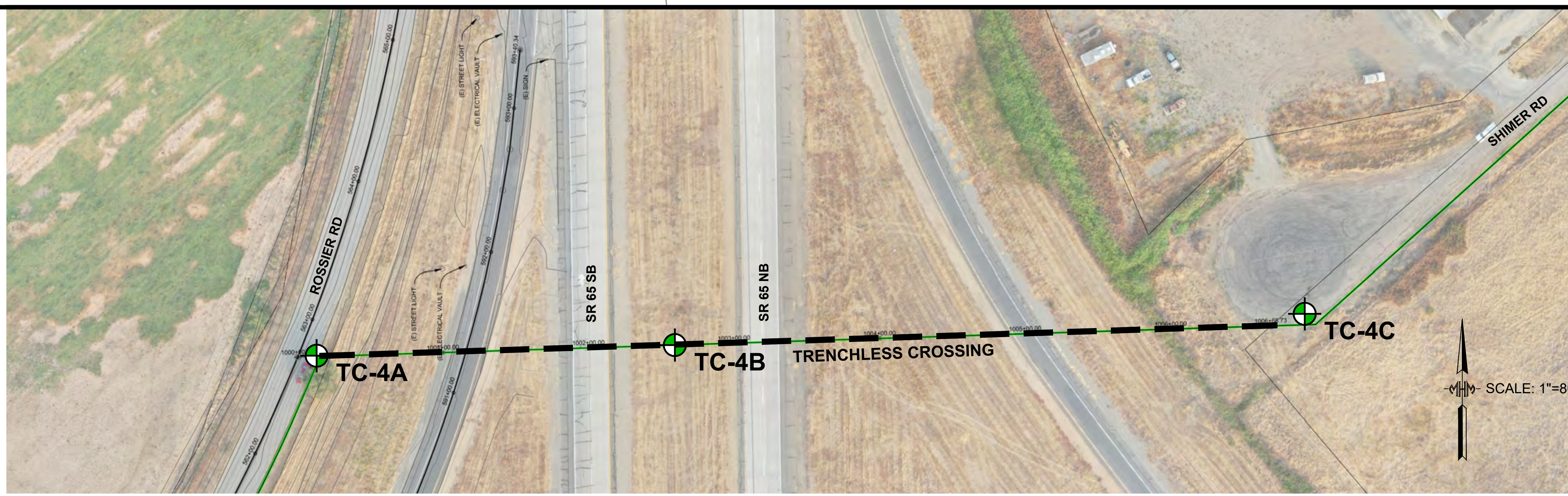
File No. 3842.x

April 2021

Appendix B1c

4/30/2021 3842.x AppB1 OPUD South Yuba Sewer.dwg





LEGEND

- Approximate Water Pipeline Location
- Approximate Sewer Pipeline Location
- TC-X Trenchless Crossing Boring Location
- TC-X Planned Trenchless Crossing Boring Location

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TRENCHLESS CROSSINGS

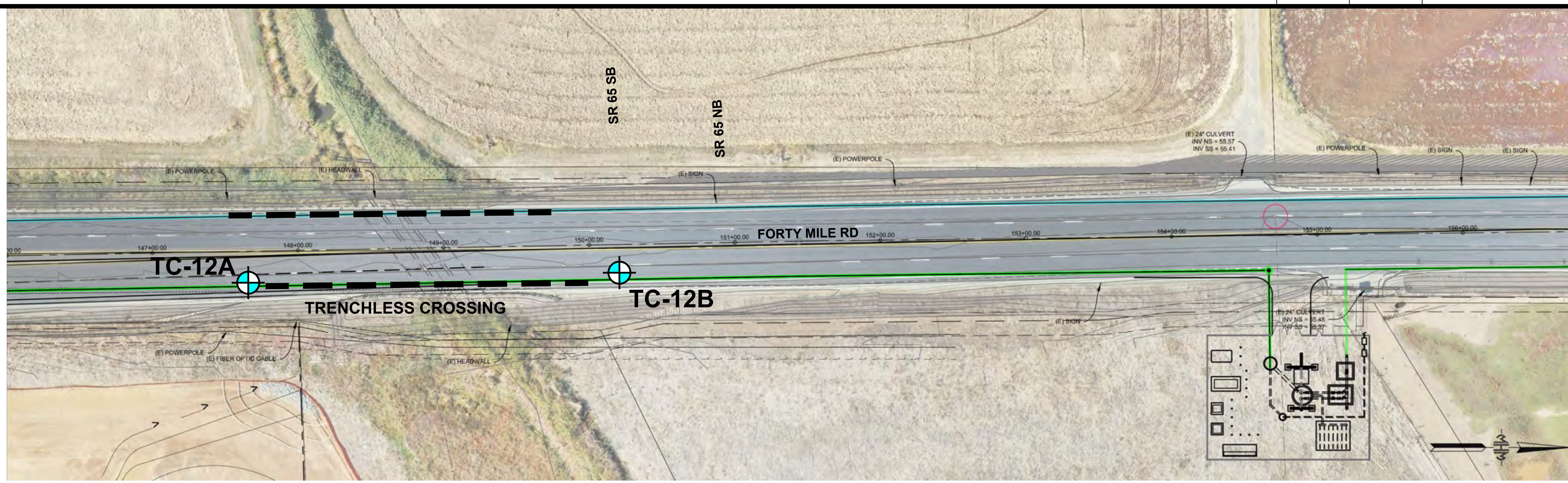
OPUD Yuba County Sewer and Water
Infrastructure Project
Olivehurst, California

File No. 3842.x

April 2021

Appendix B1d

4/30/2021 3842.x AppB1 OPUD South Yuba Sewer.dwg



LEGEND

- Approximate Water Pipeline Location
- Approximate Sewer Pipeline Location
- TC-X Trenchless Crossing Boring Location
- TC-X Planned Trenchless Crossing Boring Location

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TRENCHLESS CROSSINGS

OPUD Yuba County Sewer and Water
Infrastructure Project
Olivehurst, California

File No. 3842.x	
April 2021	
Appendix B1e	

4/30/2021 3842.x AppB1 OPUD South Yuba Sewer.dwg

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names	Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435)
CL	Collapse Potential (ASTM D 5333)
CP	Compaction Curve (ASTM D 698 & 1557, CTM 216)
CR	Corrosion, Sulfates, Chlorides (CTM 643, CTM 417, CTM 422)
CU	Consolidated Undrained Triaxial (ASTM D 4767)
DS	Direct Shear (ASTM D 3080)
EI	Expansion Index (ASTM D 4829)
M	Moisture Content (ASTM D 2216)
OC	Organic Content (ASTM D 2974)
P	Permeability (ASTM D 5084)
PA	Particle Size Analysis (ASTM D 6913 & 7928)
PI	Liquid Limit, Plastic Limit, Plasticity Index (ASTM D 4318)
PL	Point Load Index (ASTM D 5731)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301)
SE	Sand Equivalent (CTM 217)
SG	Specific Gravity (AASHTO T100)
SL	Shrinkage Limit (ASTM D 4943)
SW	Swell Potential (ASTM D 4546)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D 2166) Unconfined Compression - Rock (ASTM D 7012)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850)
UW	Unit Weight (ASTM D 7263)
VS	Vane Shear (AASHTO T223 / ASTM D 2573)

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- California Sampler (2" ID)
- Modified California Sampler (2.4" ID)
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (short-term)
- Static Water Level Reading (long-term)

BLACKBURN CONSULTING

BORING RECORD LEGEND

CONSISTENCY OF COHESIVE SOILS

Descriptor	Unconfined Compressive Strength (tsf)	Pocket Penetrometer (tsf)	Torvane (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Extrudes between fingers when squeezed
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS

Descriptor	SPT N_{60} - Value (blows / foot)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Descriptor	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Descriptor	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE

Descriptor		Size
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS

Descriptor	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION

Descriptor	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

NOTE: This legend sheet provides descriptors and associated criteria for required soil description components only. Refer to Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010), Section 2, for tables of additional soil description components and discussion of soil description and identification.

8/5/2019 Boring Legend for Reports 2019.dwg

BLACKBURN CONSULTING

BORING RECORD LEGEND

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	**9-10-20**	**9-10-20**	**39.07996° / -121.53077°**	**TC-02AA**
CONTRACTOR **Taber**			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Rick**	HELPER'S NAME **Nick/Mike**		EQUIPMENT **Diedrich D120**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**			HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**			GROUND WATER READINGS DURING **29.0 ft** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (6")															
	0.5		SANDY Lean CLAY (CL); very stiff; dark yellowish brown; moist; some fine to medium SAND															
	2.5				1	4 6 10	16		90	2.25								
	5				2	28 50/4"	50/4"		100	>4.5								
	6		mottled dark yellowish brown and black and brown; strong cementation															
	8		Lean CLAY with SAND (CL); hard; dark yellowish brown; moist; little fine SAND															
	10				3	8 12 15	27		90	4.25								
	15		fine to medium SAND		4	17 28 35	63		100	>4.5								
	17		SANDY Lean CLAY (CL); hard; olive brown; moist; some fine to medium SAND															
	20				5	9 16 35	51		90	>4.5								
	21		Lean CLAY with SAND (CL); hard; mottled olive gray and brown and black; moist; little fine SAND; some moderate cementation															
	24		SANDY Lean CLAY (CL); hard; mottled dark olive gray and brown; moist; some fine to medium SAND; some moderate															

(continued)

BLACKBURN CONSULTING

PROJECT NAME		FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water		**3842.X**	**TC-02AA**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY **DWC**		SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		cementation SANDY Lean CLAY (CL) *(continued)*.		6	22 50/5"	50/5"		100	>4.5								
	29		SANDY Lean CLAY (CL); very stiff; olive gray; moist; some fine SAND															
	30				7	7 13 21	34		85	2.25								
	35		hard; mottled olive brown and brown		8	12 16 27	43		100	>4.5								
	38		Lean CLAY with SAND (CL); hard; olive gray; moist; little fine to medium SAND; moderate cementation															
	40				9	24 38 50/4"	88/10"		85	>4.5								
	45		some strong cementation		10	17 34 50/4.5"	84/10.5"		100	>4.5								
	50		dark reddish brown veins; moderate cementation		11	14 24 50/6"	74/12"		100	>4.5								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Groundwater Encountered at 29 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME		FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water		3842.X	TC-02AA
COUNTY: YUB	ROUTE:		POSTMILE:
CLIENT: Jacobs Engineering			
PREPARED BY: LDM	CHECKED BY: DWC		SHEET: 2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	8-31-20	8-31-20	39.08058° / -121.52931°	TC-02C

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME: Toby HELPER'S NAME: Ernesto/Lawrence	EQUIPMENT CME 75	TOTAL DEPTH 51.5 ft
EXCAVATION METHOD Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4"), SPT (1.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Tremie Cement Grout Backfill	GROUND WATER READINGS: DURING 27.5 ft; AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (2.5")															
	0.2		AGGREGATE BASE (12")															
	1.25		SILT (ML); hard; mottled dark yellowish brown and grayish brown; dry; few very fine SAND															
	2.5				1	35 40 49	89		100	>4.5			29	4				
	5				2	25 50/4.5	50/4.5"		100	>4.5								
	10		medium stiff to stiff; moist; trace fine SAND		3	3 4 5	9		100	1.0								
	11.5				4	4 6 8	14		90									
	14		Lean CLAY with SAND (CL); hard; mottled dark yellowish brown and grayish brown with blackish streaks; moist; little very fine SAND															
	15				5	8 19 24	43		100	>4.5								
	20		grayish brown with dark reddish brown streaks		6	17 37 50/4"	87/10"		90	>4.5	41	78					UC	
	25																	

(continued)

BLACKBURN CONSULTING

PROJECT NAME OPUD South Yuba Sewer and Water	FILE NO. 3842.X	HOLE ID TC-02C
COUNTY YUB	ROUTE	POSTMILE
CLIENT Jacobs Engineering		
PREPARED BY LDM	CHECKED BY DWC	SHEET 1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		Lean CLAY with SAND (CL) *(continued)*. grayish brown with orangish brown streaks; increasing SAND content		7	15 50/6"	50/6"		70	>4.5								
	27.5		SILTY SAND (SM); dense; dark yellowish brown; wet; fine to medium SAND															
	30				8	11 20 23	43		100	NA			NP	NP	20			
	35		sand catcher		9	7 14 18	32		90	NA								
	38.5		Lean CLAY (CL); hard; grayish brown with orangish brown streaks; moist; few very fine SAND															
	40				10	20 46 50/4"	96/10"		100	>4.5			44	19				
	43.5		SANDY SILT (ML); hard; grayish brown with orangish brown streaks; moist; very fine SAND															
	45				11	20 26 22	48		100	>4.5								
	50				12	16 19 21	40		100	NA								
	51		Poorly Graded SAND with CLAY (SP-SC); dense; dark brown; moist; fine SAND															

Bottom of exploration at 51.5 ft below ground surface (bgs)

Groundwater Encountered at 27.5 ft bgs
Bulk A obtained 1.2-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING	PROJECT NAME OPUD South Yuba Sewer and Water		FILE NO. 3842.X	HOLE ID TC-02C
	COUNTY YUB	ROUTE		POSTMILE
	CLIENT Jacobs Engineering			
	PREPARED BY LDM	CHECKED BY DWC		SHEET 2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	8-24-20	8-24-20	39.04217° / -121.47595°	TC-06A

Field	Value
CONTRACTOR	Taber
LOCATION (Offset, Station, Line)	
SURFACE ELEVATION	
OPERATOR'S NAME	David
HELPER'S NAME	Nick/Tanner
EQUIPMENT	CME 75
TOTAL DEPTH	41.5 ft
EXCAVATION METHOD	Solid-Stem Auger/ Rotary Wash
DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	
BOREHOLE DIAMETER	4 in
SAMPLER TYPE(S) AND SIZE(S) (ID)	CalMod (2.4")
HAMMER TYPE	Safety semi-automatic drop (140#/ 30")
HAMMER EFFICIENCY, ERi	
BACKFILL AND COMPLETION	Tremie Cement Grout Backfill
GROUND WATER READINGS — DURING	Not Encountered
GROUND WATER READINGS — AFTER (DATE)	
CASING TYPE AND DIAMETER(in)	

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	Lean CLAY (CL); Hard; Reddish Brown; Dry; Medium Plasticity															
	4	Moist															
	5			1	10 12 18	30		95	>4.5								
	6.5	CLAYEY SAND (SC); Medium Dense; Reddish Brown; Moist; Mostly Fine to Medium SAND; Some CLAY															
	7.5	Lean CLAY with SAND (CL); Hard; Yellowish Brown; Moist; Little Medium SAND															
	10			2	3 14 28	42		50	>4.5			41	20				
	14	Lean CLAY (CL); Hard; Mottled Dark Yellowish Brown, Olive, and Gray; Few Medium SAND; Some Moderate Cementation															
	15			3	28 39 50/5"	89/11"		70	>4.5			43	22				
	19	Lean CLAY (CL); Hard; Mottled Olive and Dark Yellowish Brown; Moist; Trace SAND; Trace Moderate Cementation															
	20			4	25 43 50/5"	93/11"		79	>4.5			42	22				
	23.5	Fat CLAY (CH); Hard; Yellowish Brown; Moist															
	25																

(continued)

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	3842.X	TC-06A

COUNTY	ROUTE	POSTMILE
YUB		

CLIENT
Jacobs Engineering

PREPARED BY	CHECKED BY	SHEET
SS		1 of 2

BLACKBURN CONSULTING

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		Fat CLAY (CH) *(continued)*.		5	11 13 18	31		75	>4.5	29	93	57	32			UC	
	30		SANDY Lean CLAY (CL); Very Stiff; Mottled Olive and Brown; Moist; Some Fine SAND; Low to Medium Plasticity		6	12 14 17	31		70	3.5								
	34		SANDY Lean CLAY (CL); Hard; Dark Yellowish Brown; Moist; Some Fine to Medium SAND; Medium Plasticity		7	16 32 27	59		95	4.5								
	38		Lean CLAY (CL); Hard; Dark Yellow Brown; Moist; Medium Plasticity		8	12 21 39	60		100	>4.5								

Bottom of exploration at 41.5 ft below ground surface (bgs)

No Goundwater Encountered

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	3842.X	TC-06A
COUNTY: YUB	ROUTE:	POSTMILE:
CLIENT: Jacobs Engineering		
PREPARED BY: SS	CHECKED BY:	SHEET: 2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**8-28-20**	**8-28-20**	**39.0769° / -121.52352°**	**TC-07A**
CONTRACTOR **Taber**			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David**	HELPER'S NAME **Nick/Tanner**		EQUIPMENT **CME 75**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger/ Rotary Wash**			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**			HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**			GROUND WATER READINGS — DURING **23.0 ft** — AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (9")															
	1		AGGREGATE BASE (12")															
	2		Lean CLAY (CL); stiff; dark reddish brown; moist; few very fine SAND															
	3				1	10 7 6	13		80	1.25								
	5				2	14 50/5"	50/5"		55	>4.5								
	6		Lean CLAY with SAND (CL); hard; yellowish brown; little very fine SAND; moderate cementation															
	11		stiff; increasing SAND content; no cementation		3	6 8 10	18		20	1.25								
	14		SILT (ML); hard; mottled grayish brown and orangish brown; moist															
	16				4	13 26 40	66		100	>4.5			42	4				
	19		Lean CLAY (CL); hard; dark brown with orangish streaks; moist; moderate cementation; trace very fine SAND															
	21				5	12 19 35	54		100	>4.5			38	16				
	23		SANDY SILT (ML); (hard); mottled dark yellowish brown and grayish brown with orangish streaks; moist, some SAND; moderate cementation															
	25																	

Laboratory Data

(continued)

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-07A**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **1 of 2**

BLACKBURN CONSULTING

DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
25	switched to mud rotary SANDY SILT (ML) *(continued)*.	6	9 15 20	35		90				NP	NP	57		
29	Poorly Graded SAND (SP); dense; dark brown; moist; fine to medium SAND; trace fines													
30		7	15 18 23	41		65	NA							
35	dark brown with golden specs; wet	8	10 16 18	34		70	NA					5		
40	dark brown	9	19 24 23	47		70	NA							
45	dark brown with golden specs	10	11 23 25	48		70	NA							
50	trace coarse SAND	11	13 19 30	49		70	NA							

Bottom of exploration at 51.5 ft below ground surface (bgs)

Groundwater Encountered at 23 ft bgs

Tremie Cement Grout Backfill

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	8-28-20	8-28-20	39.07654° / -121.52298°	TC-07B
CONTRACTOR			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Taber				
OPERATOR'S NAME: David	HELPER'S NAME: Nick/Tanner		EQUIPMENT: CME 75	TOTAL DEPTH: 51.5 ft
EXCAVATION METHOD: Solid-Stem Auger/ Rotary Wash			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER: 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID): CalMod (2.4")			HAMMER TYPE: Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION: Tremie Cement Grout Backfill			GROUND WATER READINGS — DURING: 15.0 ft; AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (8.5")															
	1	AGGREGATE BASE (16")															
	2–3	Lean CLAY (CL); very stiff; dark brown; moist; few very fine SAND		1	5 5 5	10		50	2.25								
	6	reddish brown		2	3 4 10	14		100	3.75			24	9				
	9	Lean CLAY with SAND (CL); hard; yellowish brown; moist; little very fine SAND															
	10.5			3	16 50/6"	50/6"		60	>4.5								
	14	increasing SAND content															
	15	SANDY SILT (ML); (hard); mottled reddish brown and dark yellowish brown; wet; fines; fine SAND; some weak cementation		4	12 20 25	45		90	NA			NP	NP	51			
	17	Lean CLAY (CL); hard; yellowish brown; moist; few very fine SAND															
	21			5	11 19 19	38		70	4.5								
	23	SANDY SILT (ML); very stiff; brown; moist; some very fine SAND															
	25																

(continued)

BLACKBURN CONSULTING

PROJECT NAME		FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water		3842.X	TC-07B
COUNTY: YUB	ROUTE		POSTMILE
CLIENT: Jacobs Engineering			
PREPARED BY: LDM	CHECKED BY		SHEET 1 of 2

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	25	SANDY SILT (ML) *(continued)*.	6	5 12 19	31		90	2.5			36	10			
	26	Poorly GRADED SAND with CLAY (SP-SC); medium dense; dark brown; moist; fine to medium SAND													
	30		7	17 25 27	52		100	NA					9		
	31.5	switched to mud rotary													
	33	Poorly GRADED SAND (SP); dense; dark brown; wet; fine to medium SAND													
	35	medium dense; moist; trace fines	8	12 17 18	35		75	NA							
	40	wet; few coarse SAND	9	12 13 9	22		80	NA							
	44	CLAYEY SAND (SC); very dense; dark yellowish brown; moist; mostly fine SAND; some fines													
	45		10	17 35 50/5.5"	85/11.5"		100	NA							
	48	Poorly GRADED SAND (SP); medium dense; dark brown; moist; fine to medium SAND; trace fines													
	50		11	12 17 19	36		100	NA							

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 15 ft bgs
Bulk A obtained 2-5 ft bgs

Tremie Cement Grout Backfill

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**8-27-20**	**8-27-20**	**39.07538° / -121.5213°**	**TC-08A**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David** HELPER'S NAME **Nick/Tanner**	EQUIPMENT **CME 75**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger/ Rotary Wash**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**	GROUND WATER READINGS DURING **14.0 ft** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

Laboratory Data

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (9")															
	1	AGGREGATE BASE (9")															
	1.5	Lean CLAY (CL); Very Stiff; Dark Brown; Moist; trace SAND															
	5–6.5			1	5 10 13	23		100	2.75								
	8.5	Lean CLAY with SAND (CL); Hard; Dark Yellowish Brown with Black Streaks; Moist; Little Fine SAND; Trace Fine GRAVEL															
	10–11.5			2	16 30 37	67		90	>4.5								
	14	CLAYEY SAND (SC); (Medium Dense); Mottled Dark Brown and Grayish Brown; Wet; Fine SAND; Little Fines															
	15–16.5			3	6 9 7	16		80	NA			28	15	17			
	15.75	Poorly-graded SAND with CLAY (SP-SC); Medium Dense; Mottled Dark Brown and Black; Wet; Fine to Medium SAND															
	18.5	Lean CLAY (CL); Stiff; Mottled Light Gray and Dark Yellowish Brown; Moist; Medium Plasticity															
	20–21.5			4	3 6 12	18		90	1.25								
	21.5	CLAYEY SAND (SC); Medium Dense; mottled light gray and dark yellow brown with black streaks; moist; little to some fines															
	24	Lean CLAY (CL); hard; bluish gray; moist; few fine SAND															
	25																

(continued)

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**TC-08A**

COUNTY	ROUTE	POSTMILE
YUB		

CLIENT **Jacobs Engineering**

PREPARED BY	CHECKED BY	SHEET
SS	**DWC**	**1 of 2**

Depth (ft)	Description	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
25	Lean CLAY (CL) *(continued)*.	5	3 13 37	50		100	>4.5					91		
29	Lean CLAY (CL); (stiff); dark gray; wet; few very fine SAND													
30		6	3 5 9	14		45	NA							
35	hard; moist; weak cementation	7	10 16 19	35		100	>4.5			27	12			
38	Poorly-graded SAND (SP); dense; mottled dark brown and black; moist; fine to medium SAND; trace fines													
40		8	15 19 24	43		70	NA							
45	very dense; wet	9	20 31 31	62		65	NA							
50		10	15 26 32	58		65	NA							

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 14 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME: **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-08A**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **SS**	CHECKED BY **DWC**		SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**8-27-20**	**8-27-20**	**39.07514° / -121.52096°**	**TC-08B**
CONTRACTOR **Taber**			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David**	HELPER'S NAME **Nick/Tanner**		EQUIPMENT **CME 75**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger / Mud Rotary**			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**			HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**			GROUND WATER READINGS DURING **15.0 ft** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (8")															
	1	AGGREGATE BASE (16")															
	2	Lean CLAY (CL); hard; dark brown; moist; trace fine GRAVEL		1	6 11 12	23		100	>4.5								
	5	Lean CLAY with SAND (CL); hard; dark yellowish brown; moist; little very fine SAND; some moderate cementation		2	8 12 22	34		70	>4.5								
	10	dark yellowish brown with gray streaks and black specks; increasing SAND content		3	6 9 10	19		50	2.75			30	17				
	15	Poorly-graded GRAVEL with CLAY and SAND (GP-GC); very dense; grayish brown; wet; mostly fine GRAVEL; little fine to coarse SAND; few fines		4	31 42 28	70		75	>4.5					9			
	16	SANDY Lean CLAY (CL); hard; mottled orangish brown and light gray; moist; some fine SAND															
	18	Lean CLAY with SAND (CL); (very stiff); bluish gray; moist; moderate cementation		5	3 8 16	24		100	NA								
	21	CLAYEY SAND (SC); medium dense; dark yellowish brown with orangish brown and grayish brown streaks and golden specks; wet															
	25																

Laboratory Data

Material Graphics

(continued)

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-08B**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY **DWC**		SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	25	Lean CLAY (CL); hard; grayish brown with orangish brown streaks; moist; few fine SAND	6	8 12 23	35		100	>4.5							
	29	SILTY SAND (SM); medium dense; dark brown with orangish brown streaks and golden specks; wet													
	30		7	9 12 15	27		100	3.25			NP	NP	43		
	31	SANDY Lean CLAY (CL); very stiff; grayish brown; moist; some fine SAND													
	34	CLAYEY SAND (SC); medium dense; grayish brown with orangish brown streaks; moist; mostly fine SAND													
	35		8	7 10 16	26		90	NA			27	11	49		
	40		9	7 10 15	25		0	NA							
	41	Poorly Graded SAND (SP); dense; yellowish brown and black with golden specks; wet; fine to medium SAND no recovery, switched to mud rotary													
	45		10	22 25 26	51		75	NA							
	50	very dense	11	26 34 42	76		75	NA							

Bottom of exploration at 51.5 ft below ground surface (bgs)

Groundwater Encountered 15 ft bgs
Bulk A obtained 2-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	3842.X	TC-08B
COUNTY: YUB	ROUTE	POSTMILE
CLIENT: Jacobs Engineering		
PREPARED BY: LDM	CHECKED BY: DWC	SHEET: 2 of 2

LOGGED BY DWC	BEGIN DATE 8-26-20	COMPLETION DATE 8-26-20	LOCATION (Lat/Long or North/East and Datum) 39.07174° / -121.51609°	HOLE ID TC-09A
CONTRACTOR Taber			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME David	HELPER'S NAME Nick/Tanner		EQUIPMENT CME 75	TOTAL DEPTH 51.5 ft
EXCAVATION METHOD Solid-Stem Auger			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")			HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Tremie Cement Grout Backfill			GROUND WATER READINGS DURING 25.0 ft AFTER (DATE) 24.0 ft on 8-26-20	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (8")															
	0.7		AGGREGATE BASE (16")															
	2		Lean CLAY (CL); Hard; Dark Brown; Dry; Medium to High Plasticity															
	5				1	8 8 8	16		70	>4.5								
	10				2	16 9 9	18		95	NA			27	12	46			
	10.5		CLAYEY SAND (SC); Medium Dense; Dark Reddish Brown; Moist; Fine to Medium SAND															
	14		Lean CLAY (CL); Very Stiff; Reddish Brown; Moist; Trace Fine SAND															
	15				3	10 7 10	17		90	3.5			34	19				
	18		SANDY Lean CLAY (CL); (Stiff to Very Stiff); Olive; Moist; Some Fine through Coarse SAND; Few Fine GRAVEL															
	20				4	6 7 10	17		100	3.0								
	20.5		Lean CLAY with SAND (CL); Very Stiff; Olive; Moist; Little Fine SAND															
	25																	

(continued)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		Lean CLAY (CL); Stiff; Olive Gray; Moist; Interbedded Lenses of CLAYEY SAND (SC); (Medium Dense); Dark Yellowish Brown; Wet; Fine to Medium SAND; Few to Little Fines		5	5 6 6	12		100	1.75			38	17	56			
	30				6	4 6 9	15		100	2.75								
	33		SILTY SAND (SM); Medium Dense; Reddish Brown; Wet; Mostly Fine SAND; Some Medium SAND; Interbedded Lenses of SANDY SILT (ML); (Stiff); Reddish Brown; Moist; Some Fine SAND															
	35				7	8 10 13	23		85	NA			NP	NP	34			
	38		Lean CLAY (CL); Medium Stiff; Dark Reddish Brown; Moist; Little Weak Cementation															
	40				8	6 9 12	21		80	1.25 2.0								
	41		SANDY Lean CLAY/CLAYEY SAND (CL/SC); Stiff/Medium Dense; Dark Reddish Brown; Moist to Wet; Some Fine to Medium SAND; Some Weak Cementation															
	44		SANDY Lean CLAY (CL); Stiff; Dark Reddish Brown; Moist; Some Fine SAND															
	45				9	8 11 11	22		80	1.75								
	50		Some Fine to Medium SAND; Weak to Moderate Cementation		10	14 29 33	62		85	>4.5								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 25 ft bgs
Bulk A obtained 2-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME		FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water		3842.X	TC-09A
COUNTY: YUB	ROUTE		POSTMILE
CLIENT: Jacobs Engineering			
PREPARED BY: SS	CHECKED BY		SHEET: 2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	**8-26-20**	**8-26-20**	**39.07146° / -121.5157°**	**TC-09B**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **David** / HELPER'S NAME **Nick/Tanner**	EQUIPMENT **CME 75**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**	GROUND WATER READINGS — DURING **23.0 ft** — AFTER (DATE) **25.0 ft on 8-26-20**	CASING TYPE AND DIAMETER(in)

Laboratory Data

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (6")															
	0.5	AGGREGATE BASE (12")															
	1.5	Lean CLAY (CL); Hard; Dark Reddish Brown; Moist; Trace Medium SAND; Few Moderate Cementation															
	2–3.5			1	6 9 9	18		60	>4.5								
	4	SILTY CLAY (CL-ML); Hard; Dark Reddish Brown; Moist; Trace Medium SAND															
	5–6.5			2	5 6 8	14		90	>4.5			22	7				
	8	Lean CLAY (CL); Hard; Dark Yellowish Brown; Dry; Strong Cementation															
	10–11.5	Lean CLAY (CL); Hard; Dark Brown; Moist		3	9 8 8	16		80	>4.5								
	13	SANDY Lean CLAY (CL); Stiff; Olive Brown; Moist; Some Fine to Medium SAND															
	15–16.5			4	5 7 10	17		70	1.5 3.0								
	16	SANDY Lean CLAY with GRAVEL (CL); Very Stiff; Olive Brown; Moist; Some Fine to Medium SAND; Little Fine GRAVEL															
	19	Lean CLAY (CL); Hard; Mottled Olive Gray and Dark Reddish Brown; Moist; Medium Plasticity; Few Moderate to Strong Cementation															
	20–21.5			5	6 13 21	34		95	>4.5								
	23	CLAYEY SAND (SC); (Medium Dense); Dark Reddish Brown; Wet; Fine to Medium SAND; Some CLAY															
	25																

(continued)

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**TC-09B**
COUNTY **YUB**	ROUTE	POSTMILE
CLIENT **Jacobs Engineering**		
PREPARED BY **SS**	CHECKED BY	SHEET **1 of 2**

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 11/5/20

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		CLAYEY SAND (SC) *(continued)*.															
	25–29		Lean CLAY with SAND (CL); Very Stiff; Strong Brown; Some Weak Cementation		6	4 4 6	10		100	2.75	40	81	42	17			UC	
	29–30		SILTY SAND (SM); (Medium Dense); Dark Reddish Brown; Wet; Fine SAND; Some Fines															
	30–34		SILT (ML); Very Stiff; Dark Yellowish Brown; Moist		7	5 7 12	19		100	3.25	43	79	46	16			UC	
	34–38		SANDY Lean CLAY (CL); Very Stiff; Dark Yellowish Brown; Moist; Some Fine SAND		8	7 10 11	21		80	2.5								
	38–45		CLAYEY SAND (SC); Loose to Medium Dense; Dark Yellowish Brown; Wet		9	5 5 6	11		85	1.0								
					10	3 5 9	14		100	NA								
	45–48		SANDY Lean CLAY (CL); Very Stiff; Dark Yellowish Brown; Moist; Some Fine to Medium SAND		11	16 21 30	51		85	4.0								
	48–51.5		CLAYEY SAND (SC); Medium Dense; Dark Yellowish Brown; Wet; Fine to Medium SAND; Some Fines; Weak Cementation		12	8 9 12	21		85	1.5								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Groundwater Encountered at 25 ft bgs

Tremie Cement Grout Backfill

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 11/5/20

BLACKBURN CONSULTING

PROJECT NAME		FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water		3842.X	TC-09B
COUNTY: YUB	ROUTE		POSTMILE
CLIENT: Jacobs Engineering			
PREPARED BY: SS	CHECKED BY		SHEET 2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
SS	**9-2-20**	**9-2-20**	**39.06253° / -121.5029°**	**TC-10A**

CONTRACTOR **Taber**	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Toby** / HELPER'S NAME **Ernesto/Jason**	EQUIPMENT **CME 75**	TOTAL DEPTH **51.5 ft**
EXCAVATION METHOD **Solid-Stem Auger/ Rotary Wash**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**	HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**	GROUND WATER READINGS DURING **24.0 ft** AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0	ASPHALT CONCRETE (7")															
	0.6	AGGREGATE BASE (10")															
	1.4	SANDY Lean CLAY (CL); hard; reddish brown; dry; some fine through coarse SAND; few fine to coarse GRAVEL															
	2.5–4			1	4 / 6 / 11	17		80	>4.5								
	5–6.5			2	12 / 18 / 21	39		95	4.0								
	5.3	Lean CLAY (CL); very stiff to hard; dark yellowish brown; dry; little fine SAND															
	9	CLAYEY SAND (SC); medium dense; strong brown; moist; fine through coarse SAND; some fines															
	10–11.5			3	8 / 9 / 14	23		100	2.0			47	29				
	15	SANDY SILT (ML); very stiff; olive; dry; some fine to medium SAND		4	7 / 14 / 22	36		90	3.0								
	19	Poorly Graded SAND with SILT (SP-SM); medium dense; dark yellowish brown; wet; fine through coarse SAND															
	20–21.5			5	8 / 12 / 10	22		100	2.25								
	23	Poorly-graded SAND (SP); medium dense; dark yellowish brown; moist; fine to medium SAND; interbedded lenses with few fines ▽															
	25																

(continued)

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**	FILE NO. **3842.X**	HOLE ID **TC-10A**
COUNTY **YUB**	ROUTE	POSTMILE
CLIENT **Jacobs Engineering**		
PREPARED BY **LDM**	CHECKED BY	SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	25	Poorly Graded SAND (SP) *(continued)*.	6	10 13 15	28		100	NA							
	26	SANDY SILT (ML); very stiff; dark yellowish brown; moist; some very fine SAND													
	29	SILTY SAND (SM); dense; mottled dark yellowish brown and olive gray; moist; fine SAND; some fines													
	30		7	13 22 27	49		100	>4.5					43		
	33	switched to mud rotary													
	35	dark yellowish brown; fine to medium SAND; little fines	8	13 22 27	49		100	>4.5			NP	NP			UC
	38	Poorly Graded SAND (SP); medium dense; dark yellowish brown; wet; fine to medium SAND; trace fines													
	40		9	12 16 15	31		85	NA							
	41	SILTY SAND (SM); medium dense; dark yellowish brown; moist; fine to medium SAND; little fines													
	43	Poorly Graded SAND (SP); medium dense; gray; wet; fine to medium SAND													
	45		10	15 16 18	34		95	NA							
	50	fine through coarse SAND; trace GRAVEL in shoe	11	20 29 30	59		80	NA							

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 24 ft bgs
Bulk A obtained 1.4-5 ft bgs

Tremie Cement Grout Backfill

Depth scale: 25 – 55

BLACKBURN CONSULTING

PROJECT NAME: **OPUD South Yuba Sewer and Water**	FILE NO.: **3842.X**	HOLE ID: **TC-10A**
COUNTY: **YUB**	ROUTE:	POSTMILE:
CLIENT: **Jacobs Engineering**		
PREPARED BY: **LDM**	CHECKED BY:	SHEET: **2 of 2**

LOGGED BY DWC	BEGIN DATE 8-25-20	COMPLETION DATE 8-25-20	LOCATION (Lat/Long or North/East and Datum) 39.06202° / -121.50216°	HOLE ID TC-10B
CONTRACTOR Taber			LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME David	HELPER'S NAME Nick/Tanner		EQUIPMENT CME 75	TOTAL DEPTH 51.5 ft
EXCAVATION METHOD Solid-Stem Auger/ Rotary Wash			DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")			HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Tremie Cement Grout Backfill			GROUND WATER READINGS DURING 24.0 ft AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		Lean CLAY (CL); Stiff; Reddish Brown; Moist; Medium Plasticity															
	2.5				1	3 4 5	9		60	1.0								
	5.5				2	2 2 3	5		80	1.25								
	8		SANDY Lean CLAY (CL); (Very Stiff); Reddish Brown; Moist															
	10		Lean CLAY (CL); Hard; Dark Yellowish Brown; Moist; Weakly Cemented		3	14 31 32	63		90	>4.5								
	14		Well Graded GRAVEL with CLAY and SAND (GW-GC); Very Dense; Dark Yellowish Brown; Moist; Fine to Coarse GRAVEL; Some Fine through Coarse SAND															
	15.5				4	33 30 45	75		80	NA					11			
	17		Lean CLAY with SAND (CL); Hard; Yellowish Brown; Moist; Little Fine to Medium Sand															
	20.5				5	10 14 19	33		100	4.0			46	21				
	24		SILTY SAND (SM); Medium Dense; Dark Olive Brown; Wet; Fine to Medium SAND; Little SILT															

(continued)

BLACKBURN CONSULTING	PROJECT NAME OPUD South Yuba Sewer and Water		FILE NO. 3842.X	HOLE ID TC-10B
	COUNTY YUB	ROUTE		POSTMILE
	CLIENT Jacobs Engineering			
	PREPARED BY SS	CHECKED BY		SHEET 1 of 2

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	25–29	SILTY SAND (SM) *(continued)*.	6	7 8 9	17		95	NA			NP	NP	19		
	29–31	SANDY Lean CLAY (CL); Hard; Dark Yellowish Brown; Moist; Some Fine to Medium SAND	7	20 23 23	46		100	4.5 2.0			27	10			
	31–38	Lean CLAY (CL); Stiff; Dark Yellowish Brown; Moist; Trace SAND; Some Moderate Cementation													
	36	Hard	8	16 24 30	54		100	>4.5							
	38–43	SILTY SAND (SM); Dense; Dark Yellowish Brown; Moist; Mostly Fine to Medium SAND; Some SILT	9	16 18 18	36		100	NA							
	43–51.5	Poorly-graded SAND (SP); Dense; Olive Gray; Moist; Fine to Medium SAND; Interbedded Lens of SANDY SILT (ML)	10	15 16 22	38		100	NA							
	51	Little Coarse SAND	11	13 14 16	30		60	NA							

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 24 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-10B**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **SS**	CHECKED BY		SHEET **2 of 2**

LOGGED BY: **SS** — BEGIN DATE: **9-9-20** — COMPLETION DATE: **9-9-20**	LOCATION (Lat/Long or North/East and Datum): **39.05402° / -121.51507°**		HOLE ID: **TC-12A**
CONTRACTOR: **Taber**	LOCATION (Offset, Station, Line)		SURFACE ELEVATION
OPERATOR'S NAME: **Rick** — HELPER'S NAME: **Nick/Mike**	EQUIPMENT: **Diedrich D120**		TOTAL DEPTH: **51.5 ft**
EXCAVATION METHOD: **Solid-Stem Auger/ Rotary Wash**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH		BOREHOLE DIAMETER: **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID): **CalMod (2.4")**	HAMMER TYPE: **Safety semi-automatic drop (140#/ 30")**		HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION: **Tremie Cement Grout Backfill**	GROUND WATER READINGS — DURING: **24.0 ft**	AFTER (DATE)	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (3')															
			AGGREGATE BASE (4")															
			Lean CLAY (CL); very stiff; dark yellowish brown; moist; few fine SAND															
	2.5				1	6 8 12	20		100	2.25								
	5		some cementation; few fine through coarse SAND		2	5 8 13	21		85	1.25			40	26				
	6		Lean CLAY (CL); stiff; mottled dark yellowish brown and olive; moist; few very fine to fine SAND; trace cementation															
	10		SILT with SAND (ML); very stiff; dark yellowish brown; moist; little fine SAND; black specks (organics?)		3	3 6 8	14		85	2.0								
	15		CLAYEY SAND (SC); medium dense; dark yellowish brown; moist; fine to medium SAND; some fines		4	4 7 9	16		100	NA								
	20		Poorly Graded SAND with SILT (SP-SM); medium dense; dark brown; moist; fine to medium SAND; few fines		5	9 11 13	24		85	NA			NP	NP	9			
	25																	

(continued)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		fine through coarse SAND; wet Poorly Graded SAND with SILT (SP-SM) *(continued)*.		6	4 7 12	19		60	NA								
	27		switched to mud rotary															
	30		SILT (ML); hard; yellowish brown; moist; trace fine SAND; weak cementation		7	8 15 23	38		95	>4.5			42	11				
	35		olive brown		8	20 50/4"	50/4"		100	>4.5								
	40		Poorly Graded SAND with SILT (SP-SM); very dense; dark brown; wet; fine to medium SAND; few fines		9	16 24 31	55		65	NA								
	45		dense; lenses of SILT with SAND (ML); (stiff); olive brown; moist; little fine SAND		10	18 20 22	42		65	NA								
	50				11	14 19 24	43		65	NA								

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 24 ft bgs
Bulk A obtained 0.6-5 ft bgs

Tremie Cement Grout Backfill

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	**9-9-20**	**9-9-20**	**39.05476° / -121.51507°**	**TC-12B**

CONTRACTOR: **Taber**	LOCATION (Offset, Station, Line):
SURFACE ELEVATION:	
OPERATOR'S NAME: **Chad**	HELPER'S NAME: **Caleb/Cody**
EQUIPMENT: **CME 75**	TOTAL DEPTH: **51.5 ft**
EXCAVATION METHOD: **Solid-Stem Auger**	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH:
BOREHOLE DIAMETER: **4 in**	
SAMPLER TYPE(S) AND SIZE(S) (ID): **CalMod (2.4")**	HAMMER TYPE: **Safety semi-automatic drop (140#/ 30")**
HAMMER EFFICIENCY, ERi:	
BACKFILL AND COMPLETION: **Tremie Cement Grout Backfill**	GROUND WATER READINGS: DURING **17.0 ft**; AFTER (DATE) **18.0 ft on 9-9-20**
CASING TYPE AND DIAMETER(in)	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (7")															
	1		AGGREGATE BASE (12")															
	2		Lean CLAY (CL); hard; dark gray; moist; few fine to medium SAND															
	5				1	10 22 36	58		85	>4.5								
	6		Lean CLAY (CL); hard; reddish brown; moist; few fine SAND; few moderate cementation															
	9		SILT with SAND (ML); hard; dark yellowish brown; dry; little fine to medium SAND															
	10				2	24 50/4"	50/4"		100	>4.5								
	15		fine SAND; some strong cementation		3	23 50/4"	50/4"		90	>4.5			43	15				
	20		trace cementation		4	9 15 20	35		85	4.5								
	22		CLAYEY SAND (SC); (medium dense); dark yellowish brown; wet; fine to medium SAND; some fines															
	25																	

(continued)

PROJECT NAME: **OPUD South Yuba Sewer and Water**	FILE NO.: **3842.X**	HOLE ID: **TC-12B**	
COUNTY: **YUB**	ROUTE:	POSTMILE:	
CLIENT: **Jacobs Engineering**			
PREPARED BY: **LDM**	CHECKED BY:	SHEET: **1 of 2**	

BLACKBURN CONSULTING

Depth (ft)	Description	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
25	CLAYEY SAND (SC) *(continued)*.													
25.5	Lean CLAY (CL); hard; olive gray; moist	5	7 12 20	32		95	4.0							
28.5	SILT (ML); hard; mottled dark yellowish brown and brown; moist; few fine SAND													
30		6	15 28 45	73		85	>4.5			39	8			UC
33	SILTY SAND (SM); hard; mottled dark olive gray and dark brown; moist													
35		7	26 23 24	47		100	>4.5			NP	NP	46		
37	Poorly Graded SAND (SP); (dense); dark gray; wet													
40	SANDY SILT (ML); very stiff; dark gray; moist; some fine SAND	8	15 25 38	63		100	2.0							
41	SILTY SAND (SM); very dense; dark gray; moist; fine to medium SAND; little fines													
44	Poorly Graded SAND (SP); dense; dark gray; wet; fine to medium SAND; trace fines													
45		9	9 23 31	54		60	NA							
50		10	8 20 36	56		95	NA							

Bottom of exploration at 51.5 ft below ground surface (bgs)

Goundwater Encountered at 17 ft bgs
Bulk A obtained 1.5-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**TC-12B**
COUNTY: **YUB**	ROUTE:	POSTMILE:
CLIENT: **Jacobs Engineering**		
PREPARED BY: **LDM**	CHECKED BY:	SHEET: **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
SS	**9-8-20**	**9-8-20**	**39.03709° / -121.51498°**	**TC-13**

CONTRACTOR **Taber**		LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Rick**	HELPER'S NAME **Nick/Mike**	EQUIPMENT **Diedrich D120**	TOTAL DEPTH **51.4 ft**
EXCAVATION METHOD **Solid-Stem Auger/ Rotary Wash**		DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER **4 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **CalMod (2.4")**		HAMMER TYPE **Safety semi-automatic drop (140#/ 30")**	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION **Tremie Cement Grout Backfill**		GROUND WATER READINGS — DURING **28.0 ft** — AFTER (DATE) **26.0 ft on 9-8-20**	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
	0	ASPHALT CONCRETE (6.5")													
	0.5	AGGREGATE BASE (12")													
	2	SILT (ML); very stiff; dark brown; moist													
	2.5–4		1	5 6 7	13		80	2.25							
	5–6.5		2	3 4 6	10		95	1.75							
	5.5	Lean CLAY (CL); stiff; dark yellowish brown; moist; trace fine SAND													
	10	SILT (ML); hard; grayish brown; dry; few fine SAND; little cementation	3	18 50/4"	50/4"		90	>4.5							
	15	light brown	4	8 19 27	46		85	>4.5							
	20	trace cementation	5	10 14 19	33		100	4.0							
	25														

(continued)

BCI LOG FOR SOIL 3842.X FIELD EXPLORATIONS.GPJ LIBRARY_2019.GLB 11/5/20

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-13**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY		SHEET **1 of 2**

DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests
25	SILT (ML); hard; mottled grayish brown and yellowish brown; moist; trace; fine SAND	6	16 47 50/4"	97/10"		100	>4.5							
30		7	10 17 30	47		90	>4.5							
32	switched to mud rotary													
35	SANDY SILT (ML); hard; dark brown; moist; some very fine SAND; trace cementation	8	13 30 50/5.5"	80/11.5"		100	>4.5							
40	SILTY SAND (SM); dense; dark brown; wet; very fine to fine SAND; some fines; interbedded lenses of fines	9	12 22 33	55		90	NA							
45		10	15 26 31	57		85	2.75							
46	SILT (ML); very stiff; light brown; moist													
50	Poorly Graded SAND with SILT (SP-SM); very dense; dark brown; wet; fine through coarse SAND; few fines	11	22 41 50/5"	91/11"		90	NA							

Bottom of exploration at 51.4 ft below ground surface (bgs)

Goundwater Encountered at 28 ft bgs
Bulk A obtained 1.5-5 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING

PROJECT NAME: **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TC-13**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **LDM**	CHECKED BY	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	LOCATION (Lat/Long or North/East and Datum)	HOLE ID
DWC	9-8-20	9-8-20	39.05742° / -121.49553°	TC-14

CONTRACTOR Taber	LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME: Chad HELPER'S NAME: Caleb/Cody	EQUIPMENT CME 75	TOTAL DEPTH 41.5 ft
EXCAVATION METHOD Solid-Stem Auger	DRILLING ROD TYPE AND DIAMETER / BUCKET WIDTH	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) CalMod (2.4")	HAMMER TYPE Safety semi-automatic drop (140#/ 30")	HAMMER EFFICIENCY, ERi
BACKFILL AND COMPLETION Tremie Cement Grout Backfill	GROUND WATER READINGS — DURING: 28.0 ft; AFTER (DATE):	CASING TYPE AND DIAMETER(in)

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	0		ASPHALT CONCRETE (8")															
	1		AGGREGATE BASE (2")															
			Lean CLAY (CL); hard; brown; dry; trace fine SAND															
	3				1	20 36 29	65		60	>4.5								
	4		Lean CLAY with SAND (CL); hard; brown; moist; little fine to medium SAND															
	5.5				2	10 50/4"	50/4"		90	>4.5								
	6		dry															
	11		dark yellowish brown; moist; some moderate to strong cementation		3	12 28 50/6"	78/12"		80	>4.5								
	13.5		SILTY SAND (SM); dense; dark yellowish brown; moist; fine SAND; some fines															
	16				4	12 19 28	47		65	NA								
	20		Poorly Graded SAND (SP); medium dense to dense; olive gray; moist; fine to medium SAND; trace coarse SAND		5	12 16 16	32		90	NA								
	24		CLAYEY GRAVEL with SAND (GC); very dense; gray; dry; some fine GRAVEL; some fine through coarse SAND; little fines															
	25																	

(continued)

BLACKBURN CONSULTING

PROJECT NAME OPUD South Yuba Sewer and Water	FILE NO. 3842.X	HOLE ID TC-14
COUNTY YUB	ROUTE	POSTMILE
CLIENT Jacobs Engineering		
PREPARED BY LDM	CHECKED BY	SHEET 1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	N60 (ASTM)	Recovery (%)	Pocket Penetrometer	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength Test	Additional Lab Tests	Drilling Method
	25		CLAYEY GRAVEL with SAND (GC) *(continued)*.		6	23 50/3"	50/3"		100	NA								
	29		CLAYEY SAND with GRAVEL (SC); dense; gray; wet; mostly fine to medium SAND; little fines; few fine GRAVEL; few coarse SAND															
	30				7	17 22 27	49		45	NA								
	34		CLAYEY SAND (SC); very dense; gray; moist; fine to medium SAND; some fines; trace fine GRAVEL															
	35				8	14 23 49	72		45	NA								
	38		Lean CLAY (CL); (stiff); dark yellowish brown; moist; trace fine SAND															
	40				9	10 11 11	22		30									

Depth scale (ft): 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55

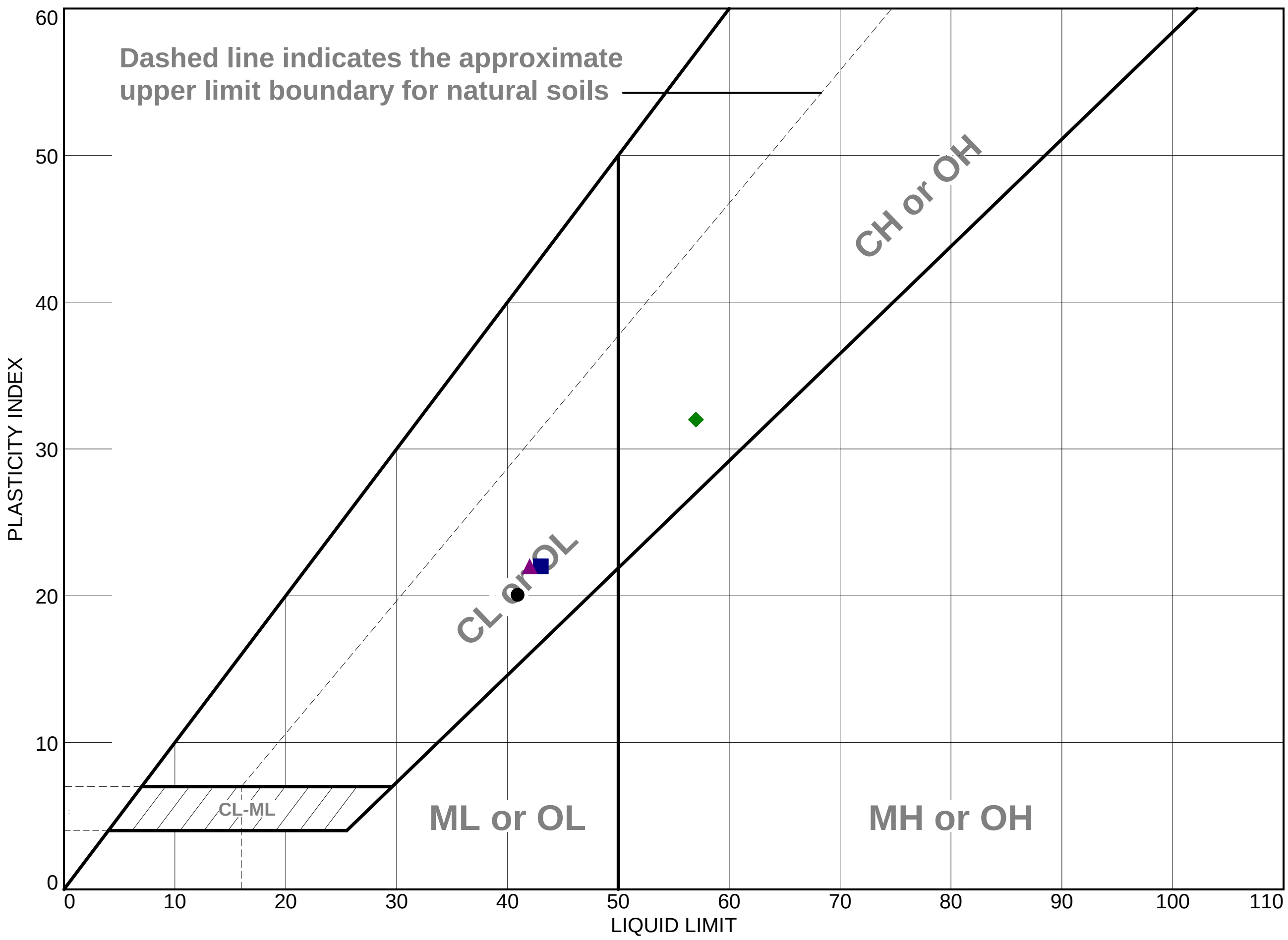
Bottom of exploration at 41.5 ft below ground surface (bgs)

Goundwater Encountered at 28 ft bgs

Tremie Cement Grout Backfill

BLACKBURN CONSULTING	PROJECT NAME **OPUD South Yuba Sewer and Water**	FILE NO. **3842.X**	HOLE ID **TC-14**
	COUNTY **YUB**	ROUTE	POSTMILE
	CLIENT **Jacobs Engineering**		
	PREPARED BY **LDM**	CHECKED BY	SHEET **2 of 2**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY with SAND, yellowish brown	41	21	20			CL
■	Lean CLAY, dark yellowish brown	43	21	22			CL
▲	Lean CLAY, yellowish brown	42	20	22			CL
◆	Fat CLAY, yellowish brown	57	25	32			CH

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-6A **Depth:** 10.5-11' **Sample Number:** 2B

■ **Source of Sample:** TC-6A **Depth:** 16-16.5' **Sample Number:** 3C

▲ **Source of Sample:** TC-6A **Depth:** 21-21.5' **Sample Number:** 4C

◆ **Source of Sample:** TC-6A **Depth:** 26-26.5' **Sample Number:** 5C

Remarks:

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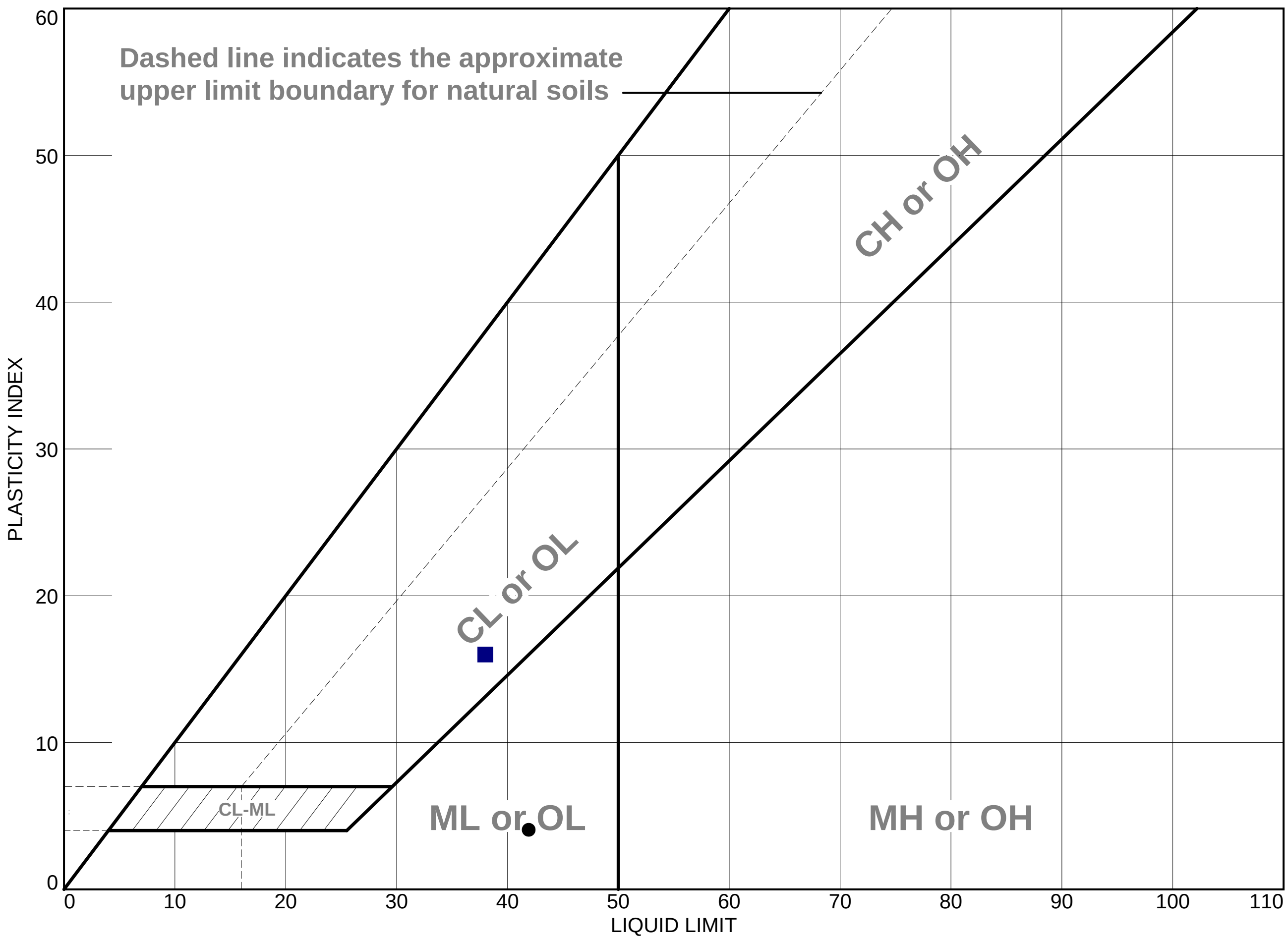
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILT, yellowish brown	42	38	4			ML
■	Lean CLAY, yellowish brown	38	22	16			CL
▲	SANDY SILT, dark yellowish brown	NP	NP	NP		57.0	ML

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-7A **Depth:** 15.5-16.5' **Sample Number:** 4

■**Source of Sample:** TC-7A **Depth:** 20.5-21.5' **Sample Number:** 5

▲**Source of Sample:** TC-7A **Depth:** 25.5-26.5' **Sample Number:** 6

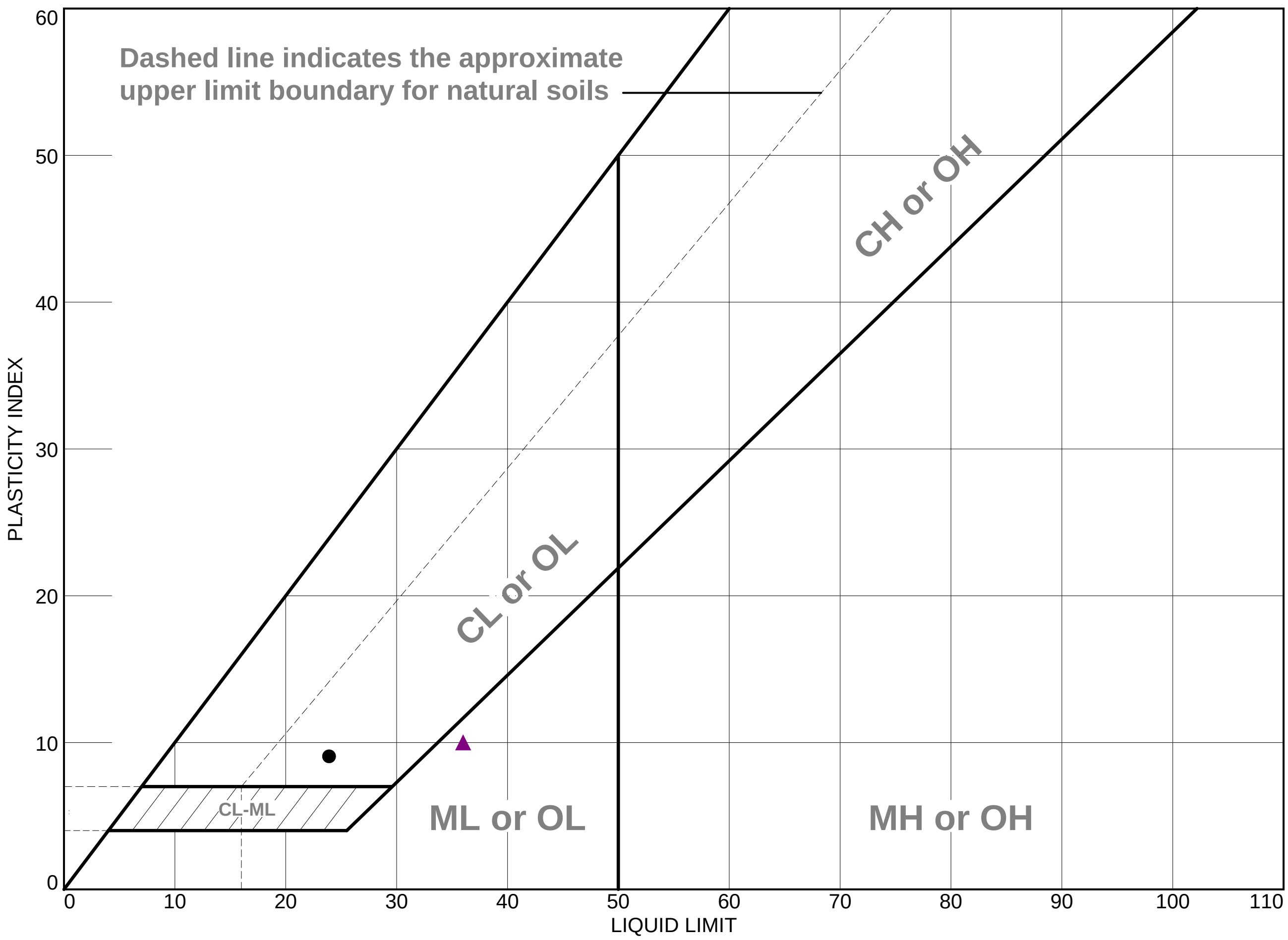
Remarks:

Blackburn Consulting

W. Sacramento, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY, dark brown	24	15	9			CL
■	SANDY SILT, dark brown	NP	NP	NP		51.2	ML
▲	SANDY SILT, brown	36	26	10			ML

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-7B **Depth:** 5.5-6.5' **Sample Number:** 2

■ **Source of Sample:** TC-7B **Depth:** 15.5-16.5' **Sample Number:** 4

▲ **Source of Sample:** TC-7B **Depth:** 25.5-26.5' **Sample Number:** 6

Remarks:

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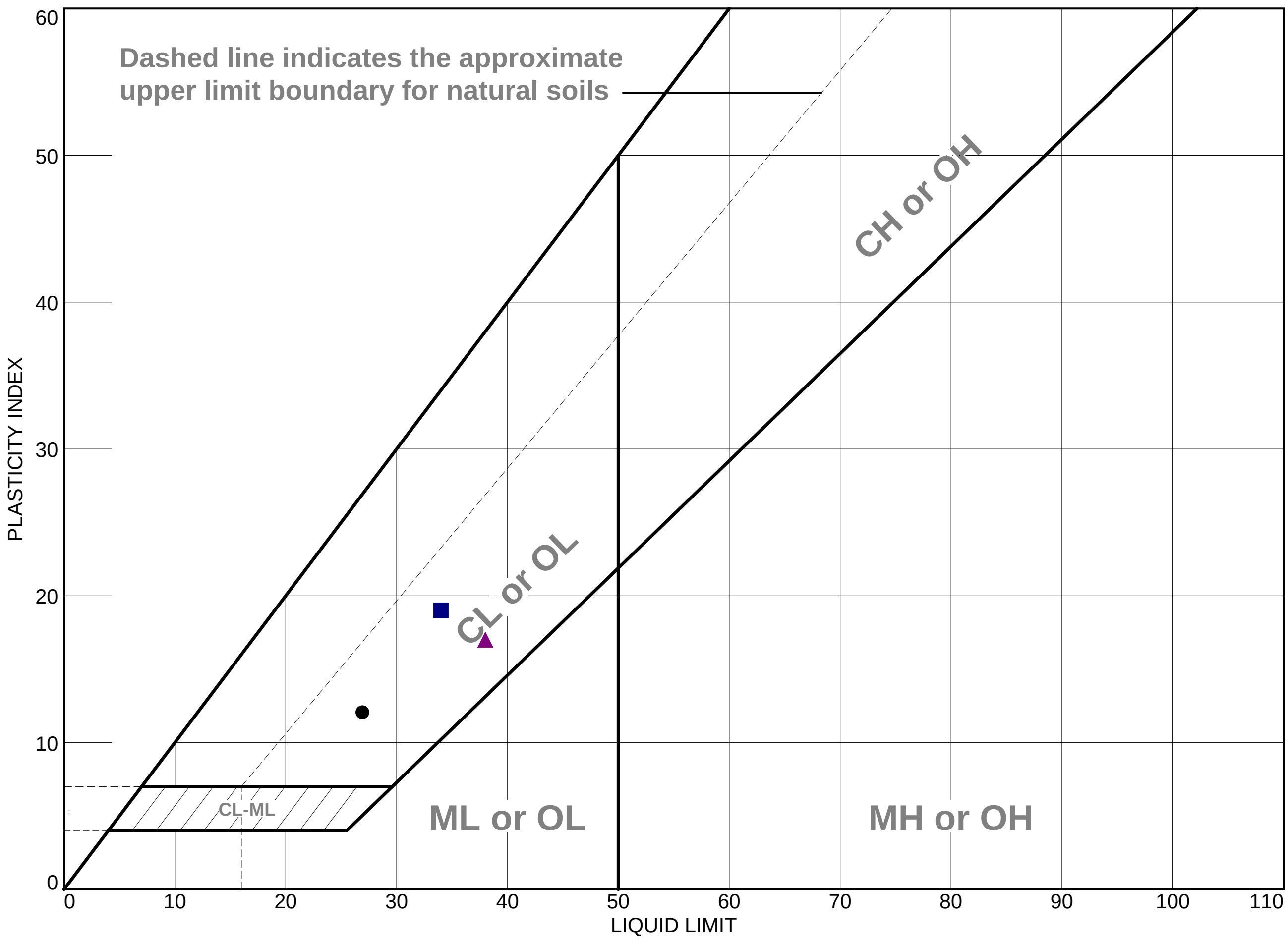
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	CLAYEY SAND, dark reddish brown	27	15	12		45.9	SC
■	Lean CLAY, reddish brown	34	15	19			CL
▲	Interbedded lenses of lean CLAY and CLAYEY SAND, yellowish brown	38	21	17		56.3	CL,SC
◆	Interbedded lenses of SILTY SAND and SANDY SILT, dark yellowish brown	NP	NP	NP		34.0	SM,ML

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-9A **Depth:** 10.5-11.5' **Sample Number:** 2
■ **Source of Sample:** TC-9A **Depth:** 15.5-16.5' **Sample Number:** 3
▲ **Source of Sample:** TC-9A **Depth:** 25.5-26.5 **Sample Number:** 5
◆ **Source of Sample:** TC-9A **Depth:** 35.5-36.5' **Sample Number:** 7

Remarks:

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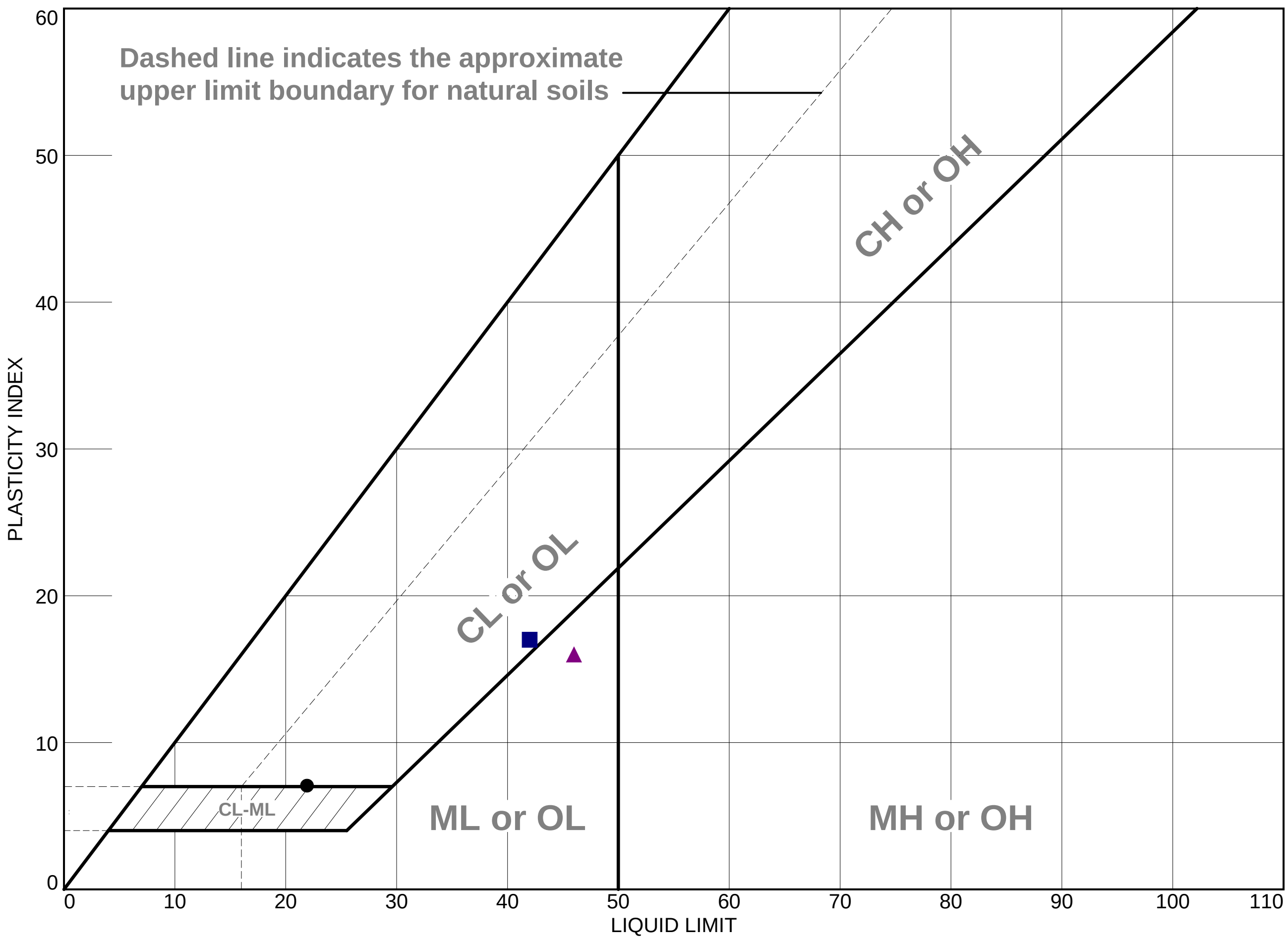
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILTY CLAY, dark reddish brown	22	15	7			CL-ML
■	Lean CLAY with SAND, strong brown	42	25	17			CL
▲	SILT, dark yellowish brown	46	30	16			ML

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-9B **Depth:** 5.5-6.5' **Sample Number:** 2

■ **Source of Sample:** TC-9B **Depth:** 25.5-26' **Sample Number:** 6B

▲ **Source of Sample:** TC-9B **Depth:** 31-31.5' **Sample Number:** 7C

Remarks:

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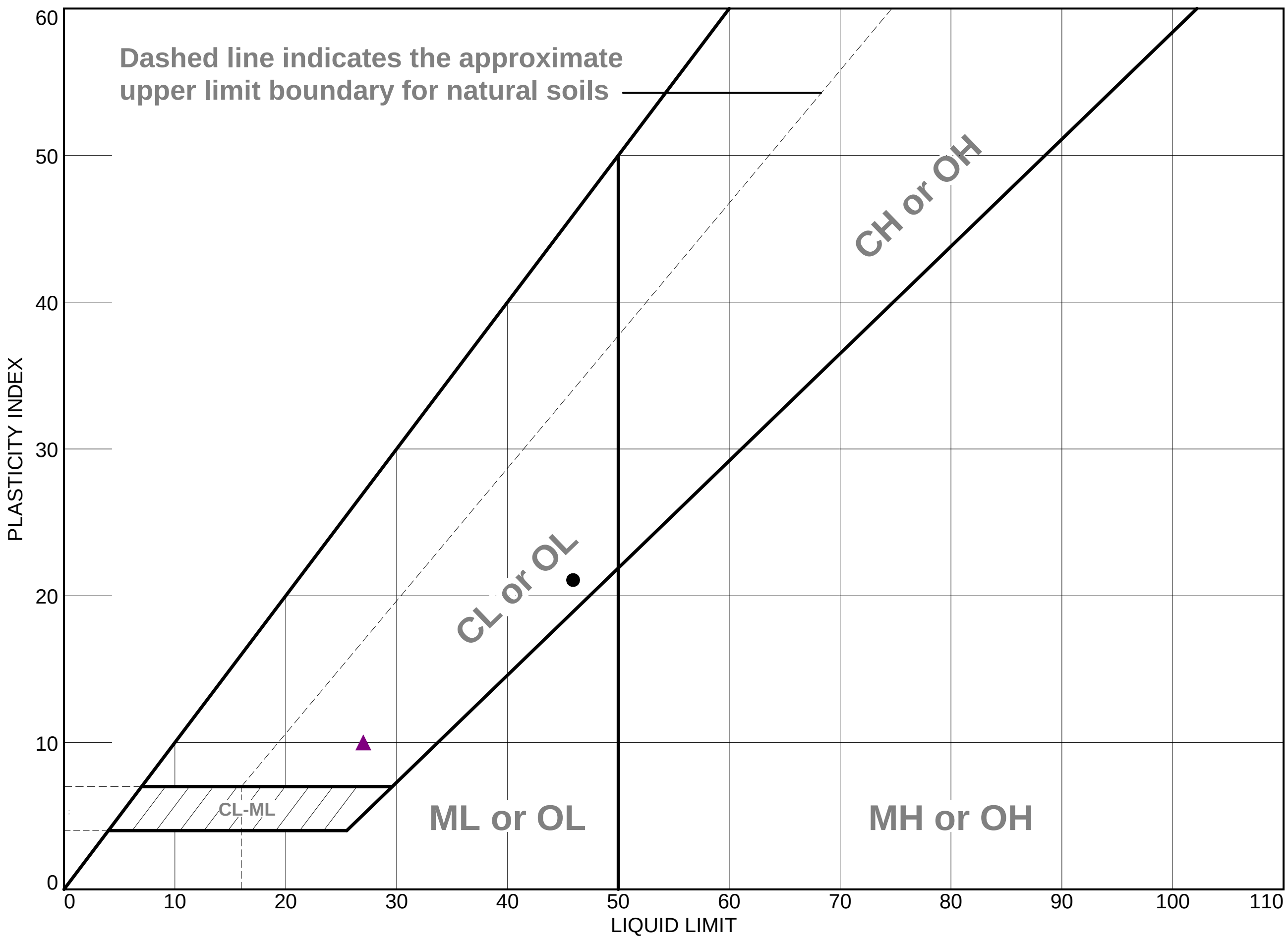
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY with SAND, yellowish brown	46	25	21			CL
■	SILTY SAND, dark olive brown	NP	NP	NP		18.6	SM
▲	Lean CLAY, dark yellowish brown	27	17	10			CL

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-10B **Depth:** 20.5-21' **Sample Number:** 5B

■**Source of Sample:** TC-10B **Depth:** 25.5-26.5' **Sample Number:** 6

▲**Source of Sample:** TC-10B **Depth:** 31-31.5' **Sample Number:** 7C

Remarks:

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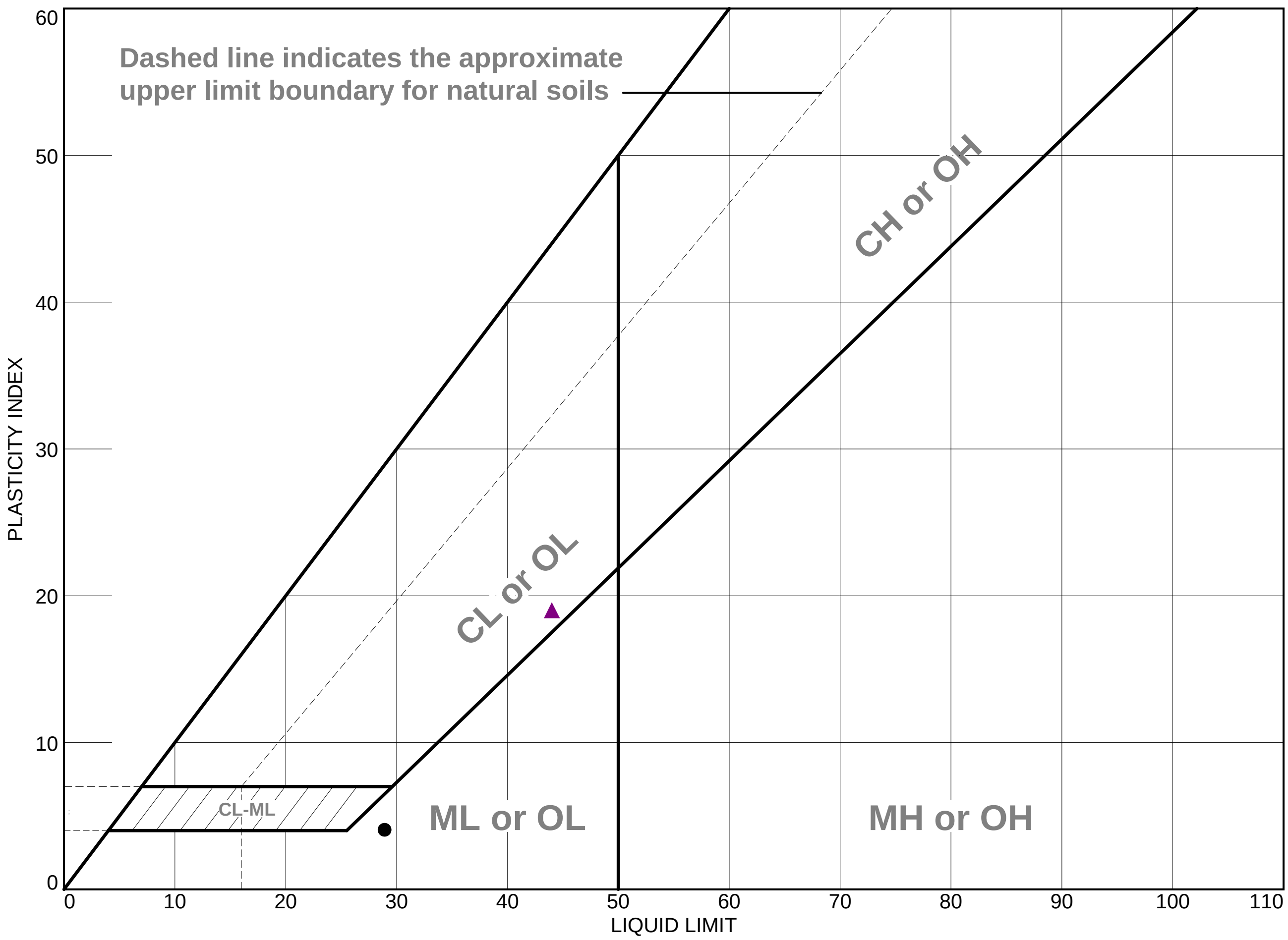
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILT, yellowish brown	29	25	4			ML
■	SILTY SAND, dark yellowish brown	NP	NP	NP	62.2	19.9	SM
▲	Lean CLAY, yellowish brown	44	25	19			CL

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-2C **Depth:** 3-3.5' **Sample Number:** 1B

■ **Source of Sample:** TC-2C **Depth:** 30.5-31' **Sample Number:** 8B

▲ **Source of Sample:** TC-2C **Depth:** 40.5-41.5' **Sample Number:** 10

Remarks:

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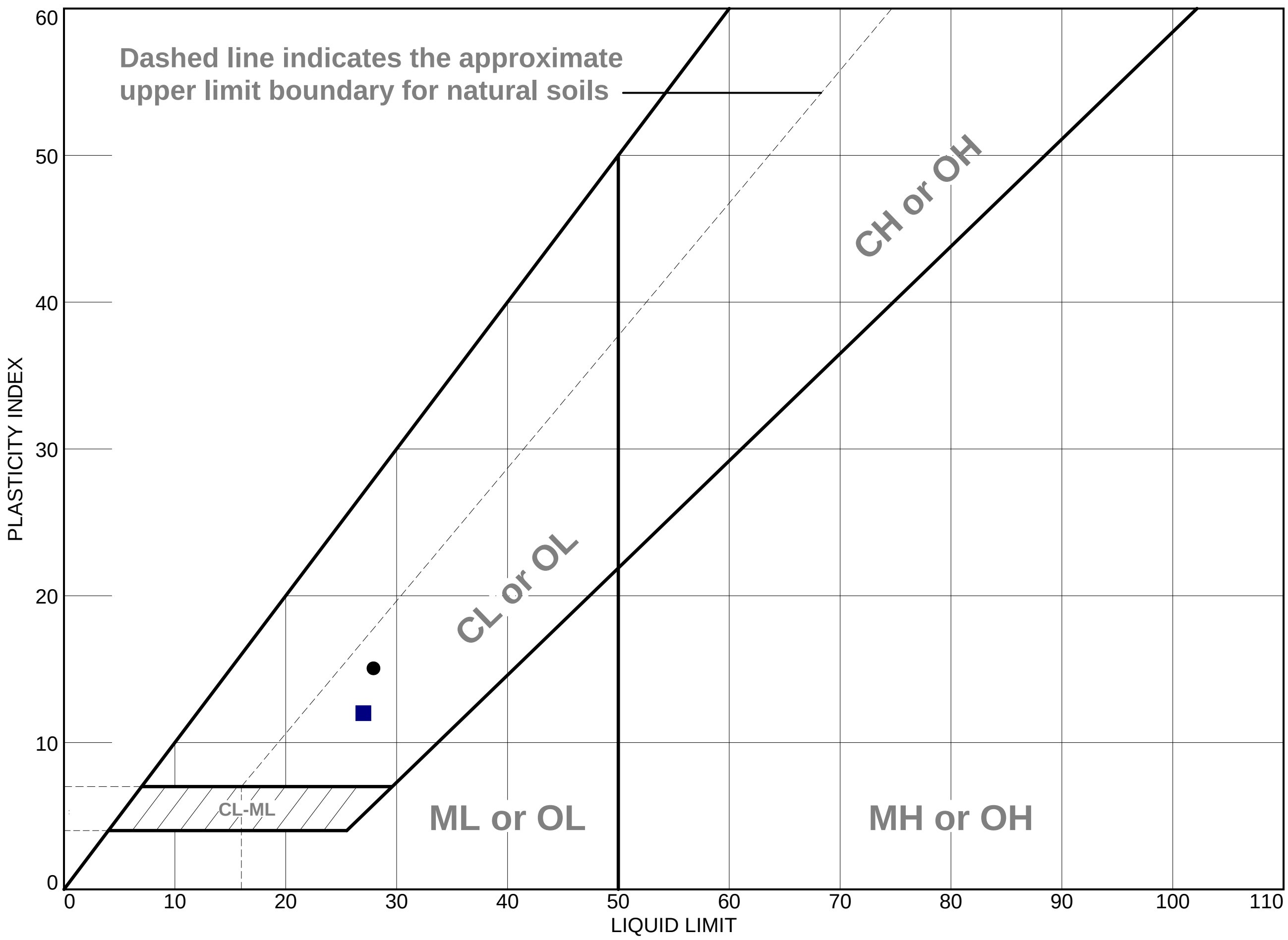
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	CLAYEY SAND, dark brown	28	13	15	72.5	17.4	SC
■	Lean CLAY, dark gray	27	15	12			CL

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-8A **Depth:** 15.5-16.5' **Sample Number:** 3

■**Source of Sample:** TC-8A **Depth:** 35.5-36' **Sample Number:** 7B

Remarks:

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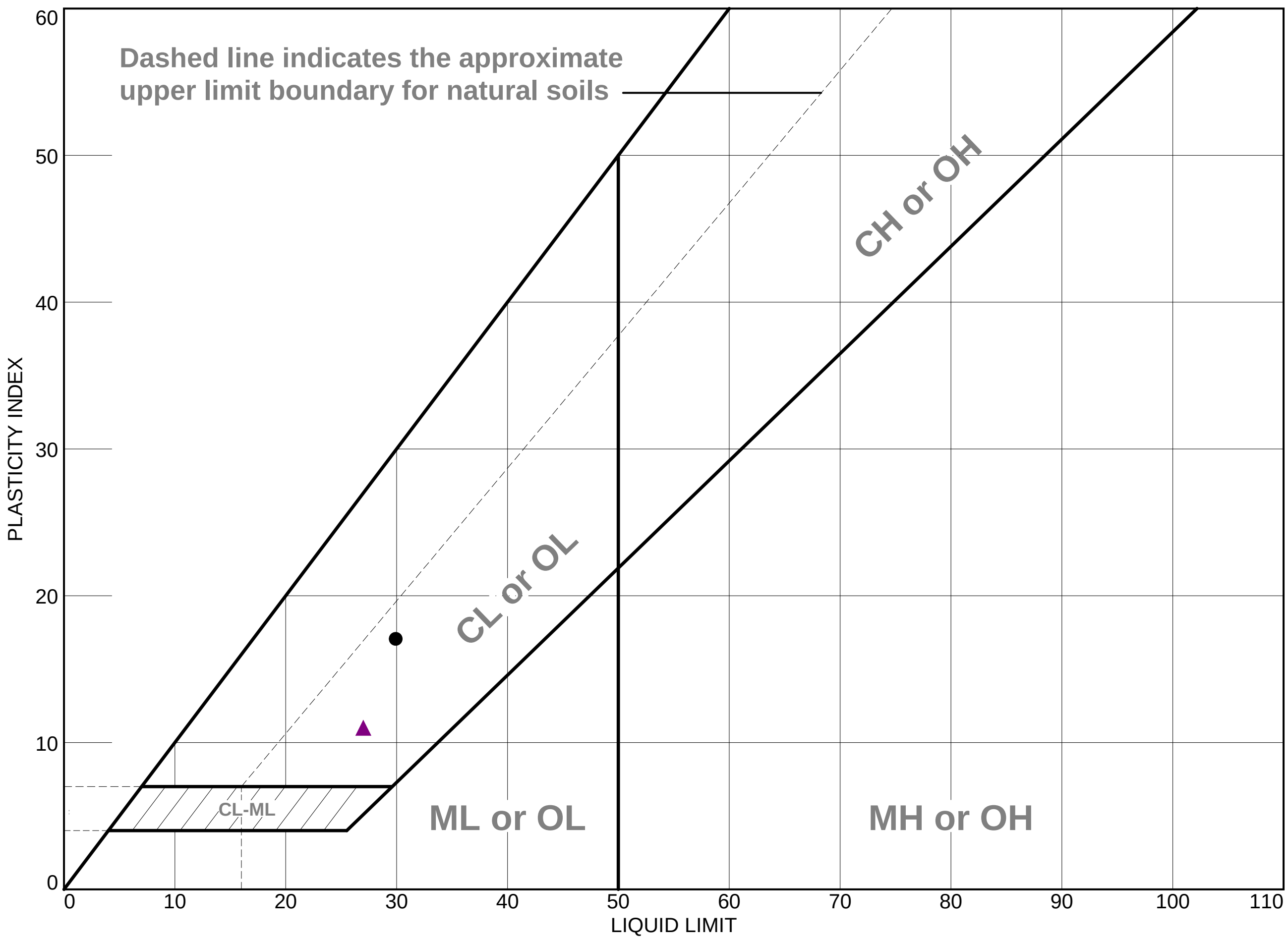
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY with SAND, brown	30	13	17			CL
■	SILTY SAND, dark yellowish brown	NP	NP	NP		42.6	SM
▲	CLAYEY SAND, dark yellowish brown	27	16	11		48.6	SC

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-8B **Depth:** 10.5-11' **Sample Number:** 3B

■ **Source of Sample:** TC-8B **Depth:** 30.5-31' **Sample Number:** 7B

▲ **Source of Sample:** TC-8B **Depth:** 35.5-36' **Sample Number:** 8B

Remarks:

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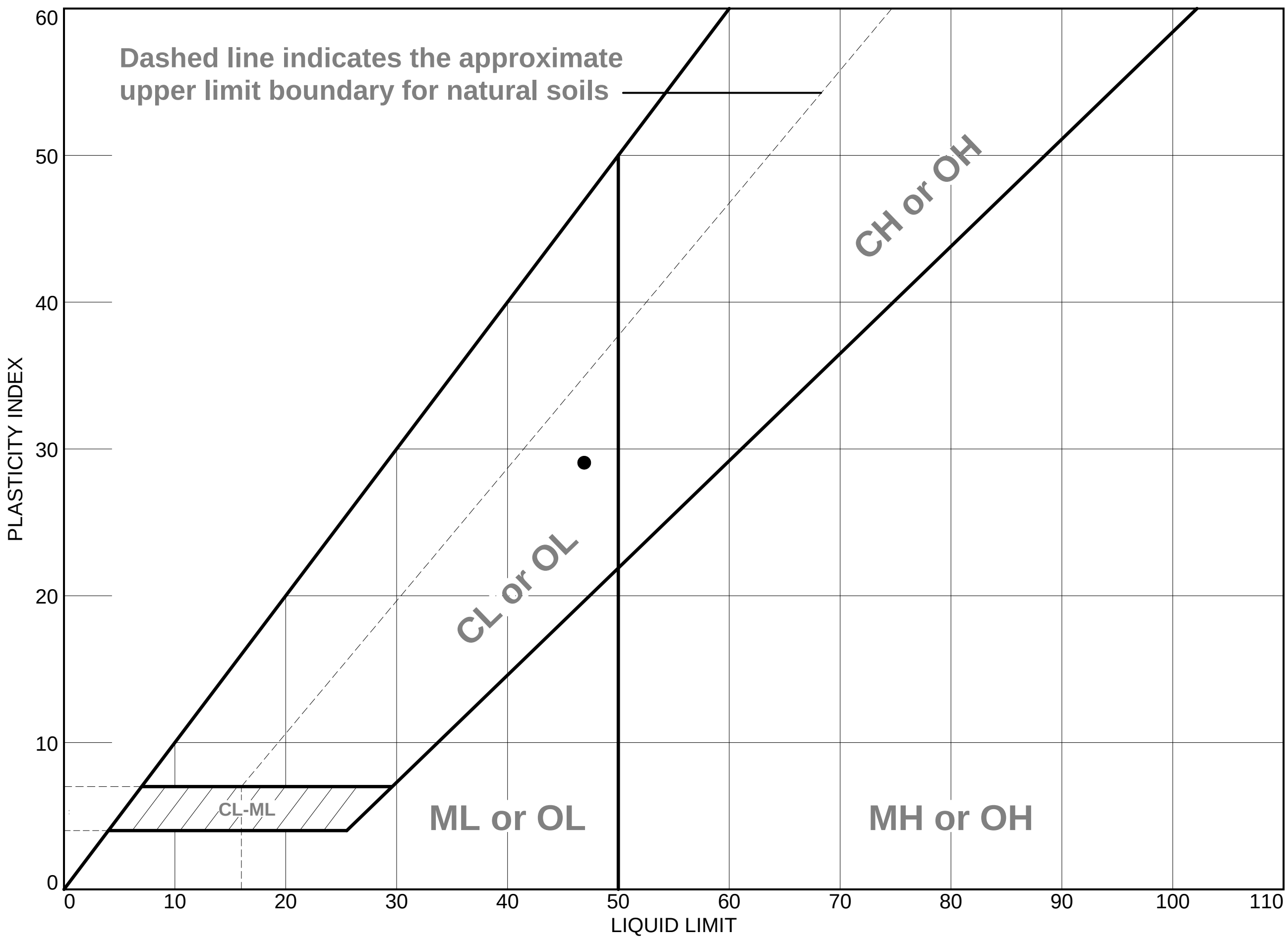
W. Sacramento, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY, reddish brown	47	18	29			CL
■	SILTY SAND, strong brown	NP	NP	NP			SM

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-10A **Depth:** 10.5-11' **Sample Number:** 3B

■ **Source of Sample:** TC-10A **Depth:** 35.3-36' **Sample Number:** 8B

Remarks:

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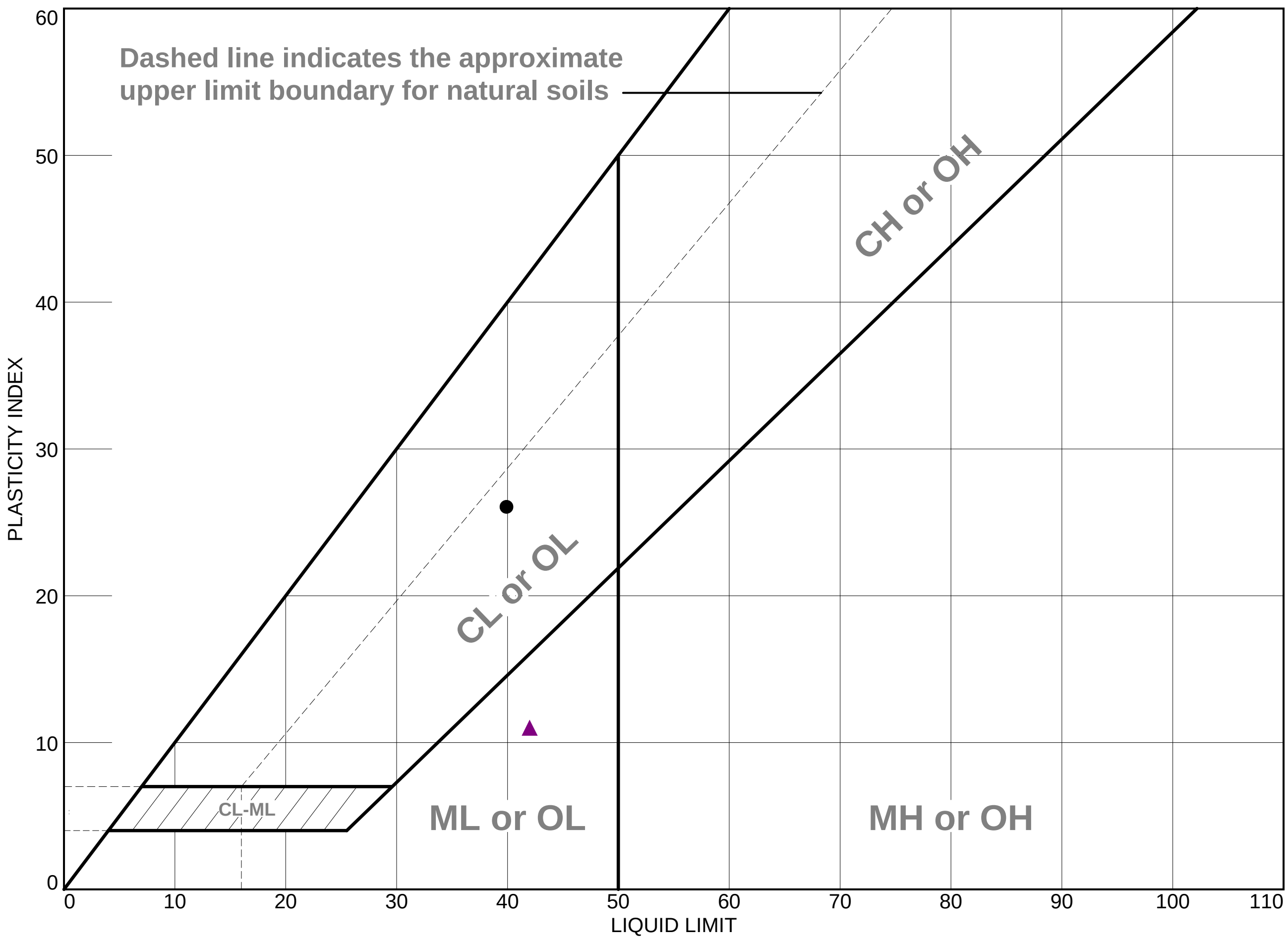
W. Sacramento, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY, dark brown	40	14	26			CL
■	Poorly-graded SAND with SILT, dark reddish brown	NP	NP	NP	73.4	9.0	SP-SM
▲	SILT, yellowish brown	42	31	11			ML

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

●**Source of Sample:** TC-12A **Depth:** 5.5-6' **Sample Number:** 2B

■**Source of Sample:** TC-12A **Depth:** 20.5-21.5' **Sample Number:** 5

▲**Source of Sample:** TC-12A **Depth:** 31-31.5' **Sample Number:** 7C

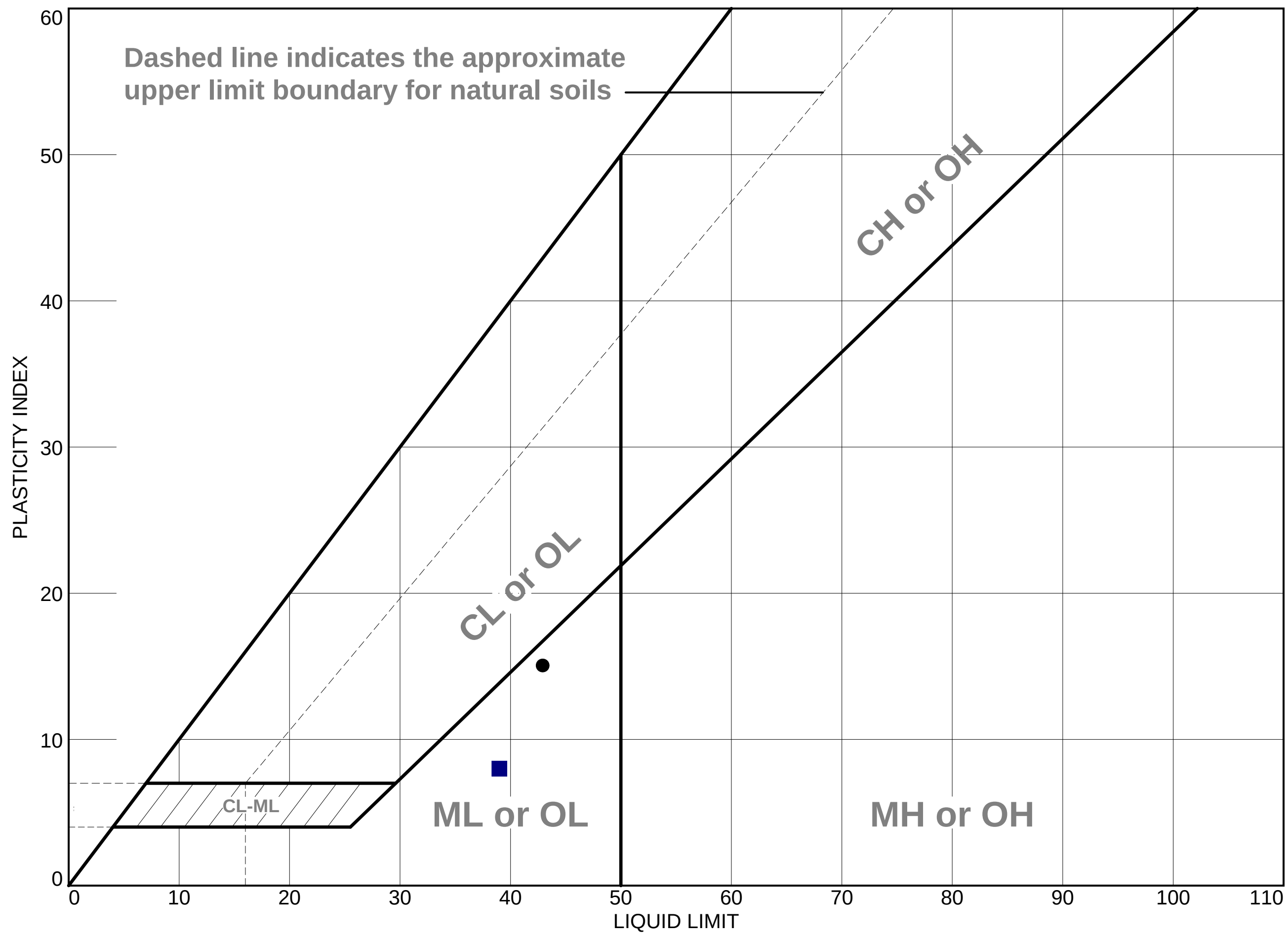
Remarks:

Blackburn Consulting

W. Sacramento, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILT with SAND, yellowish brown	43	28	15			ML
■	SILT, yellowish brown	39	31	8			ML
▲	SILTY SAND, dark yellowish brown	NP	NP	NP		46.4	SM

Project No. 3842.X **Client:** Jacobs Engineering Group Inc.

Project: OPUD South Yuba Sewer Infrastructure

● **Source of Sample:** TC-12B **Depth:** 15-16' **Sample Number:** 3

■ **Source of Sample:** TC-12B **Depth:** 31-31.5' **Sample Number:** 6C

▲ **Source of Sample:** TC-12B **Depth:** 35.5-36.5' **Sample Number:** 7

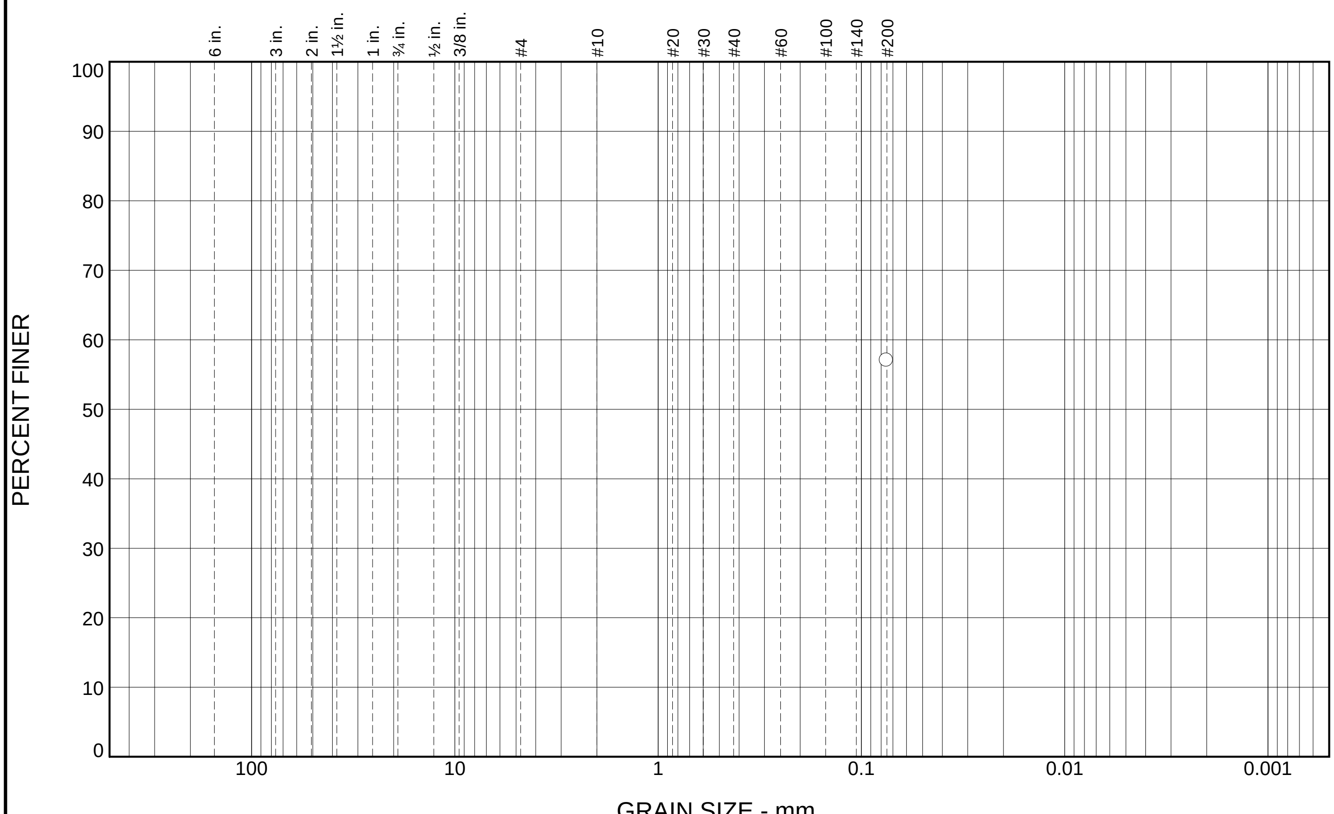
Remarks:

Blackburn Consulting

W. Sacramento, CA

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						57.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	57.0		

* (no specification provided)

Soil Description

SANDY SILT, dark yellowish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

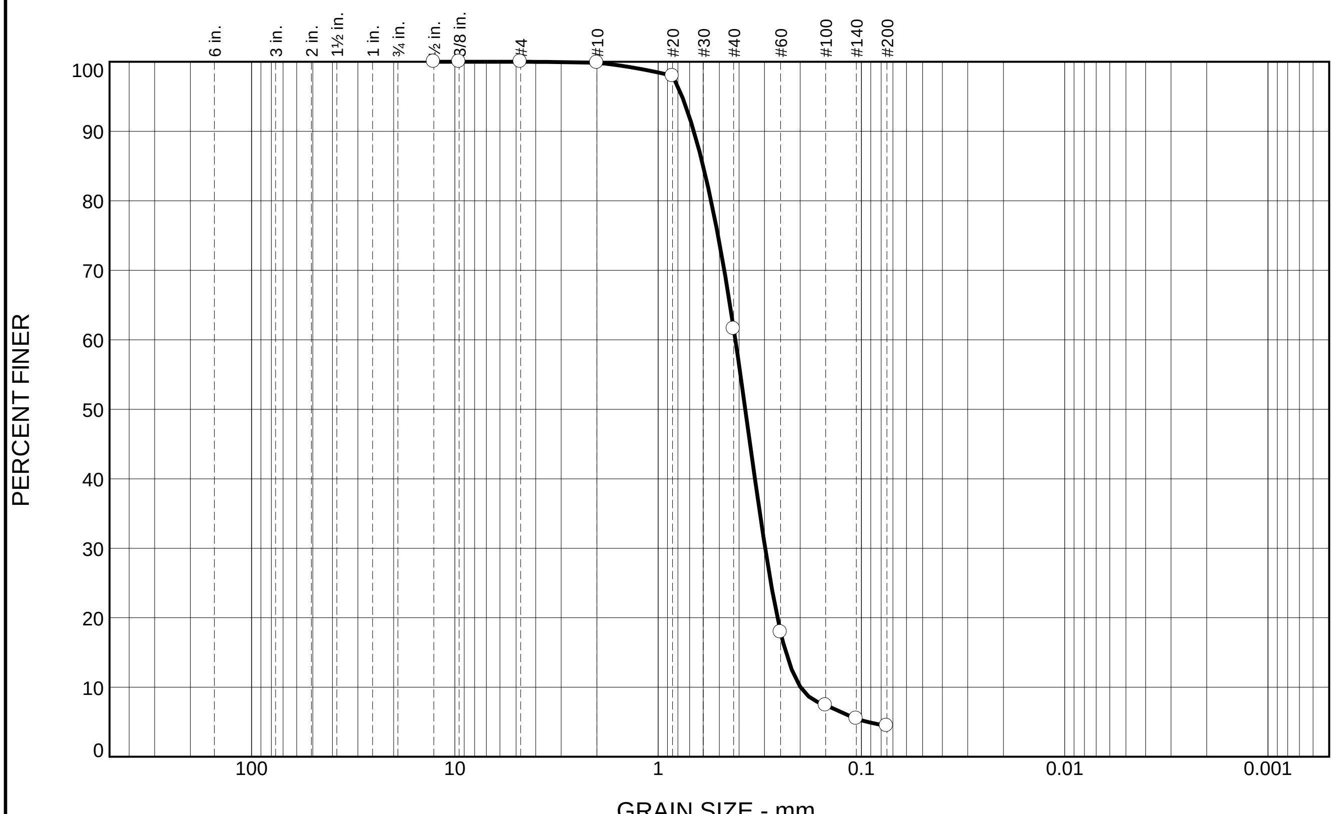
Source of Sample: TC-7A **Depth:** 25.5-26.5'
Sample Number: 6 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	38.2	57.1	4.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	100.0		
#4	100.0		
#10	99.8		
#20	98.0		
#40	61.6		
#60	17.9		
#100	7.4		
#140	5.5		
#200	4.5		

* (no specification provided)

Soil Description

Poorly-graded SAND, dark brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6669 D_{85}= 0.6004 D_{60}= 0.4170
D_{50}= 0.3727 D_{30}= 0.2975 D_{15}= 0.2354
D_{10}= 0.1991 C_u= 2.09 C_c= 1.07

Classification

USCS= SP AASHTO=

Remarks

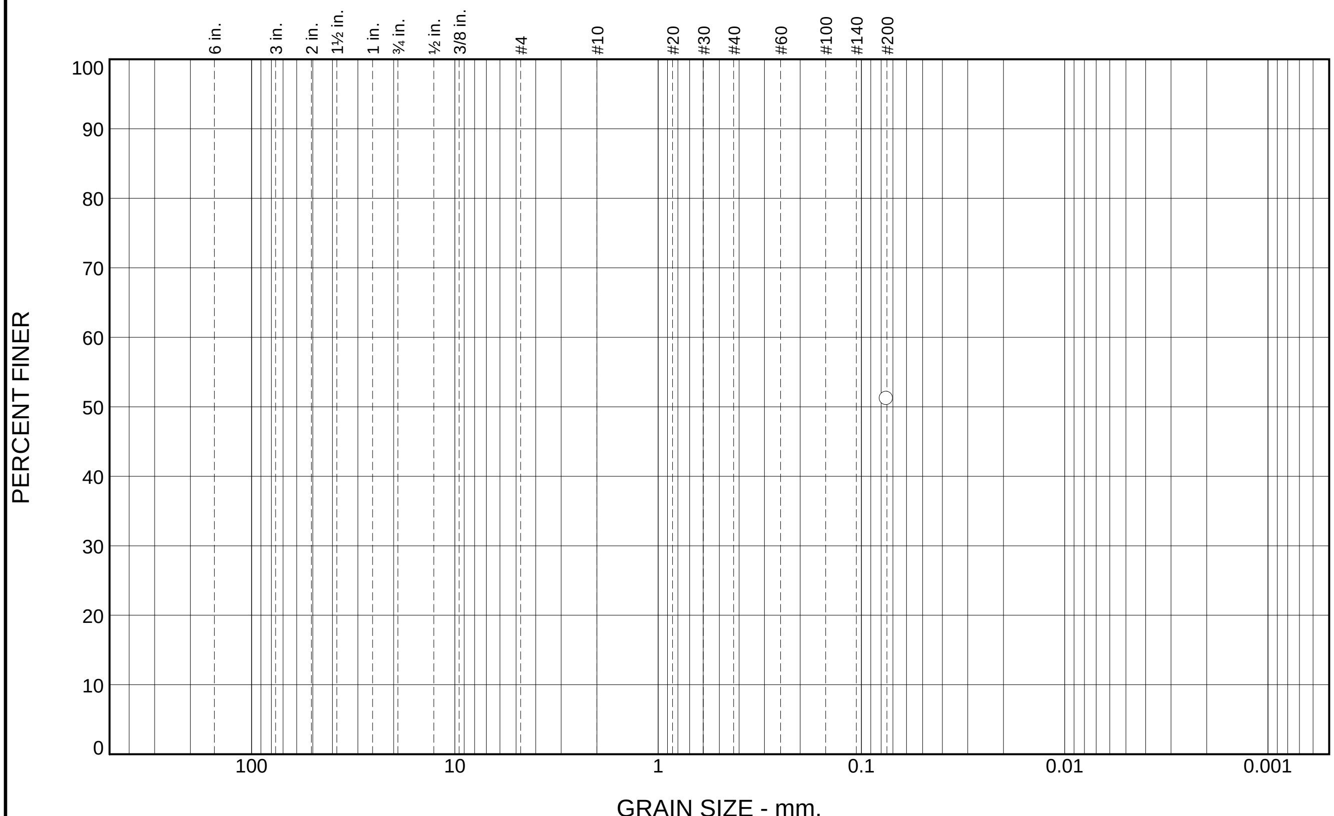
Source of Sample: TC-7A **Depth:** 35.5-36.5'
Sample Number: 8 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						51.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	51.2		

* (no specification provided)

Soil Description

SANDY SILT, dark brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Source of Sample: TC-7B **Depth:** 15.5-16.5'
Sample Number: 4 **Date:**

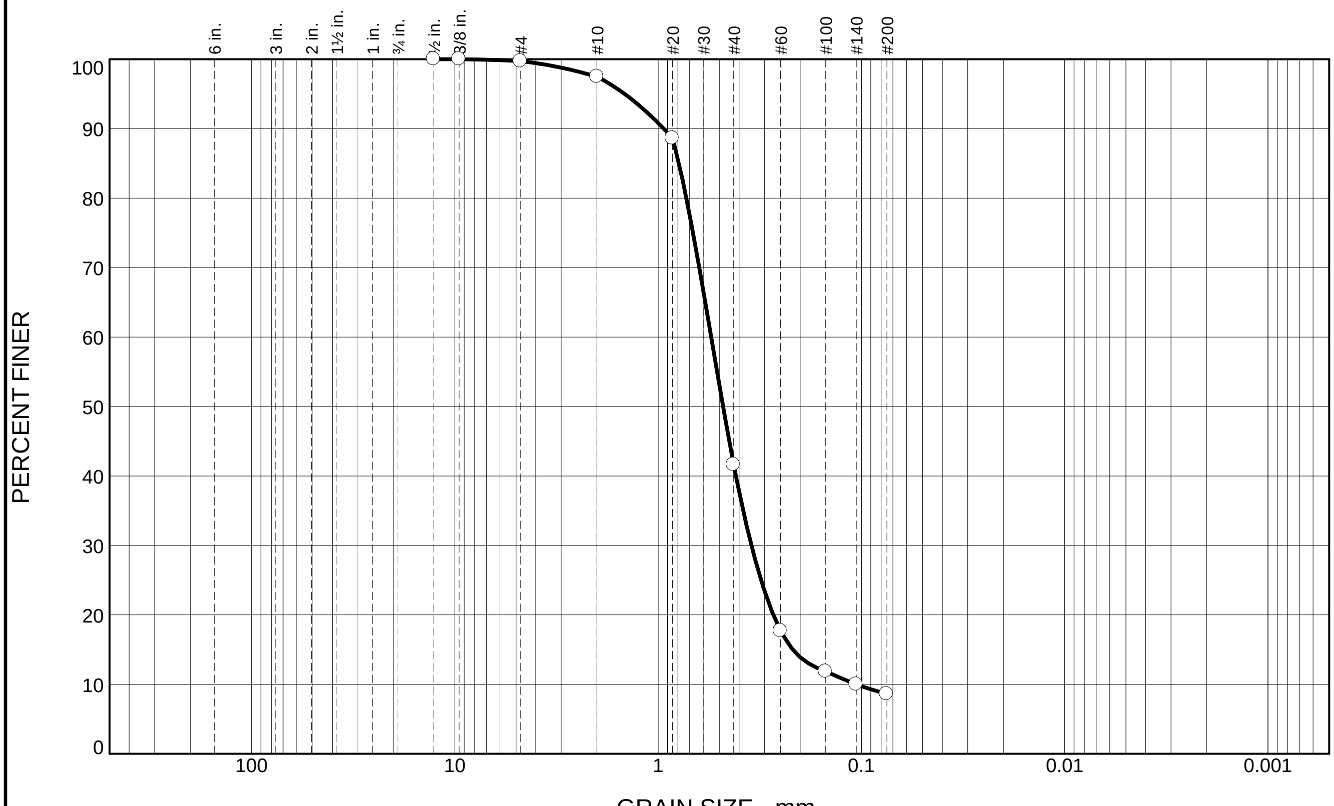
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	2.2	55.9	33.0	8.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	100.0		
#4	99.7		
#10	97.5		
#20	88.6		
#40	41.6		
#60	17.7		
#100	11.9		
#140	10.0		
#200	8.6		

* (no specification provided)

Soil Description

Poorly-graded SAND with CLAY, dark brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.9393 D_{85}= 0.7907 D_{60}= 0.5483
D_{50}= 0.4794 D_{30}= 0.3475 D_{15}= 0.2176
D_{10}= 0.1059 C_u= 5.18 C_c= 2.08

Classification

USCS= AASHTO=

Remarks

Source of Sample: TC-7B **Depth:** 30.5-31.5'
Sample Number: 7 **Date:**

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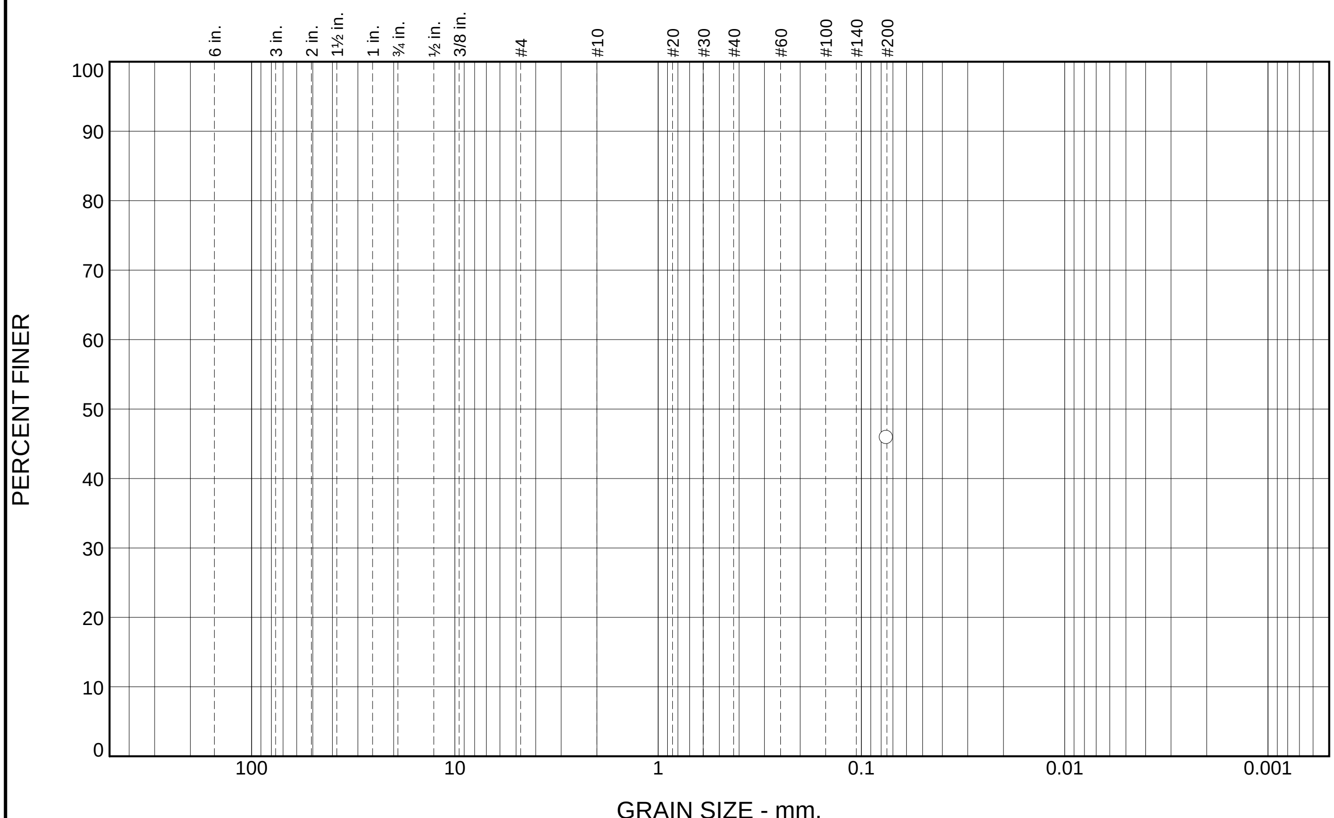
W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						45.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	45.9		

* (no specification provided)

Soil Description

CLAYEY SAND, dark reddish brown

Atterberg Limits

PL= 15 LL= 27 PI= 12

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

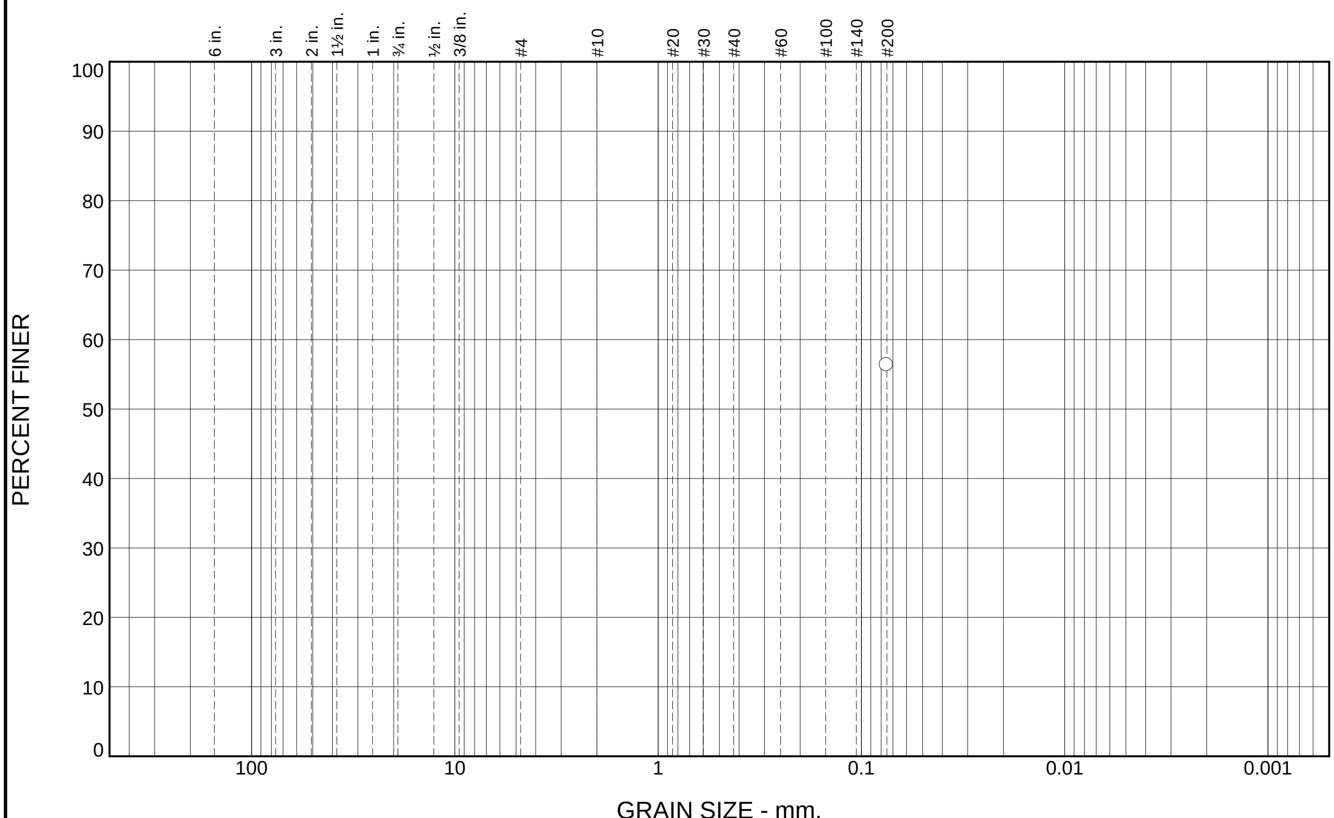
Source of Sample: TC-9A **Depth:** 10.5-11.5'
Sample Number: 2 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						56.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	56.3		

* (no specification provided)

Soil Description

Interbedded lenses of lean CLAY and CLAYEY SAND, yellowish brown

Atterberg Limits

PL= 21 LL= 38 PI= 17

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL,SC AASHTO=

Remarks

Source of Sample: TC-9A **Depth:** 25.5-26.5
Sample Number: 5 **Date:**

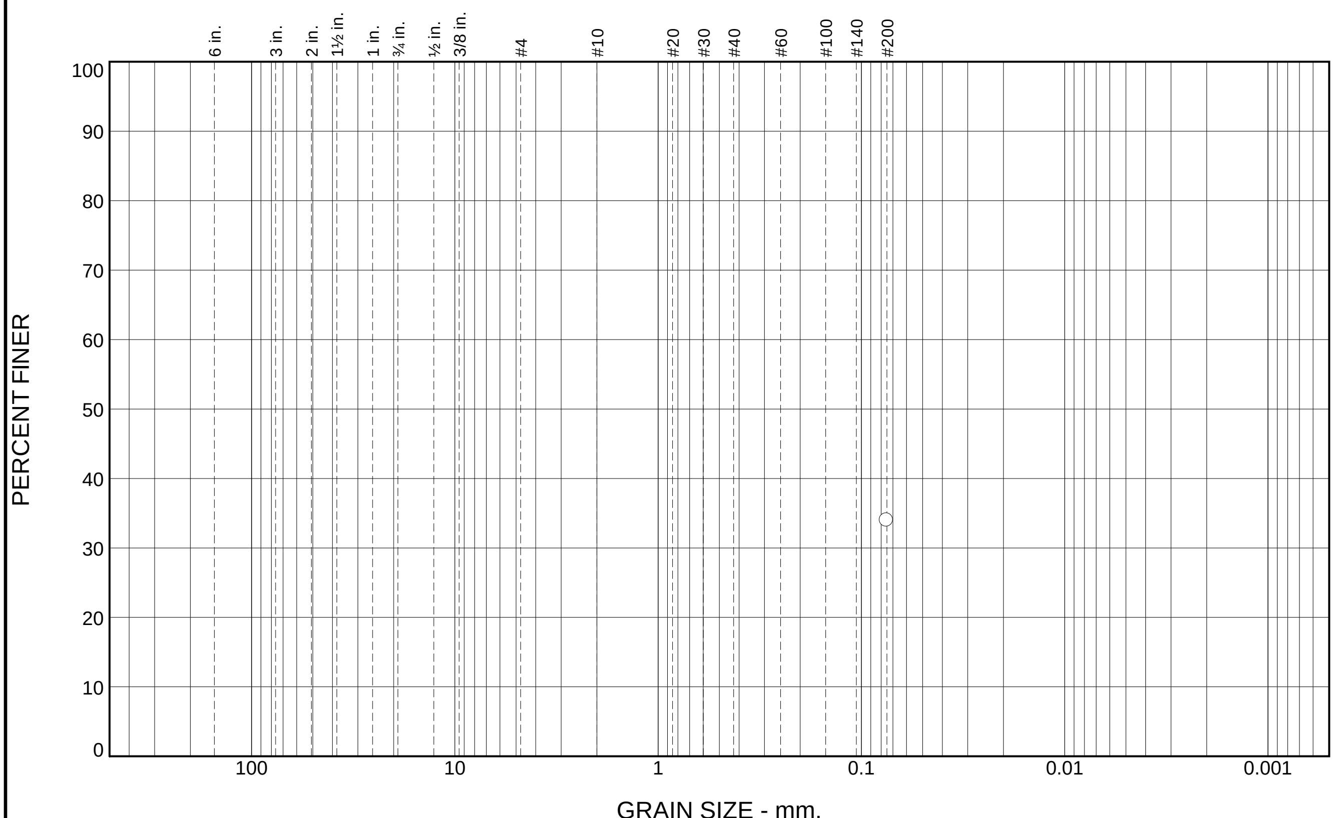
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						34.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	34.0		

* (no specification provided)

Soil Description

Interbedded lenses of SILTY SAND and SANDY SILT, dark yellowish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM,ML AASHTO=

Remarks

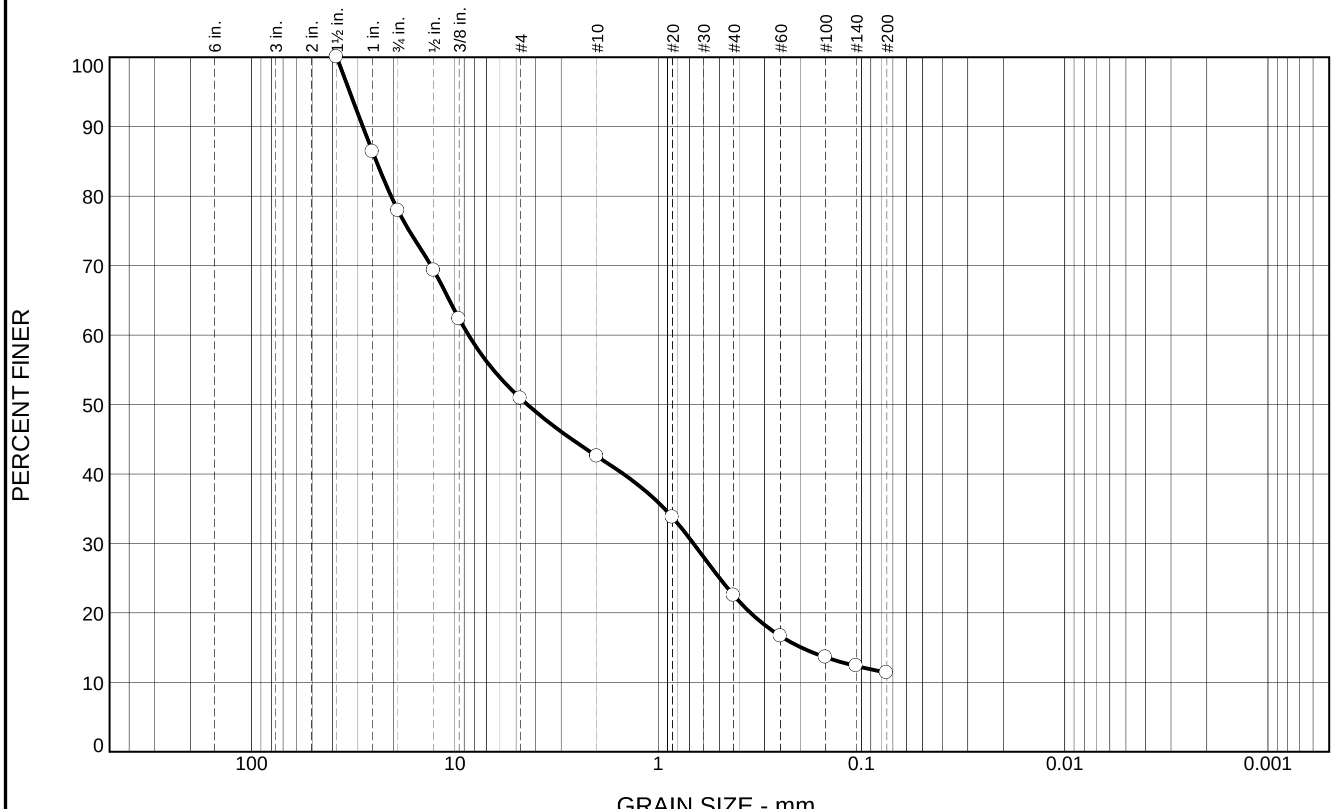
Source of Sample: TC-9A **Depth:** 35.5-36.5'
Sample Number: 7 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.1	27.0	8.4	20.0	11.1	11.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	86.4		
3/4"	77.9		
1/2"	69.3		
3/8"	62.3		
#4	50.9		
#10	42.5		
#20	33.8		
#40	22.5		
#60	16.7		
#100	13.6		
#140	12.4		
#200	11.4		

* (no specification provided)

Soil Description

Well-graded GRAVEL with CLAY and SAND, dark yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 28.3540 D_{85}= 24.3262 D_{60}= 8.5712
D_{50}= 4.4008 D_{30}= 0.6706 D_{15}= 0.1973
D_{10}= C_u= C_c=

Classification

USCS= GW-GC AASHTO=

Remarks

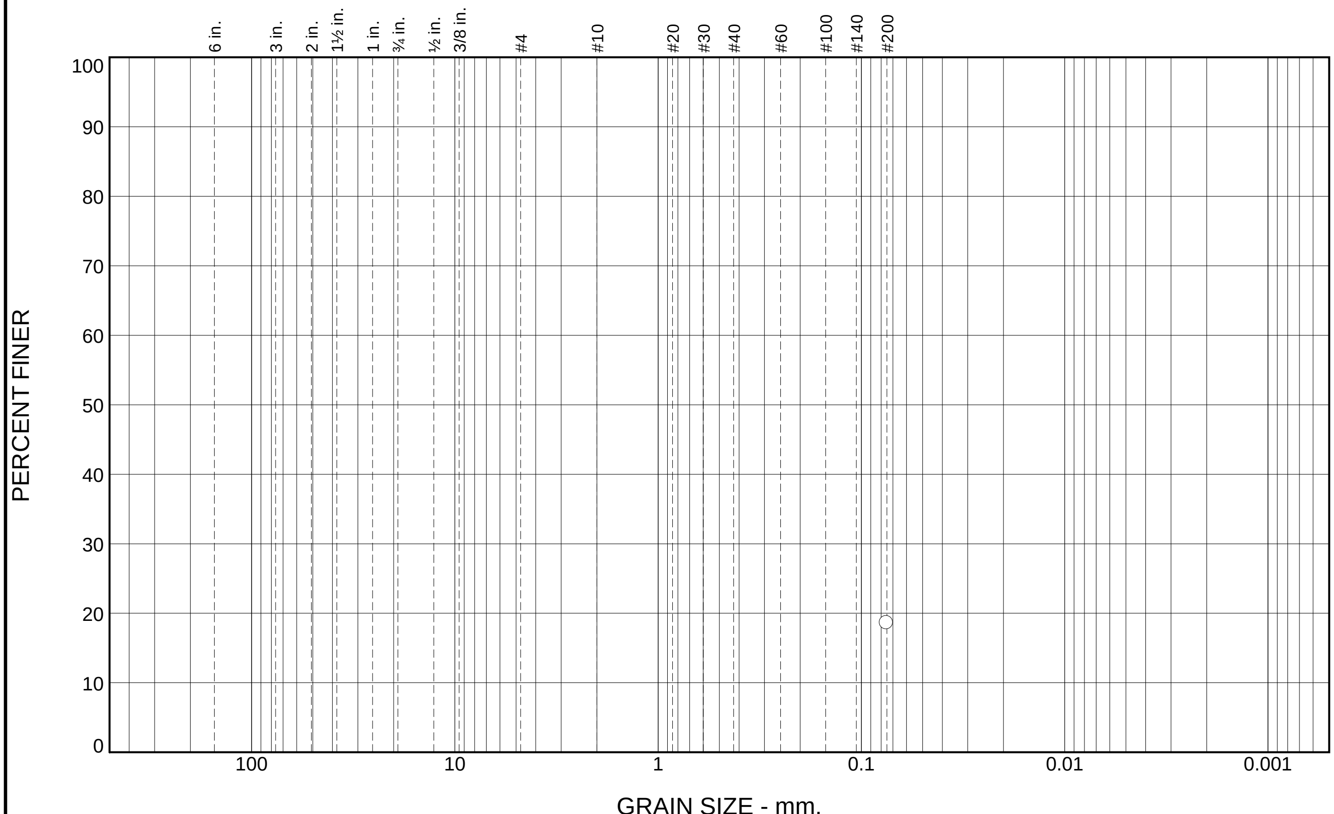
Source of Sample: TC-10B **Depth:** 15.5-16.5'
Sample Number: 4 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						18.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	18.6		

* (no specification provided)

Soil Description

SILTY SAND, dark olive brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: TC-10B **Depth:** 25.5-26.5'
Sample Number: 6 **Date:**

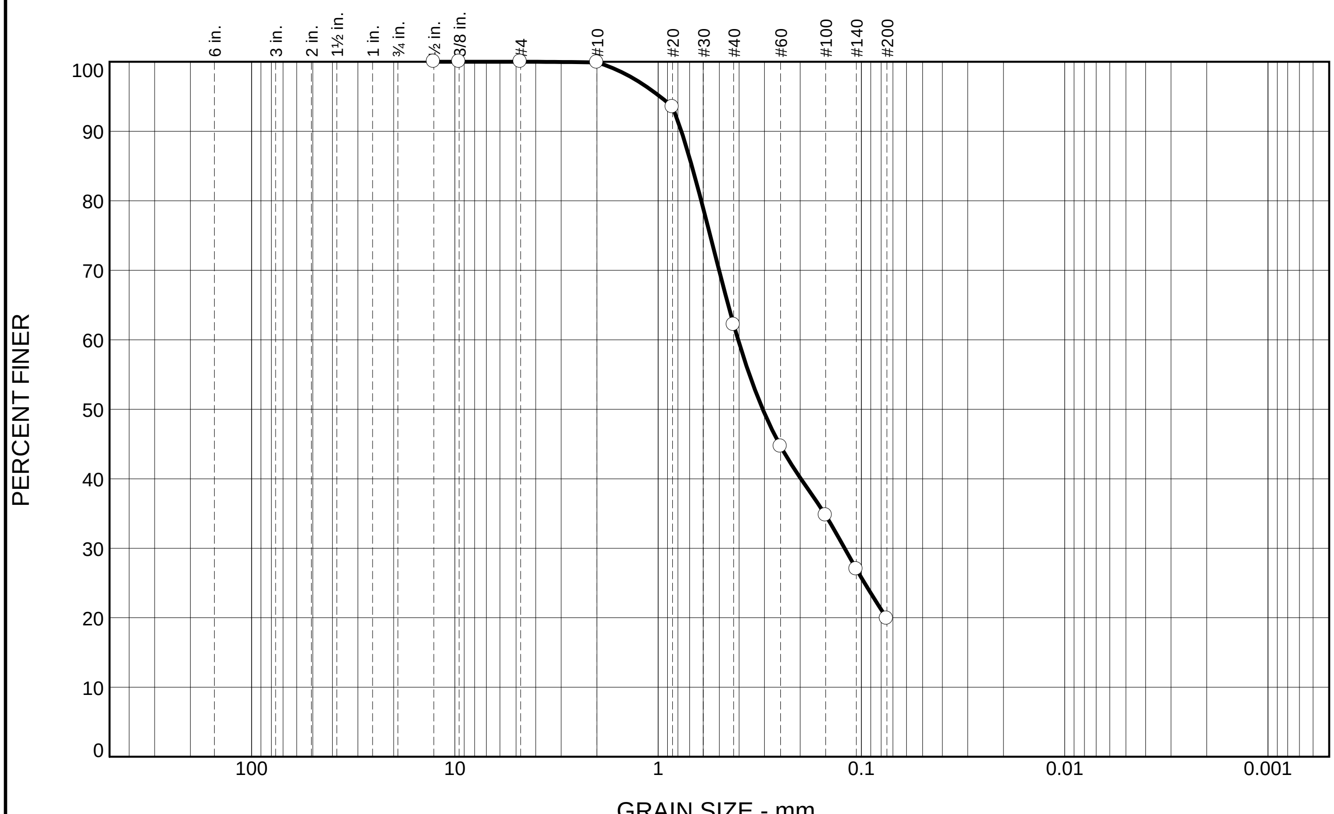
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	37.7	42.3	19.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	100.0		
#4	100.0		
#10	99.9		
#20	93.5		
#40	62.2		
#60	44.7		
#100	34.7		
#140	27.0		
#200	19.9		

* (no specification provided)

Soil Description

SILTY SAND, dark yellowish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.7686 D_{85}= 0.6823 D_{60}= 0.4042
D_{50}= 0.3057 D_{30}= 0.1210 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

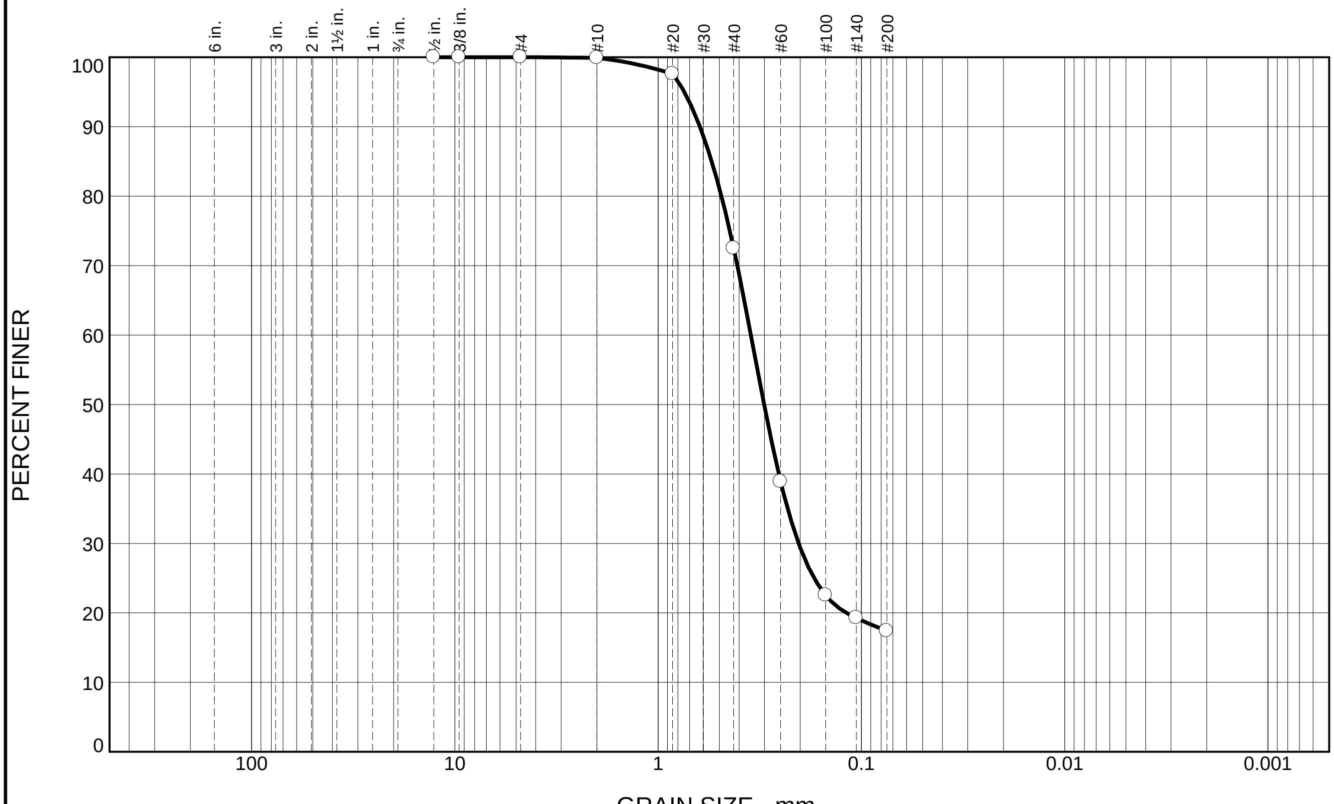
Source of Sample: TC-2C **Depth:** 30.5-31'
Sample Number: 8B **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	27.4	55.1	17.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	100.0		
#4	100.0		
#10	99.9		
#20	97.6		
#40	72.5		
#60	38.9		
#100	22.5		
#140	19.3		
#200	17.4		

* (no specification provided)

Soil Description

CLAYEY SAND, dark brown

Atterberg Limits

PL= 13 LL= 28 PI= 15

Coefficients

D_{90}= 0.6228 D_{85}= 0.5452 D_{60}= 0.3497
D_{50}= 0.3010 D_{30}= 0.2037 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

Source of Sample: TC-8A **Depth:** 15.5-16.5'
Sample Number: 3 **Date:**

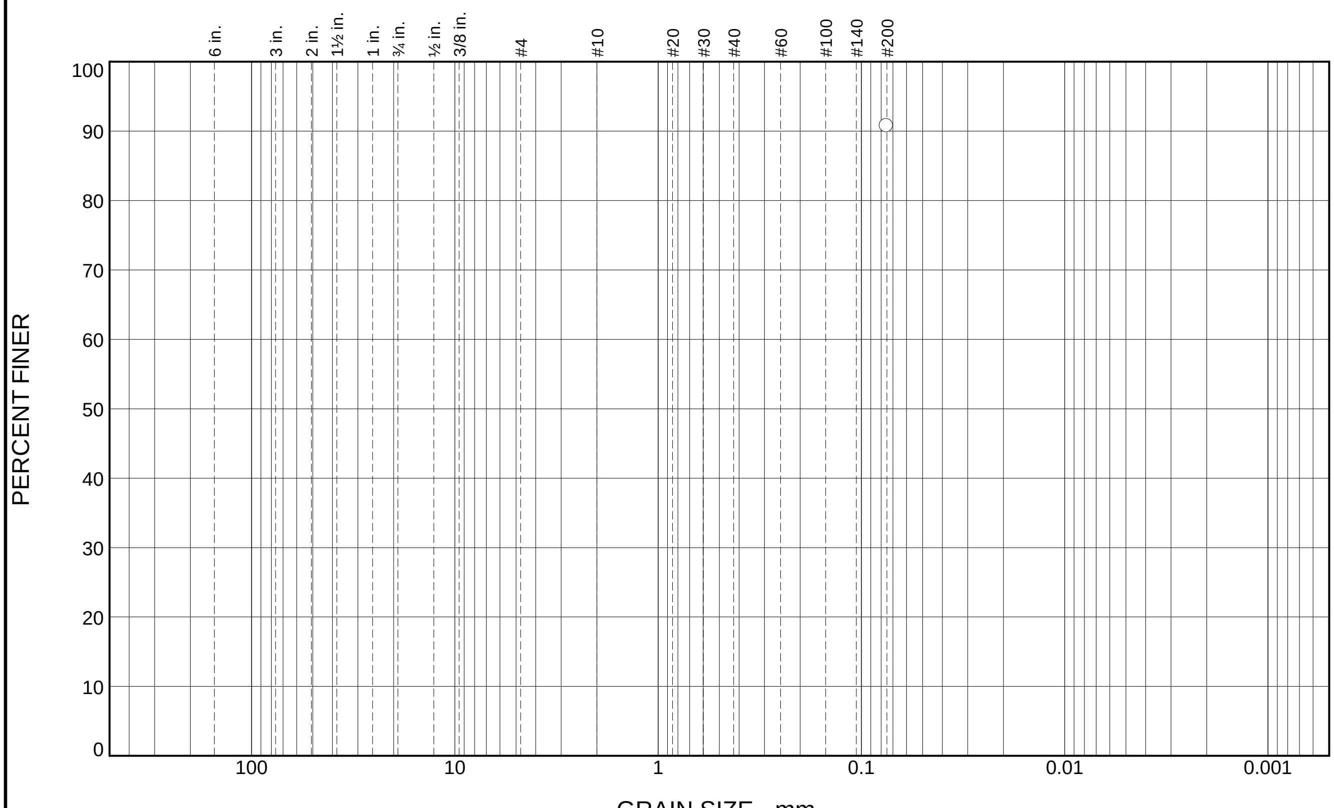
Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure

Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						90.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	90.7		

* (no specification provided)

Soil Description

Lean CLAY, dark greenish gray

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

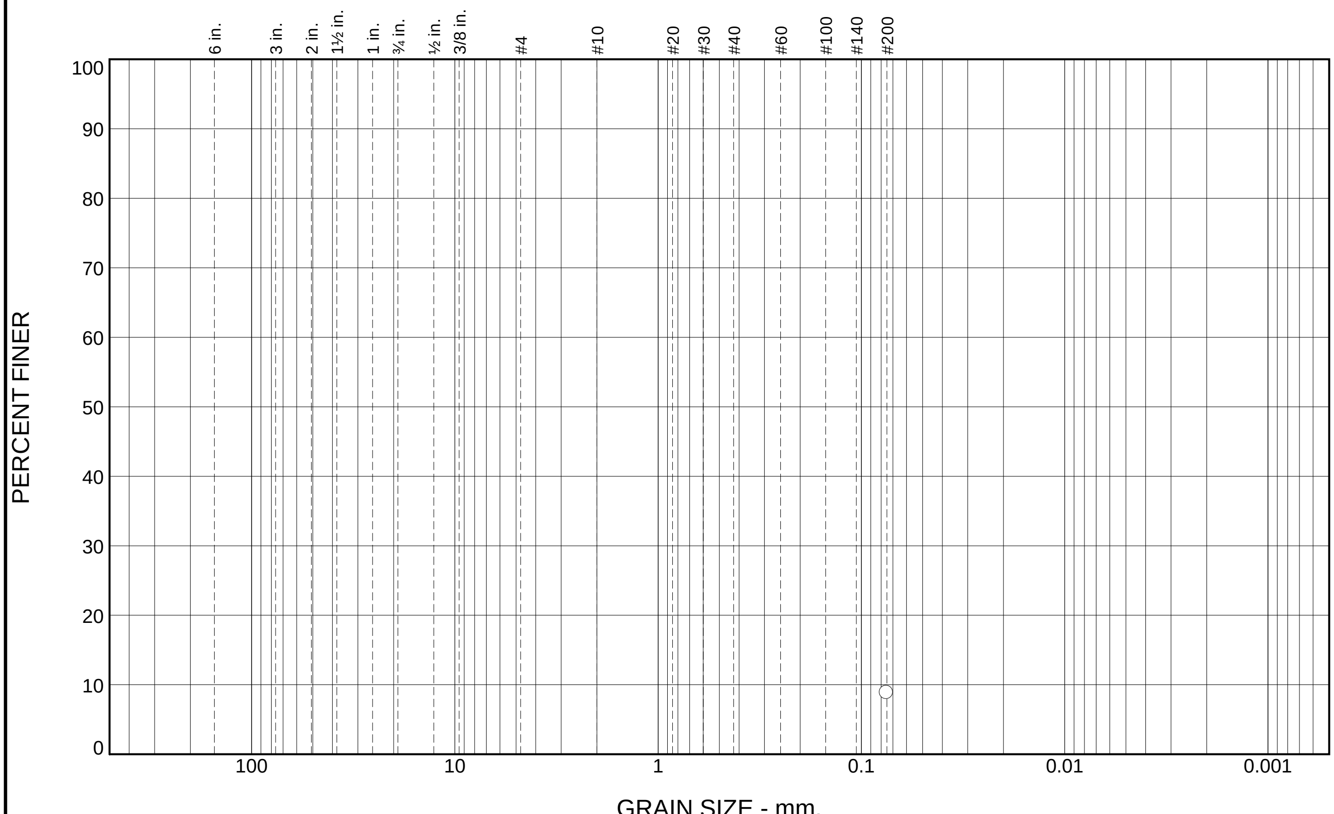
Source of Sample: TC-8A **Depth:** 25.5-26'
Sample Number: 5B **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						8.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	8.9		

* (no specification provided)

Soil Description

Poorly-graded GRAVEL with CLAY and SAND, grayish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

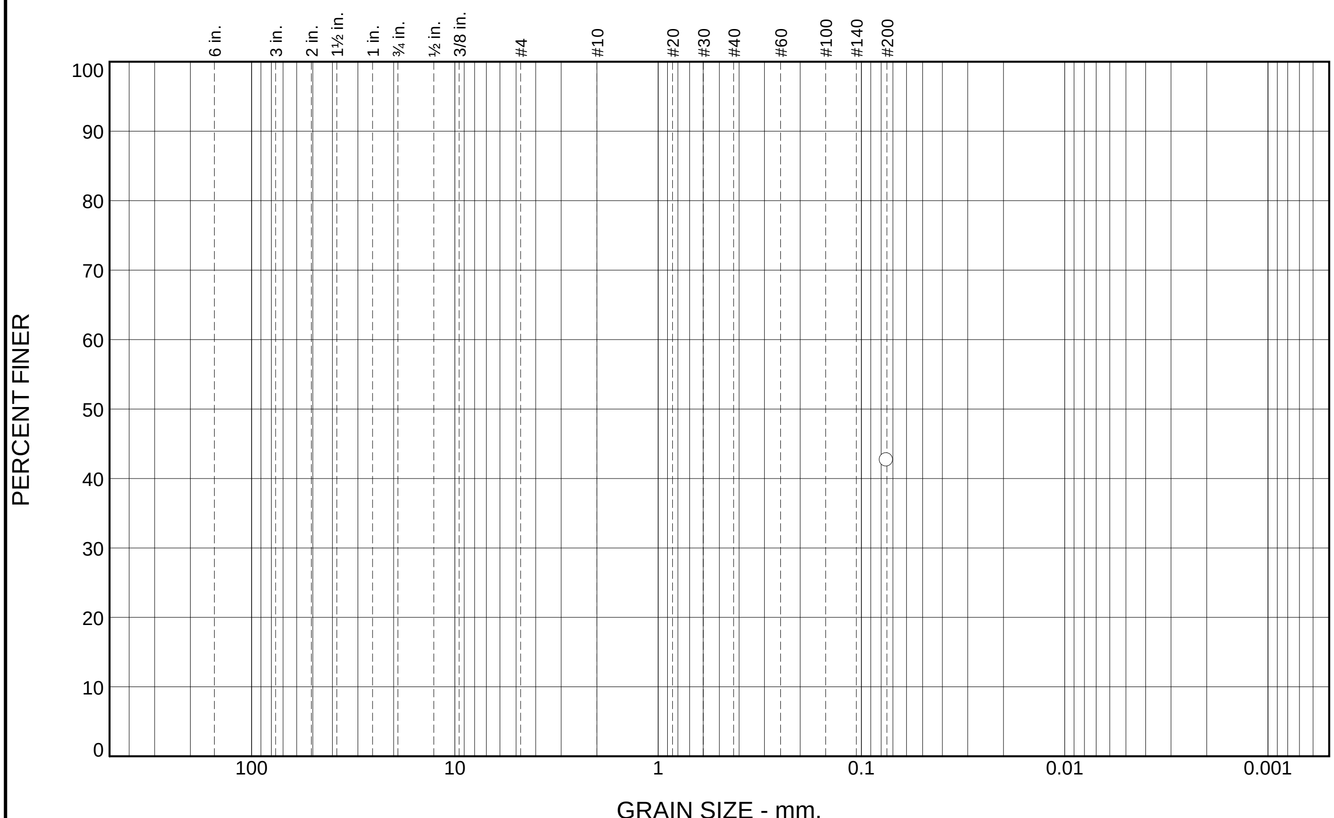
USCS= GP-GC AASHTO=

Remarks

Source of Sample: TC-8B **Depth:** 15.5-16.5'
Sample Number: 4 **Date:**

Blackburn Consulting W. Sacramento, CA	**Client:** Jacobs Engineering Group Inc. **Project:** OPUD South Yuba Sewer Infrastructure **Project No:** 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						42.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	42.6		

* (no specification provided)

Soil Description

SILTY SAND, dark yellowish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

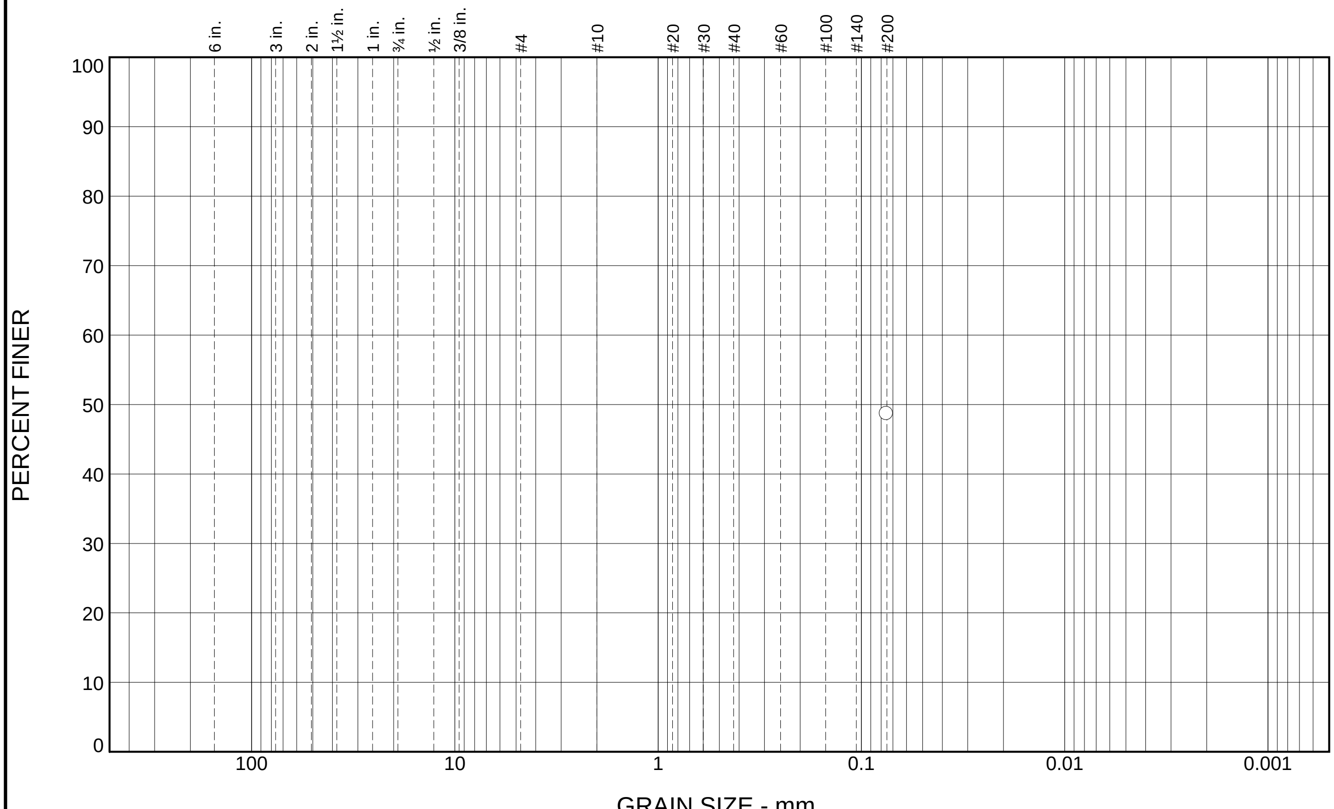
Source of Sample: TC-8B **Depth:** 30.5-31'
Sample Number: 7B **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						48.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	48.6		

* (no specification provided)

Soil Description
CLAYEY SAND, dark yellowish brown

Atterberg Limits
PL= 16 LL= 27 PI= 11

Coefficients
D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification
USCS= SC AASHTO=

Remarks

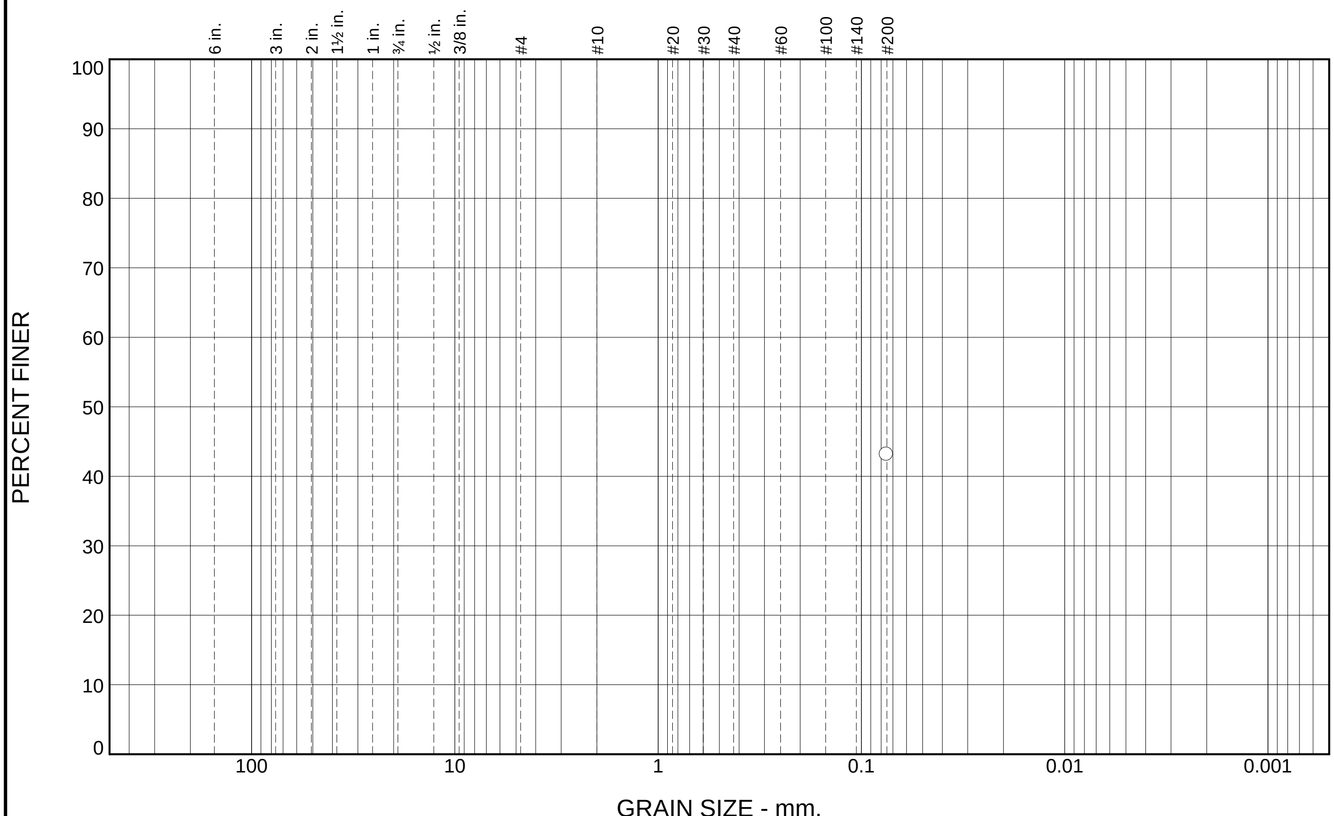
Source of Sample: TC-8B **Depth:** 35.5-36'
Sample Number: 8B **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						43.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	43.1		

* (no specification provided)

Soil Description

SILTY SAND, yellowish brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

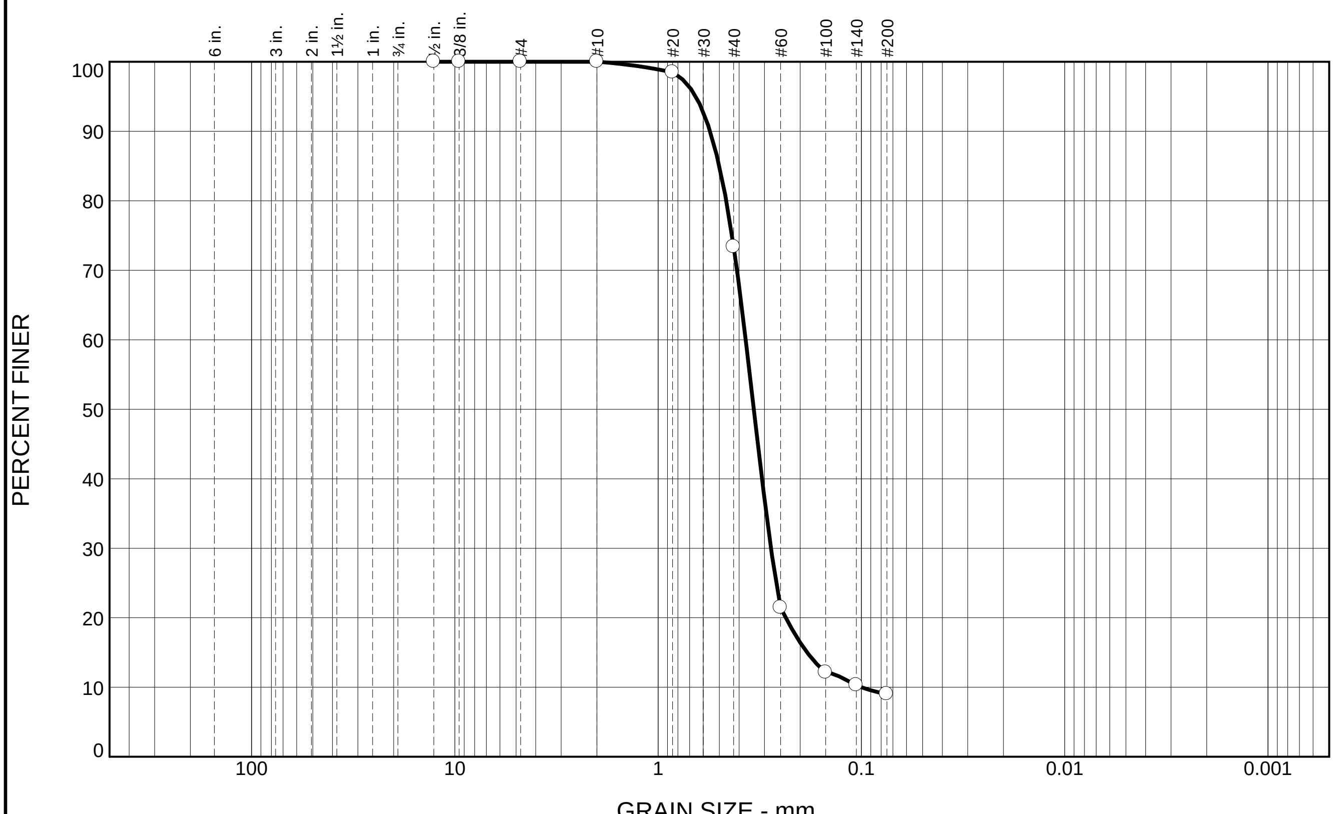
Source of Sample: TC-10A **Depth:** 30.5-31'
Sample Number: 7B **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	26.6	64.4	9.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	100.0		
#4	100.0		
#10	100.0		
#20	98.5		
#40	73.4		
#60	21.5		
#100	12.1		
#140	10.3		
#200	9.0		

* (no specification provided)

Soil Description

Poorly-graded SAND with SILT, dark reddish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.5551 D_{85}= 0.5005 D_{60}= 0.3708
D_{50}= 0.3383 D_{30}= 0.2787 D_{15}= 0.1848
D_{10}= 0.0999 C_u= 3.71 C_c= 2.10

Classification

USCS= SP-SM AASHTO= A-3

Remarks

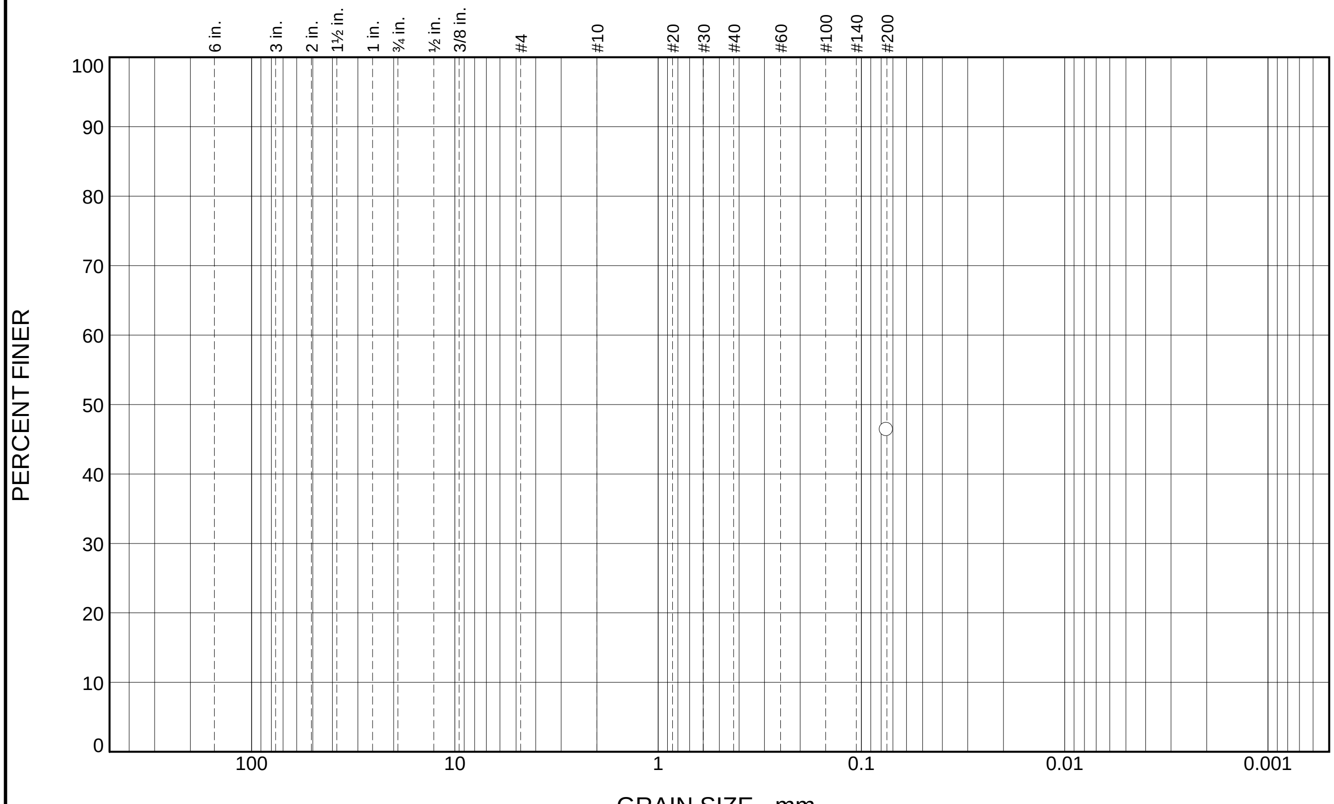
Source of Sample: TC-12A **Depth:** 20.5-21.5'
Sample Number: 5 **Date:**

Blackburn Consulting

W. Sacramento, CA

Client: Jacobs Engineering Group Inc.
Project: OPUD South Yuba Sewer Infrastructure
Project No: 3842.X **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						46.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	46.4		

* (no specification provided)

Soil Description

SILTY SAND, dark yellowish brown

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: TC-12B **Depth:** 35.5-36.5'
Sample Number: 7 **Date:**

Blackburn Consulting **W. Sacramento, CA**	**Client:** Jacobs Engineering Group Inc. **Project:** OPUD South Yuba Sewer Infrastructure **Project No:** 3842.X **Figure**

Unconfined Compression
ASTM D 2166

blackburn consulting

Project Name: OPUD
Project Number: 3842.X
Sample ID: TC-2C, 6B
Type of Sample: 2.4" Cal Mod
Sample Description: Lean CLAY with SAND, yellowish brown
Depth: 20.5-21'

Sample Data

Sample Length:	5.27	in	Sample + Tube:	692	g
Diameter:	2.40	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.19		Sample Weight:	692	g
Sample Area:	4.54	in^2	Wet Density:	110.2	pcf
Sample Volume:	23.9	in^3	Moisture:	41.3	%
Specific Gravity:	2.65	(assumed)	Dry Density:	78.0	pcf
			Saturation:	97.6	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0200	in/min
Deflection at Max. Load:	0.140	in
Maximum Load:	152	lbs
Strain at Failure:	2.66	%
Average cross-sectional area at failure:	4.66	in^2
Compressive Strength:	**2.35**	**tsf**
	32.7	**psi**

Strain Information

Rate of Strain ½%:	0.026	in/min
Rate of Strain 2%:	0.105	in/min
Strain Rate:	0.020	in/min
15% Strain:	0.791	in

Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-6A-5C
Type of Sample:	2.4" Cal Mod
Sample Description:	Fat CLAY, yellowish brown
Depth:	26-26.5’

Sample Data

Sample Length:	5.26	in	Sample + Tube:	738	g
Diameter:	2.39	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.20		Sample Weight:	738	g
Sample Area:	4.47	in^2	Wet Density:	119.7	pcf
Sample Volume:	23.5	in^3	Moisture:	29	%
Specific Gravity:	2.65	(assumed)	Dry Density:	93.0	pcf
			Saturation:	97.7	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0500	in/min
Deflection at Max. Load:	0.135	in
Maximum Load:	112	lbs
Strain at Failure:	2.56	%
Average cross-sectional area at failure:	4.58	in^2
Compressive Strength:	**1.75**	**tsf**
	24.4	**psi**

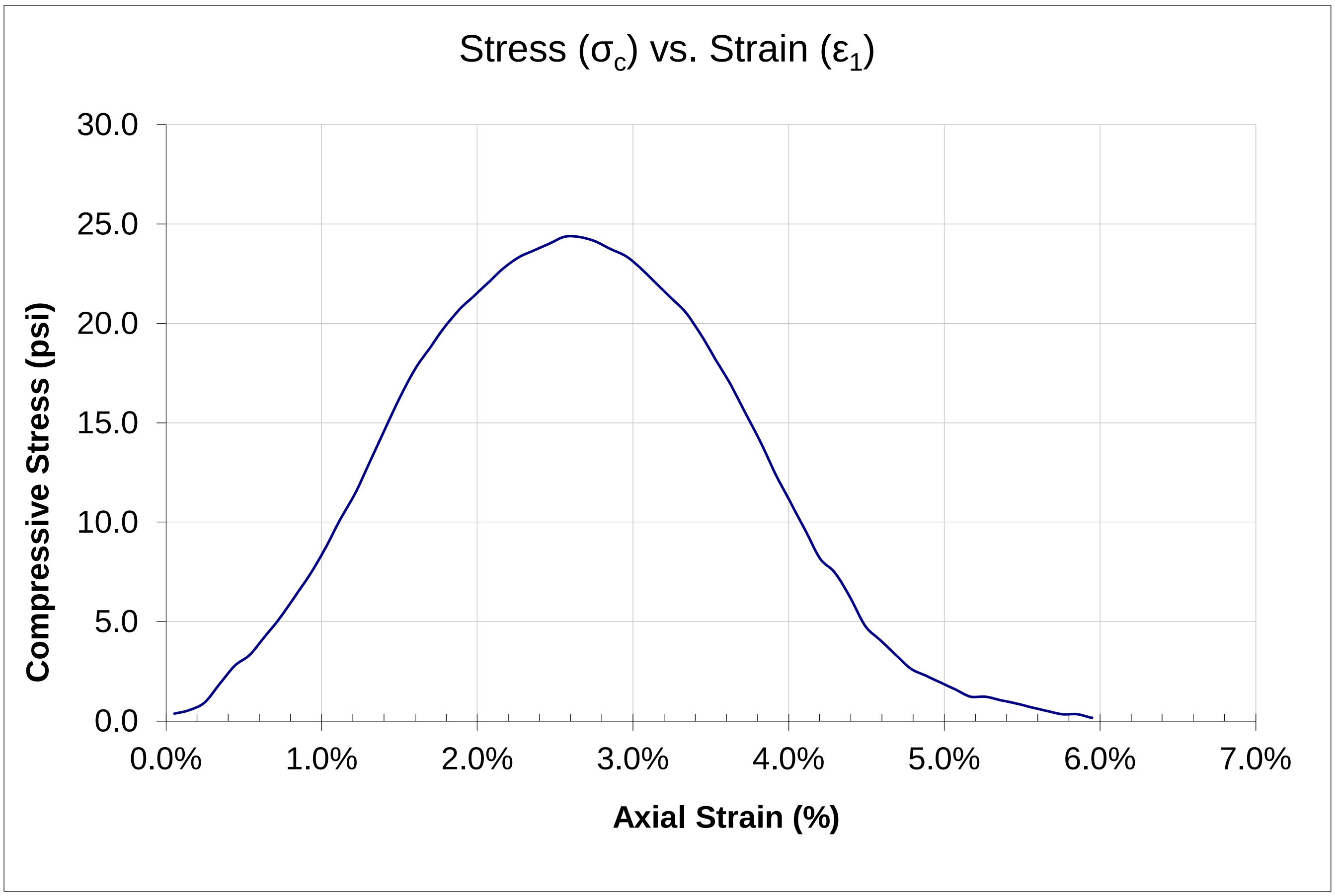
Strain Information

Rate of Strain ½%:	0.026	in/min
Rate of Strain 2%:	0.105	in/min
Strain Rate:	0.050	in/min
15% Strain:	0.788	in

Unconfined Compression
ASTM D 2166

Project Name: OPUD
Project Number: 3842.X
Sample ID: TC-6A-5C
Type of Sample: 2.4" Cal Mod
Sample Description: Fat CLAY, yellowish brown
Depth: 26-26.5’

Compressive Strength:	**1.75**	**tsf**
	24.4	**psi**



Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-9B-6B
Type of Sample:	2.4" Cal Mod
Sample Description:	Lean CLAY with SAND, strong brown
Depth:	25.5-26’

Sample Data

Sample Length:	5.02	in	Sample + Tube:	672	g
Diameter:	2.39	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.10		Sample Weight:	672	g
Sample Area:	4.49	in^2	Wet Density:	113.4	pcf
Sample Volume:	22.6	in^3	Moisture:	40	%
Specific Gravity:	2.65	(assumed)	Dry Density:	81.3	pcf
			Saturation:	101.4	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0200	in/min
Deflection at Max. Load:	0.195	in
Maximum Load:	20	lbs
Strain at Failure:	6.08	%
Average cross-sectional area at failure:	4.78	in^2
Compressive Strength:	**0.42**	**tsf**
	5.9	**psi**

Strain Information

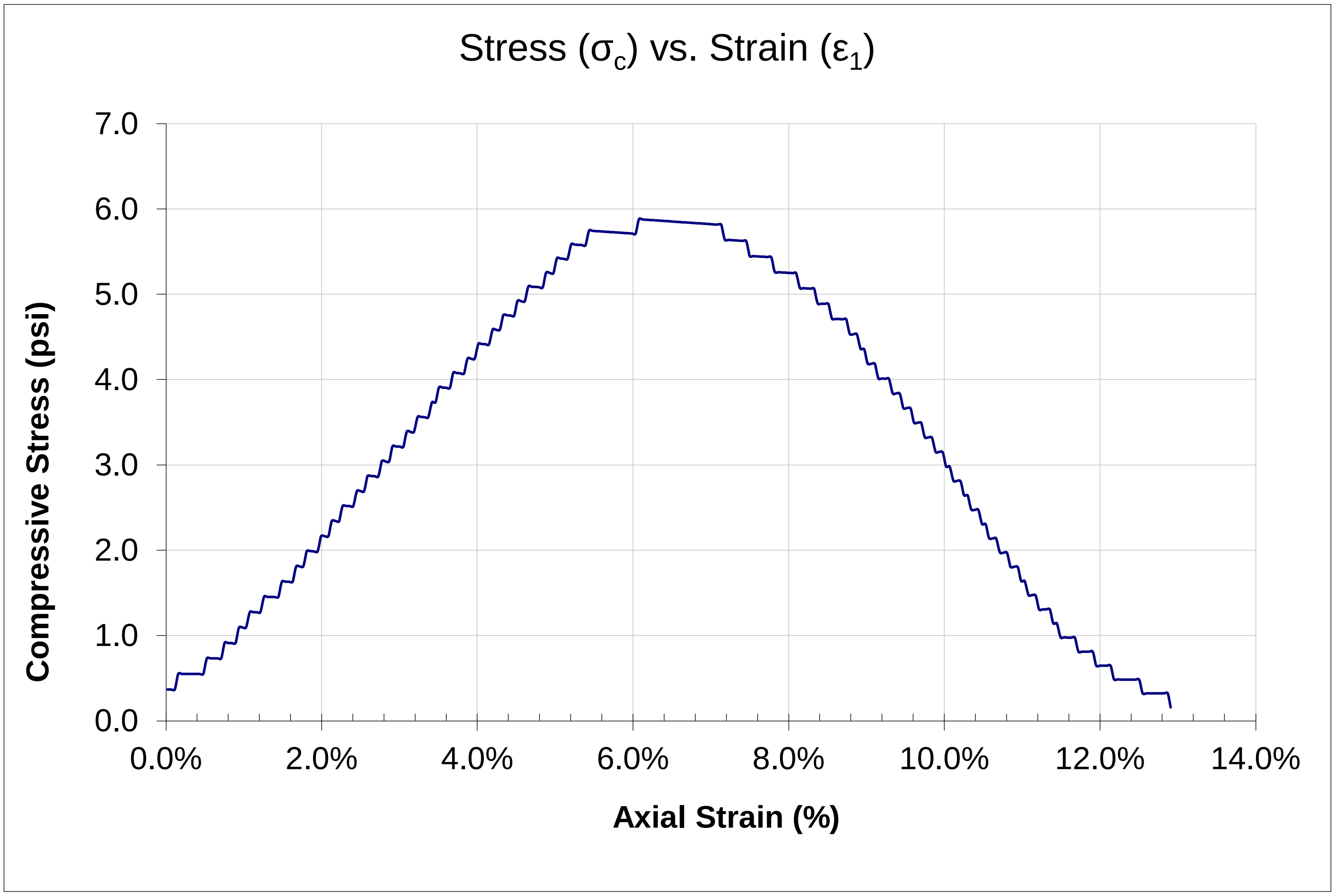
Rate of Strain ½%:	0.025	in/min
Rate of Strain 2%:	0.100	in/min
Strain Rate:	0.020	in/min
15% Strain:	0.753	in

blackburn consulting

Unconfined Compression
ASTM D 2166

Project Name: OPUD
Project Number: 3842.X
Sample ID: TC-9B-6B
Type of Sample: 2.4" Cal Mod
Sample Description: Lean CLAY with SAND, strong brown
Depth: 25.5-26’

Compressive Strength:	**0.42**	**tsf**
	5.9	**psi**



Unconfined Compression
ASTM D 2166

Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-9B-7C
Type of Sample:	2.4" Cal Mod
Sample Description:	SILT, dark yellowish brown
Depth:	31-31.5’

Sample Data

Sample Length:	5.19	in	Sample + Tube:	694	g
Diameter:	2.40	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.16		Sample Weight:	694	g
Sample Area:	4.52	in^2	Wet Density:	112.5	pcf
Sample Volume:	23.5	in^3	Moisture:	43	%
Specific Gravity:	2.65	(assumed)	Dry Density:	78.9	pcf
			Saturation:	103.0	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0200	in/min
Deflection at Max. Load:	0.242	in
Maximum Load:	56	lbs
Strain at Failure:	4.65	%
Average cross-sectional area at failure:	4.74	in^2
Compressive Strength:	**0.85**	**tsf**
	11.9	**psi**

Strain Information

Rate of Strain ½%:	0.026	in/min
Rate of Strain 2%:	0.104	in/min
Strain Rate:	0.020	in/min
15% Strain:	0.779	in

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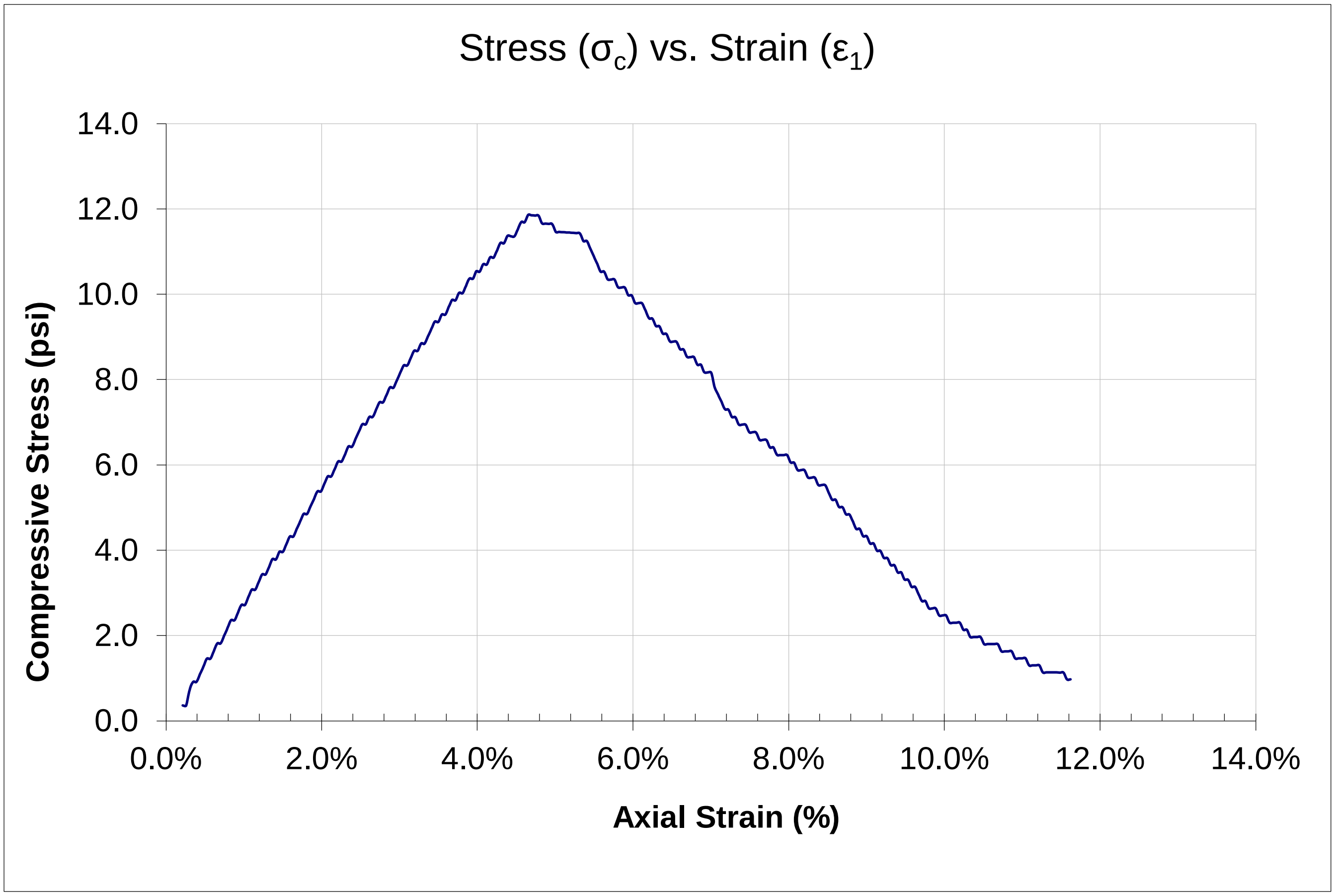
Unconfined Compression
ASTM D 2166

Project Name: OPUD
Project Number: 3842.X
Sample ID: TC-9B-7C
Type of Sample: 2.4" Cal Mod
Sample Description: SILT, dark yellowish brown
Depth: 31-31.5’

Compressive Strength:	**0.85**	**tsf**
	11.9	**psi**



Unconfined Compression
ASTM D 2166

Project Name: OPUD
Project Number: 3842.X
Sample ID: TC-10A, 8B
Type of Sample: 2.4" Cal Mod
Sample Description: SILTY SAND, strong brown
Depth: 35.5-36'

Sample Data

Sample Length:	5.00	in
Diameter:	2.41	in
Height-to-Diameter Ratio:	2.08	
Sample Area:	4.56	in^2
Sample Volume:	22.8	in^3
Specific Gravity:	2.65	(assumed)

Sample + Tube:	768	g
Tube:	0.00	g
Sample Weight:	768	g
Wet Density:	128.3	pcf
Moisture:	22.2	%
Dry Density:	105.0	pcf
Saturation:	102.2	%

**Moisture content taken after test*

Test Results

Rate of Strain:	0.0300	in/min
Deflection at Max. Load:	0.083	in
Maximum Load:	26	lbs
Strain at Failure:	1.67	%
Average cross-sectional area at failure:	4.64	in^2
Compressive Strength:	**0.41**	**tsf**
	5.7	**psi**

Strain Information

Rate of Strain ½%:	0.025	in/min
Rate of Strain 2%:	0.100	in/min
Strain Rate:	0.030	in/min
15% Strain:	0.750	in

Unconfined Compression
ASTM D 2166

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Project Name:	OPUD
Project Number:	3842.X
Sample ID:	TC-12B-6C
Type of Sample:	2.4" Cal Mod
Sample Description:	SILT, yellowish brown
Depth:	31-31.5

Sample Data

Sample Length:	4.87	in	Sample + Tube:	682	g
Diameter:	2.39	in	Tube:	0.00	g
Height-to-Diameter Ratio:	2.04		Sample Weight:	682	g
Sample Area:	4.47	in^2	Wet Density:	119.4	pcf
Sample Volume:	21.7	in^3	Moisture:	34	%
Specific Gravity:	2.65	(assumed)	Dry Density:	89.2	pcf
			Saturation:	105.2	%

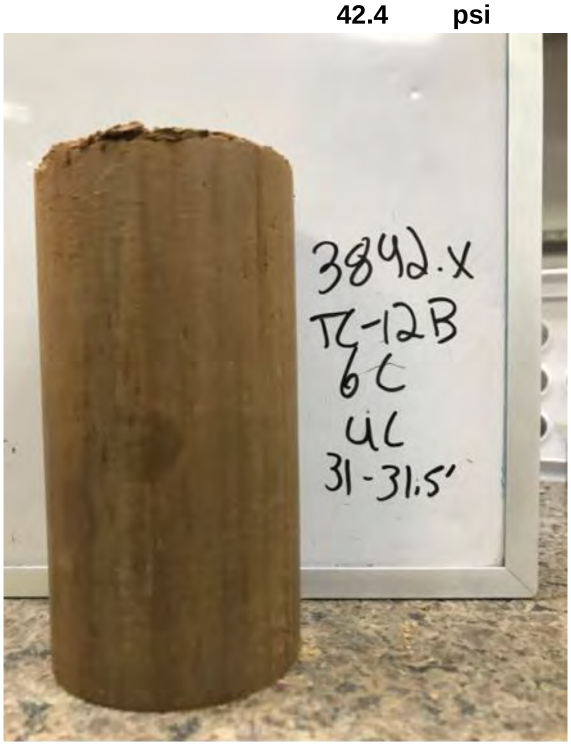
**Moisture content taken after test*

Test Results

Rate of Strain:	0.0200	in/min
Deflection at Max. Load:	0.191	in
Maximum Load:	197	lbs
Strain at Failure:	3.93	%
Average cross-sectional area at failure:	4.65	in^2
Compressive Strength:	**3.05**	**tsf**
	42.4	**psi**

Strain Information

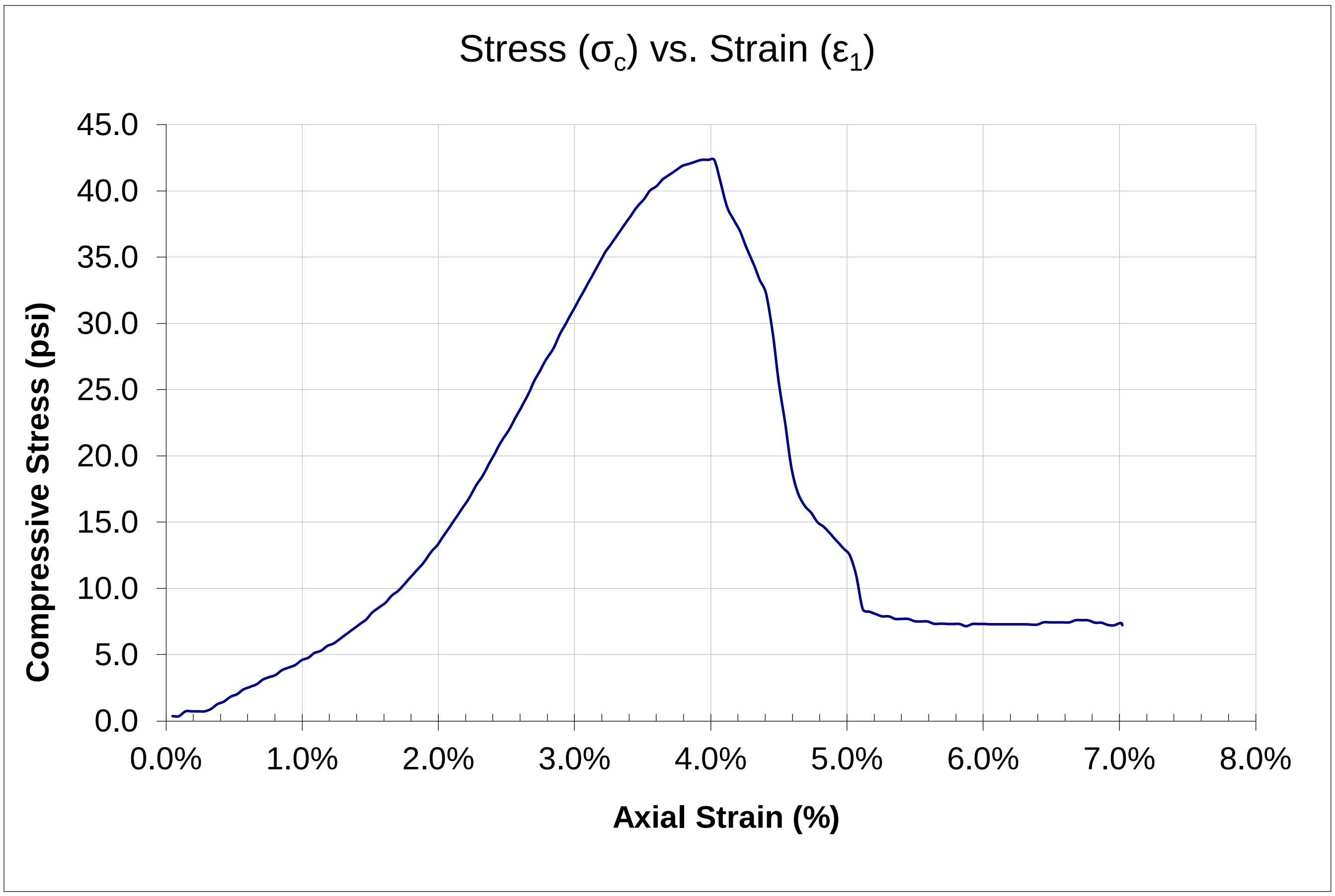
Rate of Strain ½%:	0.024	in/min
Rate of Strain 2%:	0.097	in/min
Strain Rate:	0.020	in/min
15% Strain:	0.730	in



Unconfined Compression
ASTM D 2166

Project Name: OPUD
Project Number: 3842.X
Sample ID: TC-12B-6C
Type of Sample: 2.4" Cal Mod
Sample Description: SILT, yellowish brown
Depth: 31-31.5

Compressive Strength:	**3.05**	**tsf**
	42.4	**psi**



UPDATED DRAFT PRELIMINARY GEOTECHNICAL BASIS OF DESIGN REPORT

Olivehurst Public Utilities District

South Yuba Sewer and Water Infrastructure Project

Olivehurst, CA

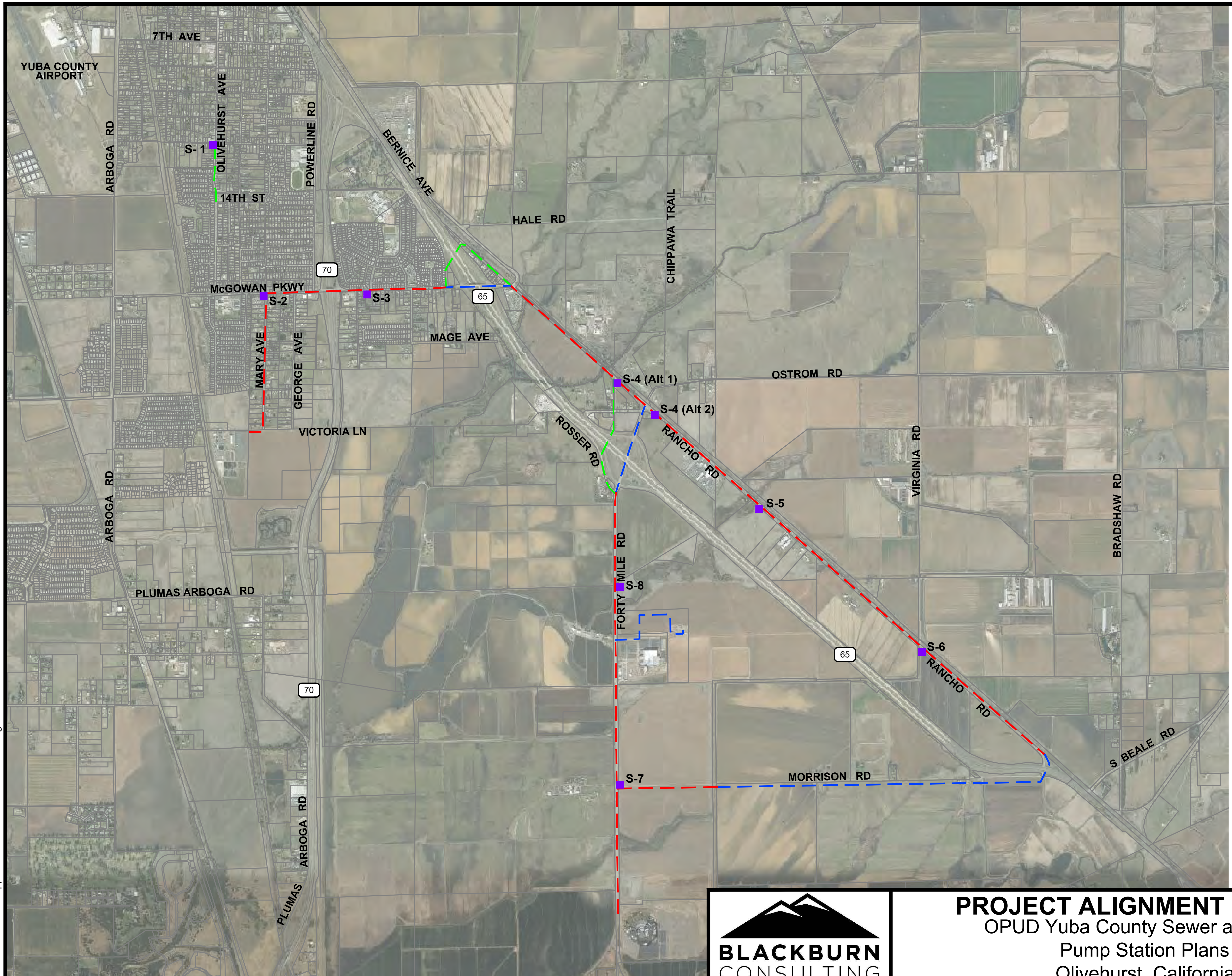
APPENDIX C: Pump Stations

C1: Site Plan

C2: Boring and Test Pit Logs Legend

Boring and Test Pit Logs

C3: Laboratory Test Results



N

SCALE 1" = 2,500'

LEGEND

- Approximate Pipeline Water Only
- Approximate Pipeline Sewer Only
- Approximate Pipeline Sewer and Water
- Pump/Lift Station Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

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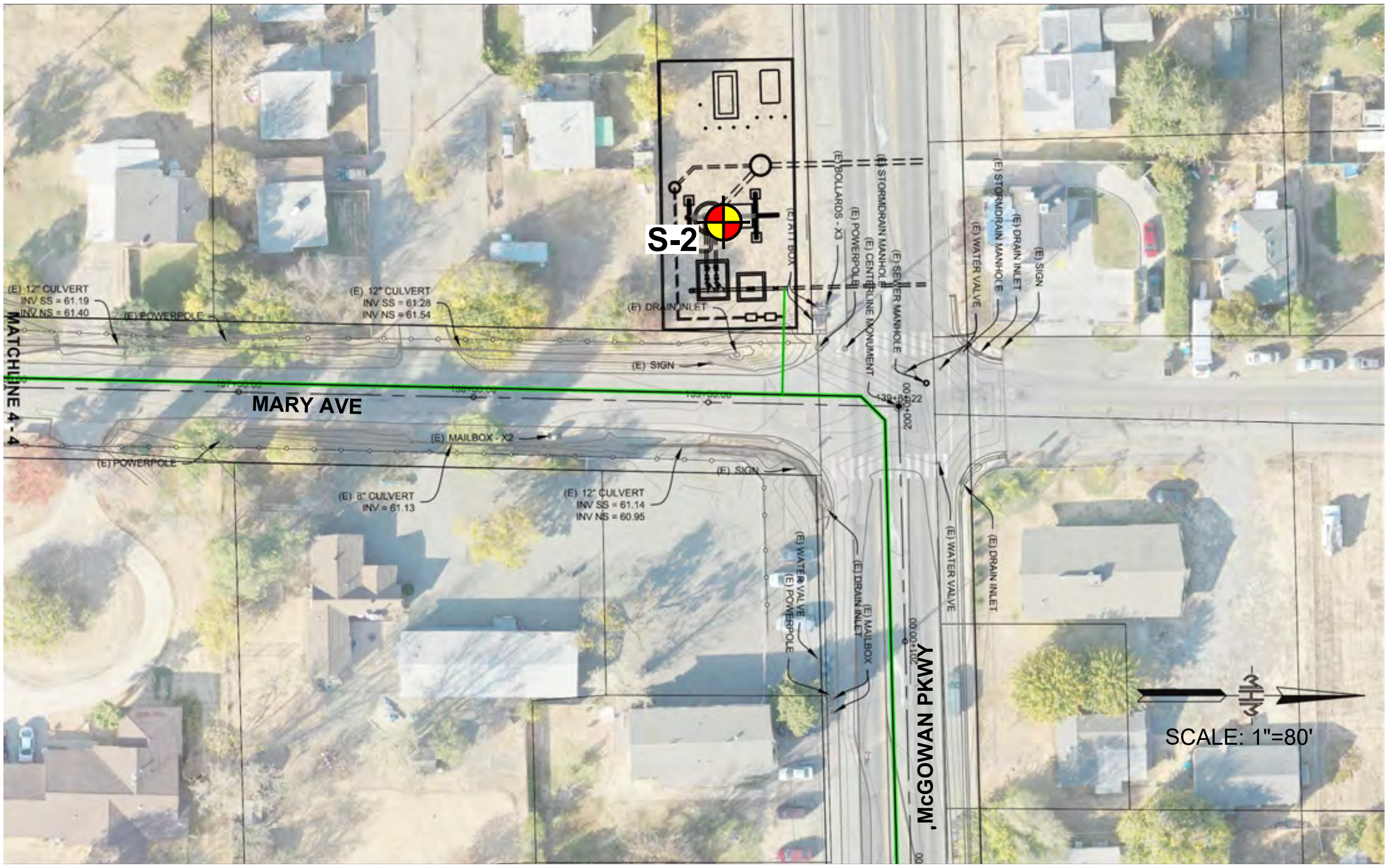
PROJECT ALIGNMENT LEGEND
OPUD Yuba County Sewer and Water
Pump Station Plans
Olivehurst, California

File No. 3842.x

April 2021

Appendix C1a

4/30/2021 3842.x AppC1 OPUD South Yuba Sewer.dwg



LEGEND

Proposed Pipeline Location

S-X Planned Pump Station/Lift Station Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

4/30/2021 3842.x AppC1 OPUD South Yuba Sewer.dwg

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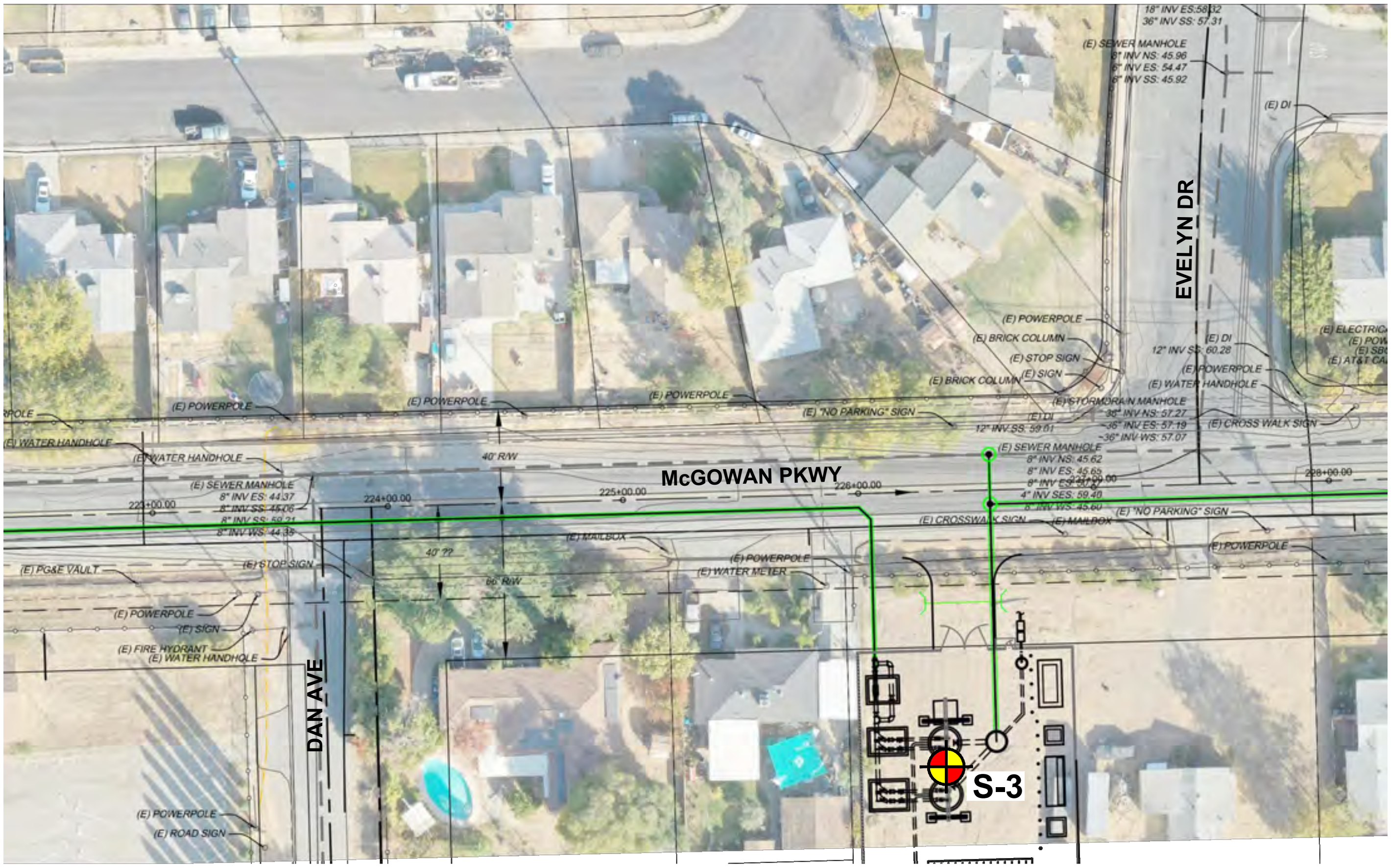
PUMP STATION #26 SITE PLAN

OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x

April 2021

Appendix C1b



SCALE: 1"=80'

LEGEND

Proposed Pipeline Location

S-X Planned Pump Station/Lift Station Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

4/30/2021 3842.x AppC1 OPUD South Yuba Sewer.dwg

BLACKBURN CONSULTING

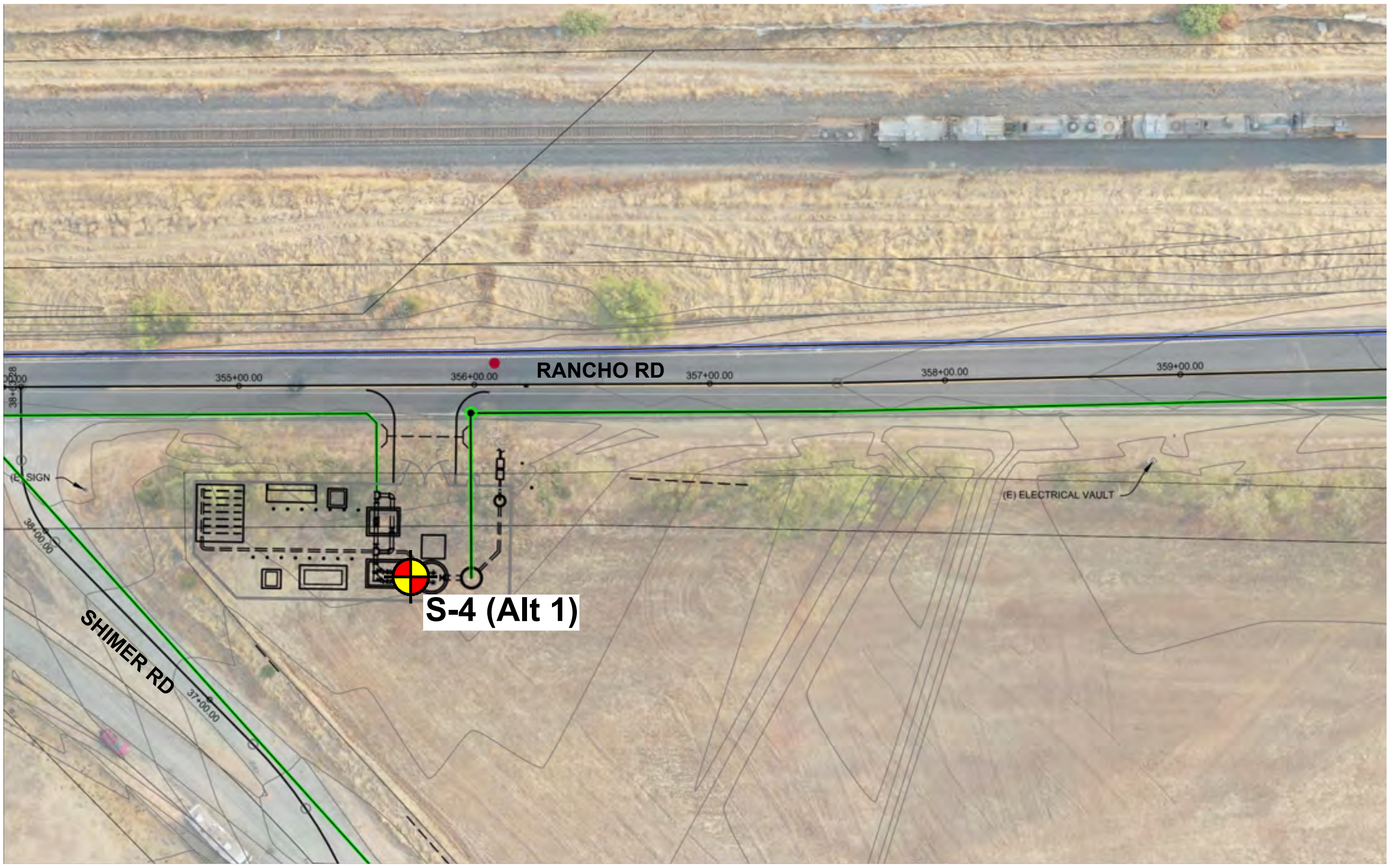
PUMP STATION #2 SITE PLAN

OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x

April 2021

Appendix C1c



SCALE: 1"=80'

LEGEND

Proposed Pipeline Location

S-X Planned Pump Station/Lift Station Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

4/30/2021 3842.x AppC1 OPUD South Yuba Sewer.dwg

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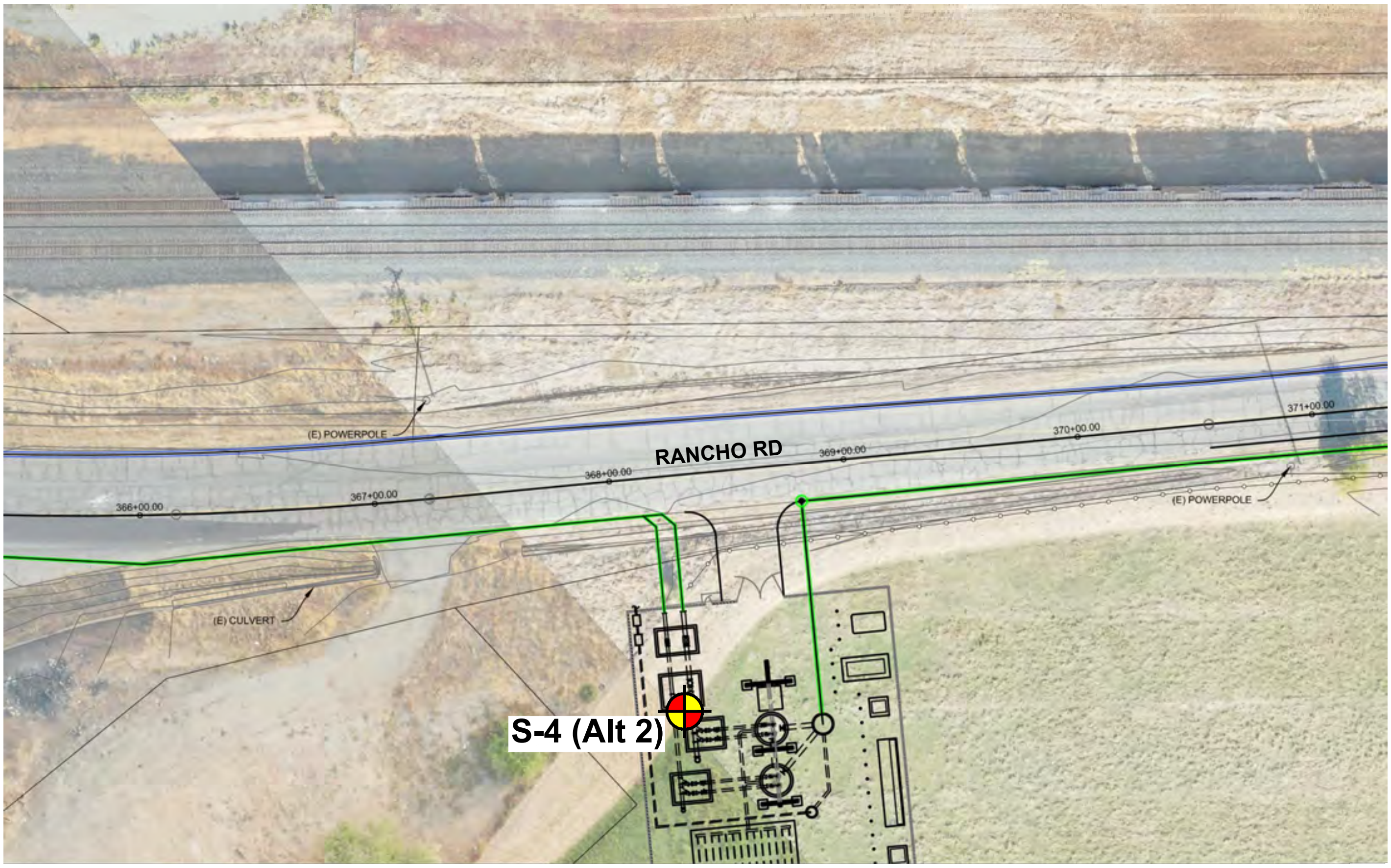
PUMP STATION # 21 (Alt 1) SITE PLAN

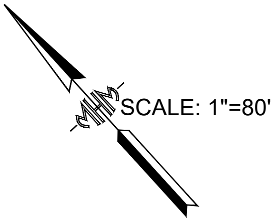
OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x

April 2021

Appendix C1d





LEGEND

Proposed Pipeline Location

S-X Planned Pump Station/Lift Station Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

4/30/2021 3842.x AppC1 OPUD South Yuba Sewer.dwg

BLACKBURN CONSULTING

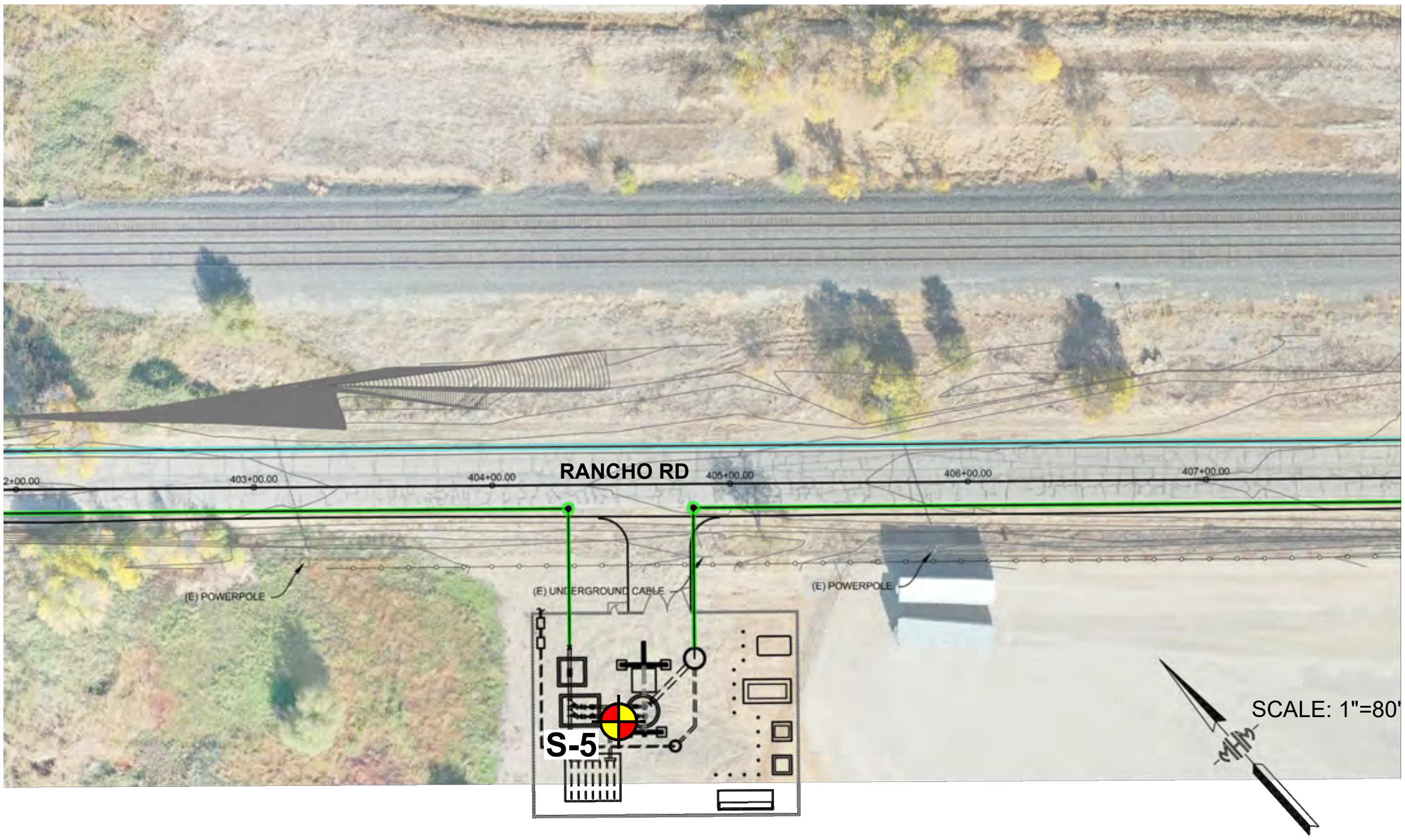
PUMP STATION #21 (Alt 2) SITE PLAN

OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x

April 2021

Appendix C1e



LEGEND

Proposed Pipeline Location

S-X Planned Pump Station/Lift Station Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

4/30/2021 3842.x AppC1 OPUD South Yuba Sewer.dwg

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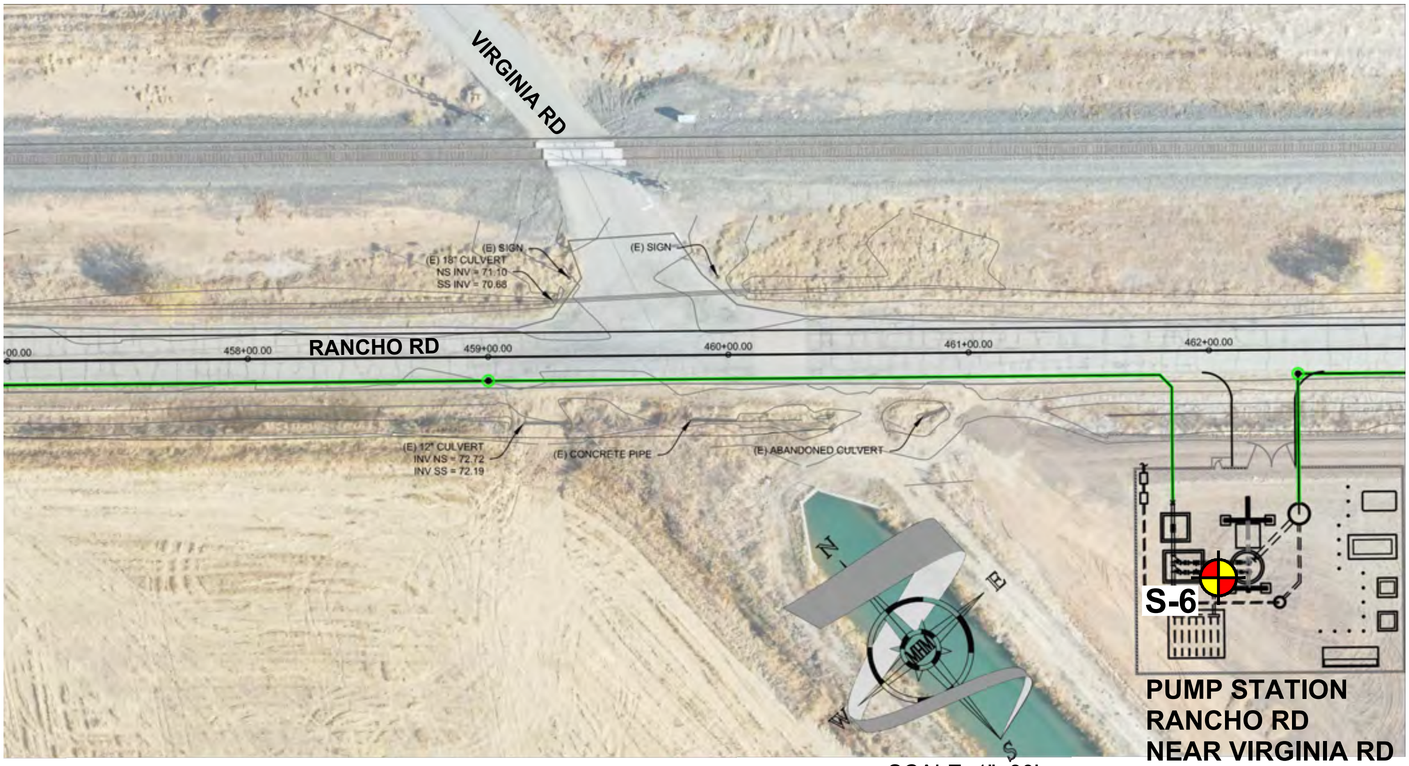
LIFT STATION #22 SITE PLAN

OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x

April 2021

Appendix C1f



SCALE: 1"=80'

LEGEND

Proposed Pipeline Location

S-X

Planned Pump Station/Lift Station Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

4/30/2021 3842.x AppC1 OPUD South Yuba Sewer.dwg

BLACKBURN CONSULTING

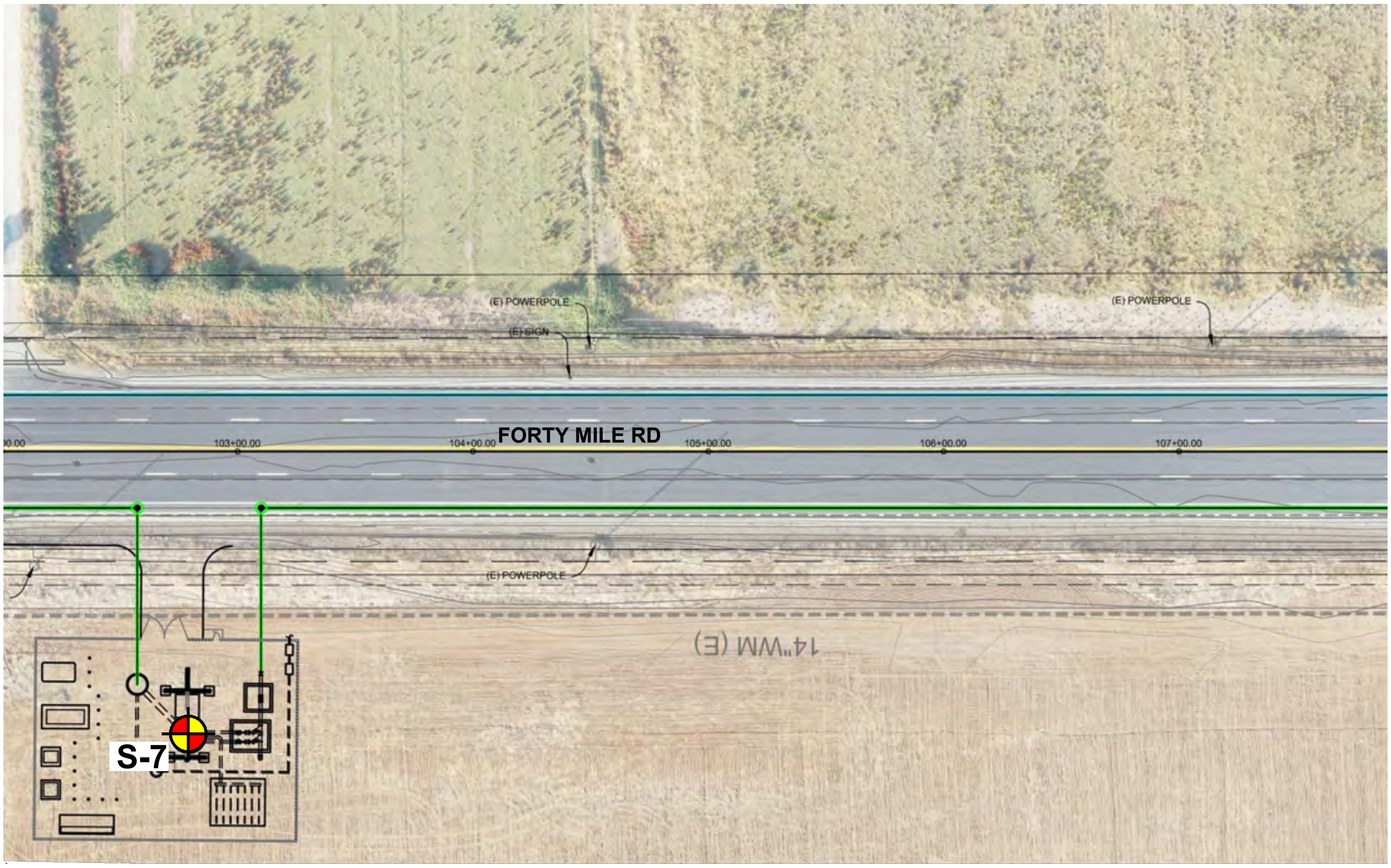
LIFT STATION #23 SITE PLAN

OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x

April 2021

Appendix C1g



SCALE: 1"=80'

LEGEND

Proposed Pipeline Location

S-X Planned Pump Station/Lift Station Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

4/30/2021 3842.x AppC1 OPUD South Yuba Sewer.dwg

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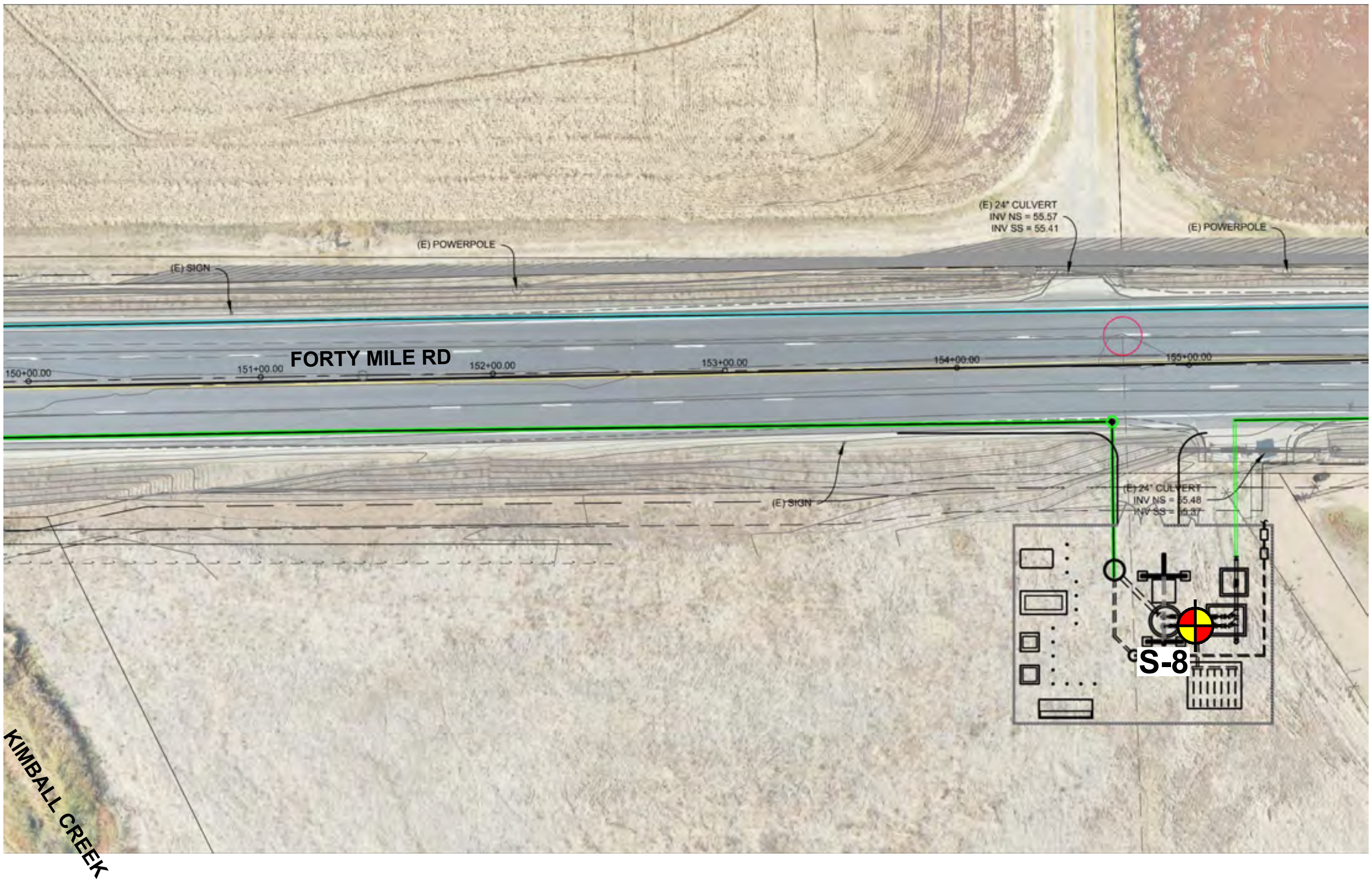
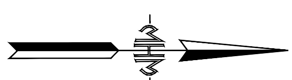
LIFT STATION #24 SITE PLAN

OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x	
April 2021	
Appendix C1h	





LEGEND

Proposed Pipeline Location

S-X Planned Pump Station/Lift Station Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

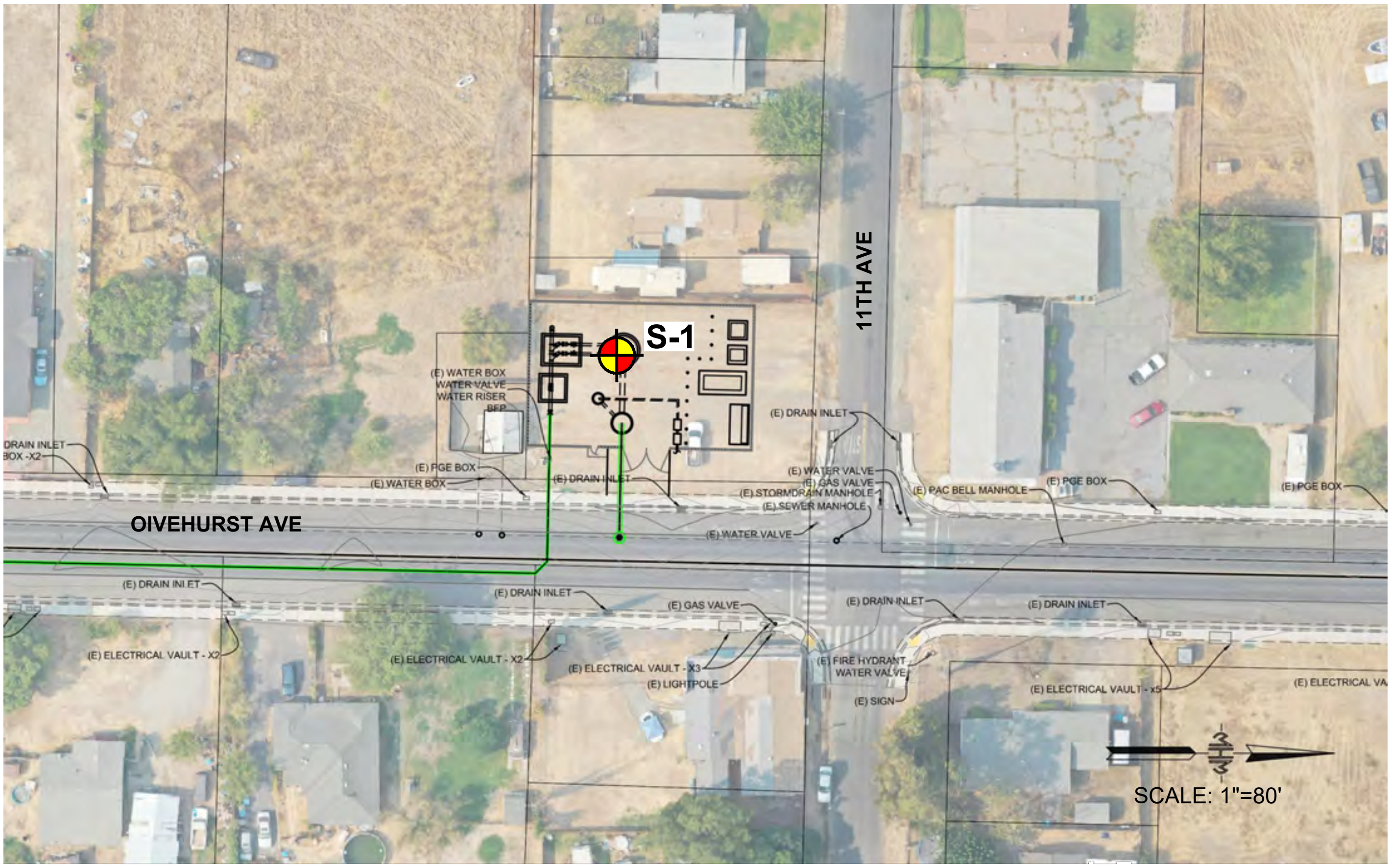
4/30/2021 3842.x AppC1 OPUD South Yuba Sewer.dwg

BLACKBURN CONSULTING

PUMP STATION #25 SITE PLAN

OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x	
April 2021	
Appendix C1i	



LEGEND

Proposed Pipeline Location

S-X Planned Pump Station/Lift Station Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

4/30/2021 3842.x AppC1 OPUD South Yuba Sewer.dwg

BLACKBURN CONSULTING

LIFT STATION #1 SITE PLAN

OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x

April 2021

Appendix C1j

Appendix C2: Exploratory Borings for Pump Stations not complete at the time of this Report

Appendix C3: Laboratory Tests for Pump Stations not complete at the time of this Report

UPDATED DRAFT PRELIMINARY GEOTECHNICAL BASIS OF DESIGN REPORT

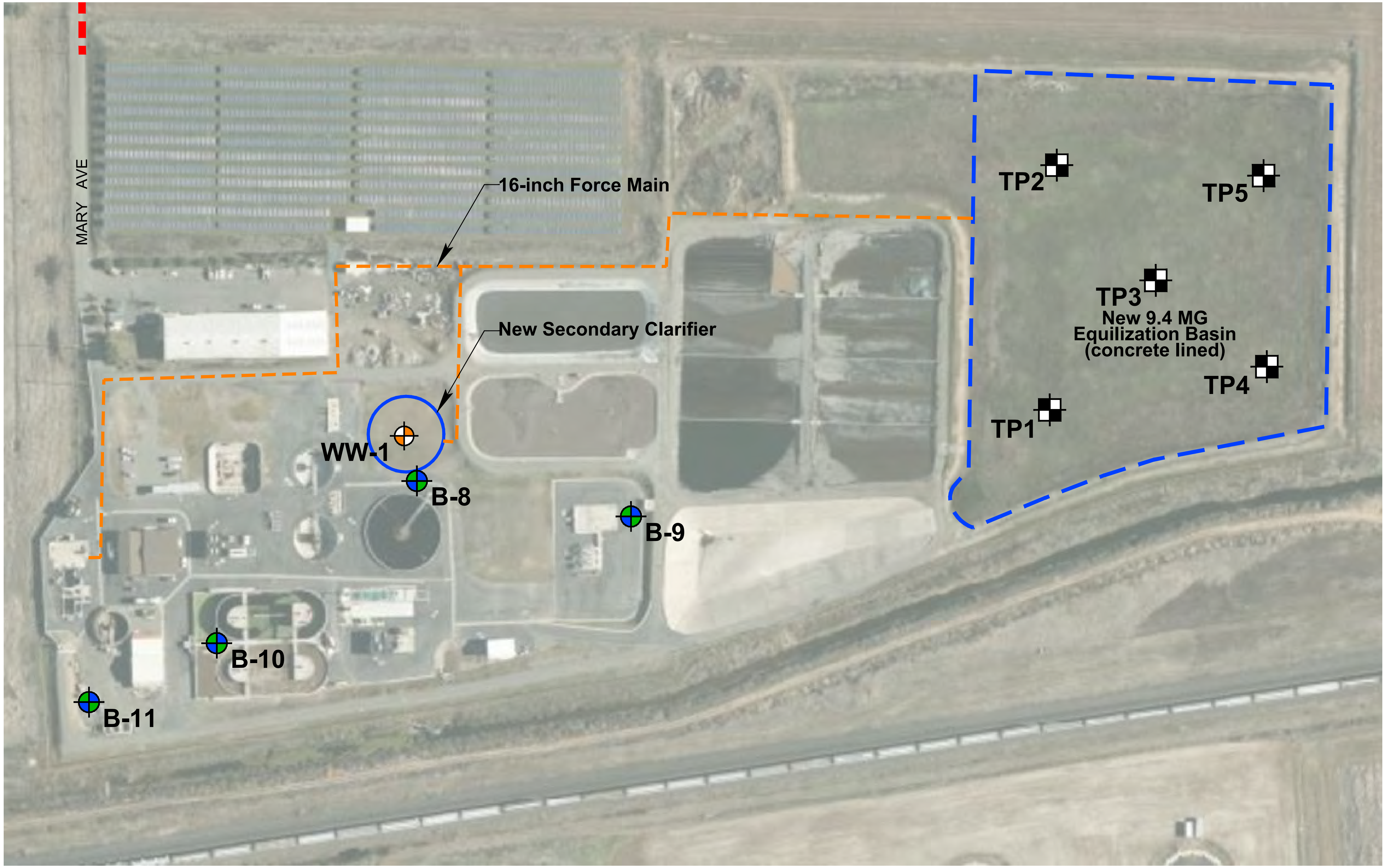
Olivehurst Public Utilities District

South Yuba Sewer and Water Infrastructure Project

Olivehurst, CA

APPENDIX D: WWTP Improvements

D1: Site Plan
D2: Boring and Test Pit Logs Legend
Boring and Test Pit Logs
D3: Laboratory Test Results
D4: Site Specific Analysis
D5: Previous Geotechnical Studies and Data



Z

SCALE 1" = 150'

LEGEND

- Approximate Planned Boring Location
- Approximate Test Pit Location
- Approximate CH2M Boring Location (2004)
- Approximate Pipeline Alignment
- Approximate Limits of 9.4 MG Basin
- Approximate 16-inch Force Main Alignment

BLACKBURN CONSULTING

WWTP IMPROVEMENTS SITE PLAN

OPUD Water and Sewer Project
Sewer Plant and Pipeline
Yuba County, California

File No. 3842.x	
April 2021	
Appendix D1	

4/30/2021 3842.x AppD1 OPUD South Yuba Sewer.dwg

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names	Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435)
CL	Collapse Potential (ASTM D 5333)
CP	Compaction Curve (ASTM D 698 & 1557, CTM 216)
CR	Corrosion, Sulfates, Chlorides (CTM 643, CTM 417, CTM 422)
CU	Consolidated Undrained Triaxial (ASTM D 4767)
DS	Direct Shear (ASTM D 3080)
EI	Expansion Index (ASTM D 4829)
M	Moisture Content (ASTM D 2216)
OC	Organic Content (ASTM D 2974)
P	Permeability (ASTM D 5084)
PA	Particle Size Analysis (ASTM D 6913 & 7928)
PI	Liquid Limit, Plastic Limit, Plasticity Index (ASTM D 4318)
PL	Point Load Index (ASTM D 5731)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301)
SE	Sand Equivalent (CTM 217)
SG	Specific Gravity (AASHTO T100)
SL	Shrinkage Limit (ASTM D 4943)
SW	Swell Potential (ASTM D 4546)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D 2166) Unconfined Compression - Rock (ASTM D 7012)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850)
UW	Unit Weight (ASTM D 7263)
VS	Vane Shear (AASHTO T223 / ASTM D 2573)

SAMPLER GRAPHIC SYMBOLS

Standard Penetration Test (SPT)

California Sampler (2" ID)

Modified California Sampler (2.4" ID)

Shelby Tube

Piston Sampler

NX Rock Core

HQ Rock Core

Bulk Sample

Other (see remarks)

DRILLING METHOD SYMBOLS

Auger Drilling

Rotary Drilling

Dynamic Cone or Hand Driven

Diamond Core

WATER LEVEL SYMBOLS

First Water Level Reading (during drilling)

Static Water Level Reading (short-term)

Static Water Level Reading (long-term)

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BORING RECORD LEGEND

CONSISTENCY OF COHESIVE SOILS				
Descriptor	Unconfined Compressive Strength (tsf)	Pocket Penetrometer (tsf)	Torvane (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Extrudes between fingers when squeezed
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS	
Descriptor	SPT N_{60} - Value (blows / foot)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE	
Descriptor	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS	
Descriptor	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE		
Descriptor		Size
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS	
Descriptor	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION	
Descriptor	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

NOTE: This legend sheet provides descriptors and associated criteria for required soil description components only. Refer to Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010), Section 2, for tables of additional soil description components and discussion of soil description and identification.

8/5/2019 Boring Legend for Reports 2019.dwg

BLACKBURN CONSULTING

BORING RECORD LEGEND

LOGGED BY	BEGIN DATE	COMPLETION DATE	TEST PIT LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**10-19-20**	**10-19-20**		**TP1**

CONTRACTOR **Burke Construction**	TEST PIT LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Keith**	EQUIPMENT **CAT 420 Backhoe**	TOTAL DEPTH OF TEST PIT **8.0 ft**
EXCAVATION METHOD **Test Pit**	BUCKET WIDTH **2'**	SAMPLER SIZE(S) **CalMod (2.4"), Bulk Bag**
TEST PIT BACKFILL AND COMPLETION **Backfilled with spoils, tamped with backhoe bucket**	GROUNDWATER DURING EXCAVATION **No Groundwater Encountered**	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength (psf)	Additional Lab Tests
	0		Lean CLAY (CL); Hard; Dark; Grayish Brown; Dry; Few Fine SAND; Weak to Moderate Cementation; PP>4.5										
	2		SANDY Lean CLAY (CL); Hard; Dark Yellowish Brown with Black Streaks; Dry; Some Fine SAND; Moderate Cementation; PP>4.5										
	4				1	>4.5							
	5		Moist										
	6		Lean CLAY with SAND (CL); (Very Stiff); Dark Brown; Moist; Little Fine SAND; No Cementation										
	8		Bottom of test pit at 8.0 ft bgs										

Backfilled with spoils, tamped with backhoe bucket
No Free Groundwater Encountered

Bulk A 0-2 ft bgs

Bulk B 2-6 ft bgs

Bulk C 6-8 ft bgs

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

BLACKBURN CONSULTING

PROJECT NAME	FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water	**3842.X**	**TP1**
COUNTY **YUB**	ROUTE	POSTMILE
CLIENT **Jacobs Engineering**		
PREPARED BY **SS**	CHECKED BY	SHEET **1 of 1**

LOGGED BY **LDM**	BEGIN DATE **10-19-20**	COMPLETION DATE **10-19-20**	TEST PIT LOCATION (Lat/Long or North/East and Datum)	HOLE ID **TP2**
CONTRACTOR **Burke Construction**			TEST PIT LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Keith**			EQUIPMENT **CAT 420 Backhoe**	TOTAL DEPTH OF TEST PIT **8.0 ft**
EXCAVATION METHOD **Test Pit**			BUCKET WIDTH **2'**	SAMPLER SIZE(S) **CalMod (2.4"), Bulk Bag**
TEST PIT BACKFILL AND COMPLETION **Backfilled with spoils, tamped with backhoe bucket**			GROUNDWATER DURING EXCAVATION **No Groundwater Encountered**	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength (psf)	Additional Lab Tests
	0		Lean CLAY (CL); Hard; Brown; Dry; Few Fine SAND; PP>4.5										
	2		SANDY Lean CLAY (CL); Hard; Yellowish Brown; Dry; Some Fine SAND; Moderate Cementation; PP>4.5		1	>4.5							
	2.5		Lean CLAY (CL); Hard; Dark Yellowish Brown; Moist; Few Fine SAND; Weak Cementation; PP>4.5										
	4				2	>4.5							
	6		(Very Stiff); Orangish Brown; No Cementation										
	8		Bottom of test pit at 8.0 ft bgs										

Backfilled with spoils, tamped with backhoe bucket
No Free Groundwater Encountered

Bulk A 0-1.5 ft bgs

Bulk B 1.5-2.5 ft bgs

Bulk C 2.5-6 ft bgs

Bulk D 6-8 ft bgs

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

TEST PITS - LEVEE 3842.X TEST PITS (10_29_20).GPJ LIBRARY_2019.GLB 11/17/20

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TP2**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **SS**	CHECKED BY	SHEET **1 of 1**	

LOGGED BY **LDM**	BEGIN DATE **10-19-20**	COMPLETION DATE **10-19-20**	TEST PIT LOCATION (Lat/Long or North/East and Datum)	HOLE ID **TP3**
CONTRACTOR **Burke Construction**			TEST PIT LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Keith**			EQUIPMENT **CAT 420 Backhoe**	TOTAL DEPTH OF TEST PIT **8.0 ft**
EXCAVATION METHOD **Test Pit**			BUCKET WIDTH **2'**	SAMPLER SIZE(S) **Bulk Bag**
TEST PIT BACKFILL AND COMPLETION **Backfilled with spoils, tamped with backhoe bucket**			GROUNDWATER DURING EXCAVATION **No Groundwater Encountered**	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength (psf)	Additional Lab Tests
	0		Lean CLAY (CL); Hard; Light Grayish Brown with Orangish Brown Streaks; Dry; Few Fine SAND; Moderate Cementation; PP>4.5										
	3		SANDY Lean CLAY (CL); Hard; Dark Yellowish Brown with Black Streaks; Moist; Some Fine SAND; Weak Cementation; PP>4.5										
	6.5		Lean CLAY (CL); (Very Stiff); Dark Brown; Moist; Few Fine SAND; No Cementation										
	8		Bottom of test pit at 8.0 ft bgs										

Backfilled with spoils, tamped with backhoe bucket
No Free Groundwater Encountered

Bulk A 0-3 ft bgs

Bulk B 3-6.5 ft bgs

Bulk C 6.5-8 ft bgs

Depth scale (ft): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

BLACKBURN CONSULTING

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TP3**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **SS**	CHECKED BY	SHEET **1 of 1**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	TEST PIT LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**10-19-20**	**10-19-20**		**TP4**

CONTRACTOR **Burke Construction**	TEST PIT LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Keith**	EQUIPMENT **CAT 420 Backhoe**	TOTAL DEPTH OF TEST PIT **8.0 ft**
EXCAVATION METHOD **Test Pit**	BUCKET WIDTH **2'**	SAMPLER SIZE(S) **Bulk Bag**
TEST PIT BACKFILL AND COMPLETION **Backfilled with spoils, tamped with backhoe bucket**	GROUNDWATER DURING EXCAVATION **No Groundwater Encountered**	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength (psf)	Additional Lab Tests
	0		Lean CLAY (CL); Hard; Dark Grayish Brown; Dry; Few Fine SAND; Weak Cementation; PP>4.5										
	3		Lean CLAY with SAND (CL); Hard; Dark Yellowish Brown with Orangish Brown Streaks; Dry; Little Fine SAND; Moderate Cementation; PP>4.5										
	5		Moist										
	6		(Very Stiff); Dark Yellowish Brown; No Cementation										
	8		Bottom of test pit at 8.0 ft bgs										

Backfilled with spoils, tamped with backhoe bucket
No Free Groundwater Encountered

Bulk A 0-3 ft bgs

Bulk B 3-5.5 ft bgs

Bulk C 5.5-8 ft bgs

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

PROJECT NAME **OPUD South Yuba Sewer and Water**		FILE NO. **3842.X**	HOLE ID **TP4**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **SS**	CHECKED BY		SHEET **1 of 1**

BLACKBURN CONSULTING

LOGGED BY	BEGIN DATE	COMPLETION DATE	TEST PIT LOCATION (Lat/Long or North/East and Datum)	HOLE ID
LDM	**10-19-20**	**10-19-20**		**TP5**

CONTRACTOR **Burke Construction**	TEST PIT LOCATION (Offset, Station, Line)	SURFACE ELEVATION
OPERATOR'S NAME **Keith**	EQUIPMENT **CAT 420 Backhoe**	TOTAL DEPTH OF TEST PIT **8.0 ft**
EXCAVATION METHOD **Test Pit**	BUCKET WIDTH **2'**	SAMPLER SIZE(S) **Bulk Bag**
TEST PIT BACKFILL AND COMPLETION **Backfilled with spoils, tamped with backhoe bucket**	GROUNDWATER DURING EXCAVATION **No Groundwater Encountered**	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Pocket Penetrometer	Laboratory Data: Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% <#200	Shear Strength (psf)	Additional Lab Tests
	0		Lean CLAY with SAND (CL); Hard; Dark Grayish Brown; Dry; Fine SAND; Weak Cementation; PP>4.5										
	2.5		SANDY Lean CLAY/CLAYEY SAND (CL/SC); Hard/Very Dense; Dark Yellowish Brown; Dry; Weak Cementation; Fine to Medium SAND; PP>4.5										
	5.5		CLAYEY SAND (SC); (Dense); Dark Yellowish Brown; Moist; Fine to Medium SAND; Little Fines										
	8		Bottom of test pit at 8.0 ft bgs										

Depth scale (ft): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Backfilled with spoils, tamped with backhoe bucket
No Free Groundwater Encountered

Bulk A 0-2.5 ft bgs

Bulk B 2.5-5.5 ft bgs

Bulk C 5.5-8 ft bgs

BLACKBURN CONSULTING

PROJECT NAME		FILE NO.	HOLE ID
OPUD South Yuba Sewer and Water		**3842.X**	**TP5**
COUNTY **YUB**	ROUTE		POSTMILE
CLIENT **Jacobs Engineering**			
PREPARED BY **SS**	CHECKED BY		SHEET **1 of 1**

Appendix D3: Laboratory Tests for WWTP not complete at the time of this Report

APPENDIX C: Site-Specific Design Spectra Calculation

In this appendix we present the details of our site-specific ground motion analysis performed in accordance with Chapter 21 of ASCE 7-16 *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. We calculated:

- Site Classification D per ASCE 7-16 Table 20.3-1.
- Probabilistic geometric mean (MCE_G[1]) and risk targeted maximum considered earthquake (MCE_R[2]) response spectra for a 5% damped, 2% probability of exceedance within a 50 year period (2,475 year return period).
- Design Earthquake (DE[3]) response spectra.
- Design acceleration parameters.
- Maximum considered earthquake geometric mean (MCE_G) peak ground acceleration (PGA_M).

C1.0 PROBABILISTIC SEISMIC HAZARD ANALYSIS

Methodology

We performed a site-specific probabilistic ground motion analysis in accordance with ASCE 7-16 Section 21.2.1.2. A probabilistic analysis is used because the location, recurrence interval, and magnitude of future earthquakes are uncertain.

To develop the site-specific probabilistic MCE_R response spectra we:

1. Used the United States Geological Survey (USGS) Unified Hazard Tool[4] to develop uniform hazard curves for spectral periods ranging from 1 to 5 seconds and calculate the MCE_G response spectra.
2. Applied scaling factors (per ASCE 7-16,21.2) to each hazard curve to calculate the maximum response in the horizontal plane.
3. Used the scaled hazard curve data and the USGS Risk-Targeted Ground Motion Calculator[5] to develop the risk targeted ground motion for selected periods (maximum of 5 seconds).
4. Plotted the risk targeted ground motion at selected periods to create the site-specific MCE_R response spectra.

[1] MCE_G - The most severe earthquake effects considered by ASCE 7-16 without adjustment for targeted risk.
[2] MCE_R - The most severe earthquake effects considered by ASCE 7-16 adjusted to the orientation considered to provide the maximum horizontal response.
[3] DE – The earthquake effects that are 2/3 of the corresponding risk-targeted maximum consider MCE_R effects.
[4] https://earthquake.usgs.gov/hazards/interactive/
[5] https://earthquake.usgs.gov/designmaps/rtgm/

Results

Figure C-1 shows the calculated site-specific MCE_G and MCE_R probabilistic spectra.

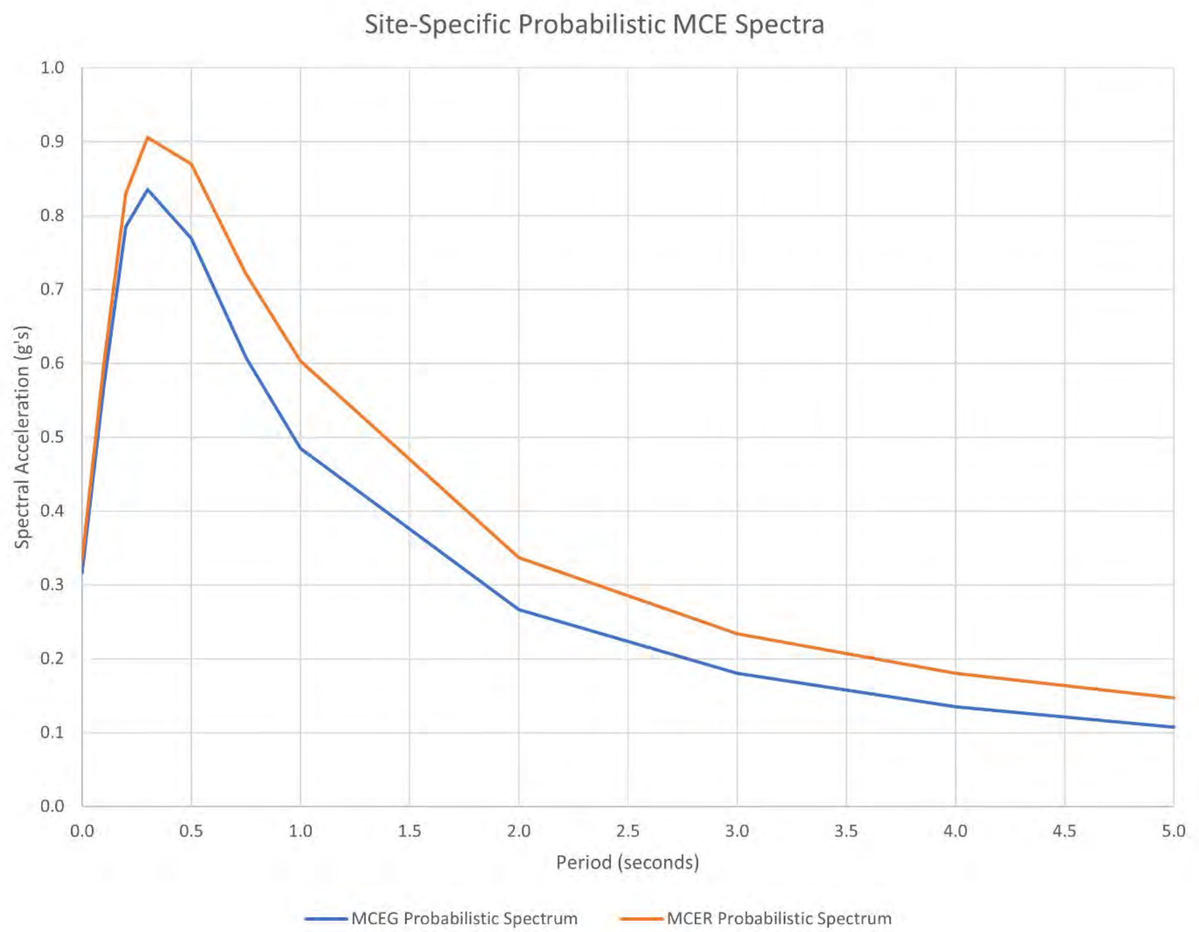


Figure C-1 – MCE_G (Geometric mean) and MCE_R (Risk Targeted) site-specific spectra for 2% probability of exceedance in 50 years.

Table C-1 shows the calculated spectral values for the probabilistic MCE_R and MCE_G spectra.

Table C-1: Probabilistic MCE_R and MCE_G Spectral Accelerations (g's)

Period	Probabilistic MCE_G Spectra	Scaled Probabilistic MCE_R Spectra
0	0.317	0.334
0.1	0.570	0.600
0.2	0.785	0.830
0.3	0.835	0.906
0.5	0.769	0.870
0.75	0.607	0.721
1	0.485	0.603
2	0.266	0.337
3	0.180	0.234
4	0.135	0.180
5	0.108	0.147

Figures C-2 through C-5 show the deaggregation of the probabilistic seismic hazard results for MCE_G hazard level for the PGA, 0.2, 1, and 5 second periods. The faults that dominate the hazard at the site are:

- PGA and 0.2 second periods - The Great Valley Mysterious Ridge and Hunting Creek-Bartlett Springs connector.
- 1 second period - The San Andreas fault, Hunting Creek-Bartlett Springs connector, Great Valley Mysterious Ridge, and Rodgers Creek-Healdsburg.
- 5 second period - The San Andreas fault and Hunting Creek-Bartlett Springs connector[6]

[6] Deaggregation results show the Cascadia Megathrust governs at the 5 second period, however we reference only the San Andreas fault and Hunting Creek-Bartlett Springs connector because the Cascadia Megathrust is over 120 miles away.

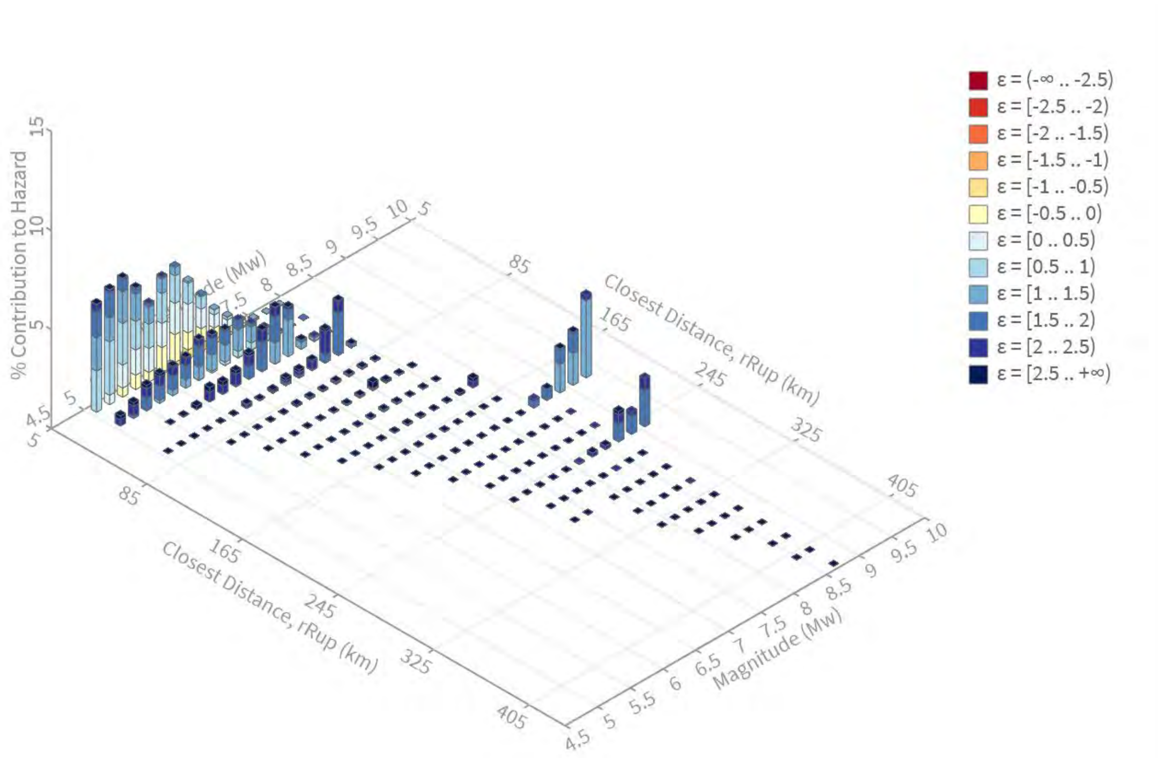


Figure C-2- Deaggregation for PGA (MCE_G)

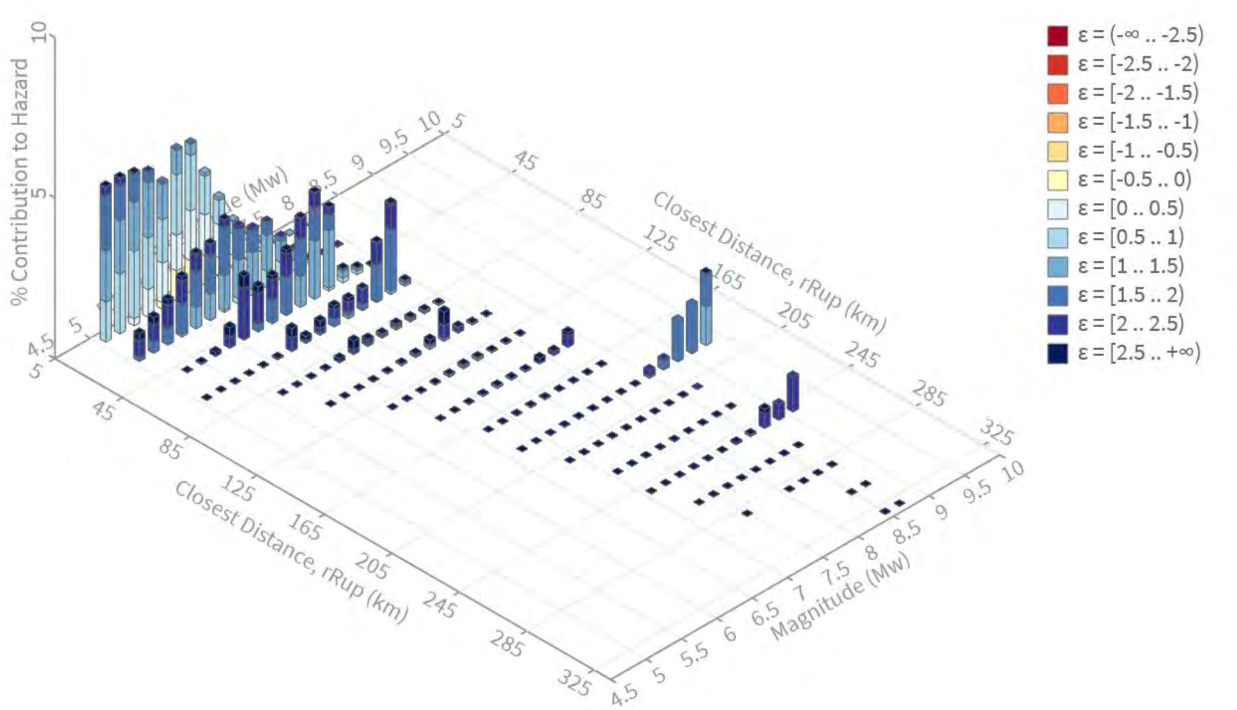


Figure C-3- Deaggregation for 0.2 seconds (MCE_G)

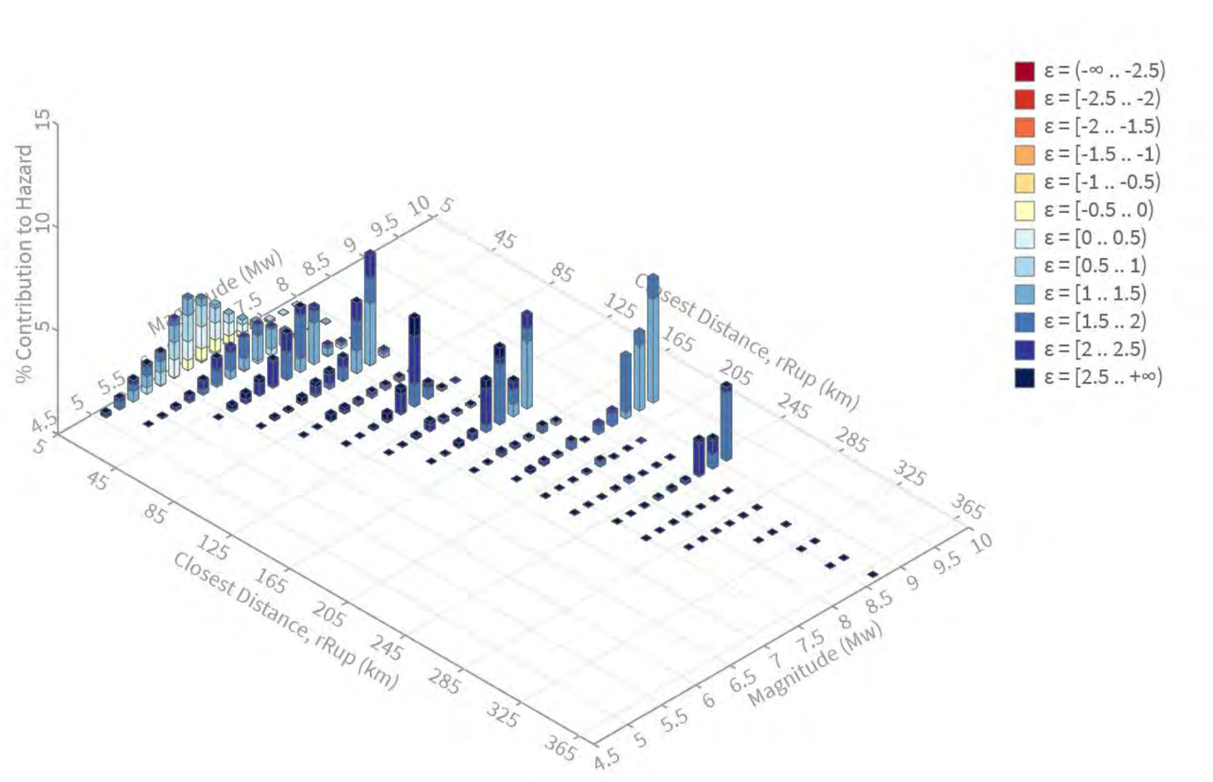


Figure C-4- Deaggregation for 1 second (MCE$_G$)

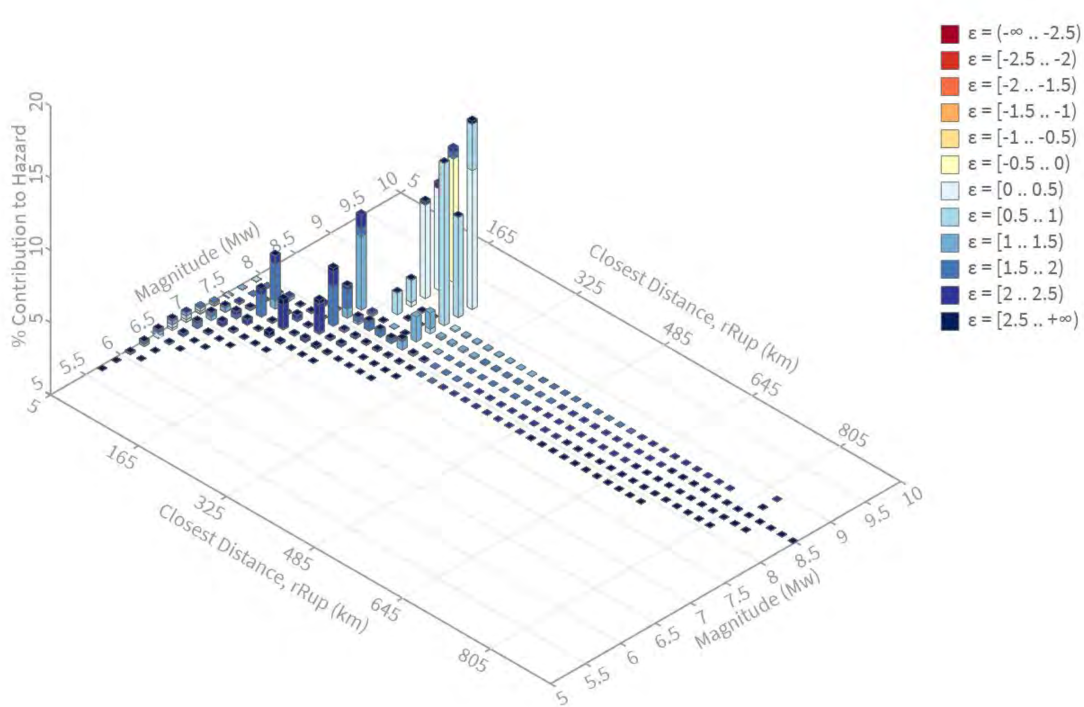


Figure C-5- Deaggregation for 5 second (MCE$_G$)

DRAFT

C2.2 Deterministic Analysis

The ASCE 7-16 Amendment for 21.2.3 states that when the largest probabilistic spectral response acceleration is less than 1.2 F_a, the site-specific MCE_R shall be taken as the site-specific probabilistic spectrum. This amendment applies to our site; therefore, a deterministic site-specific spectrum was not calculated.

C2.3 Recommended Site-Specific MCE_R and Design Response Spectra

Figure C-6 and Table C-2 compare the calculated site-specific probabilistic MCE_R spectra, the MCE_R spectra calculated in accordance with ASCE 7-16 Section 11.4.7, 80% value of the ASCE 7-16 Section 11.4.7 MCE_R spectra, and the recommended MCE_R spectra.

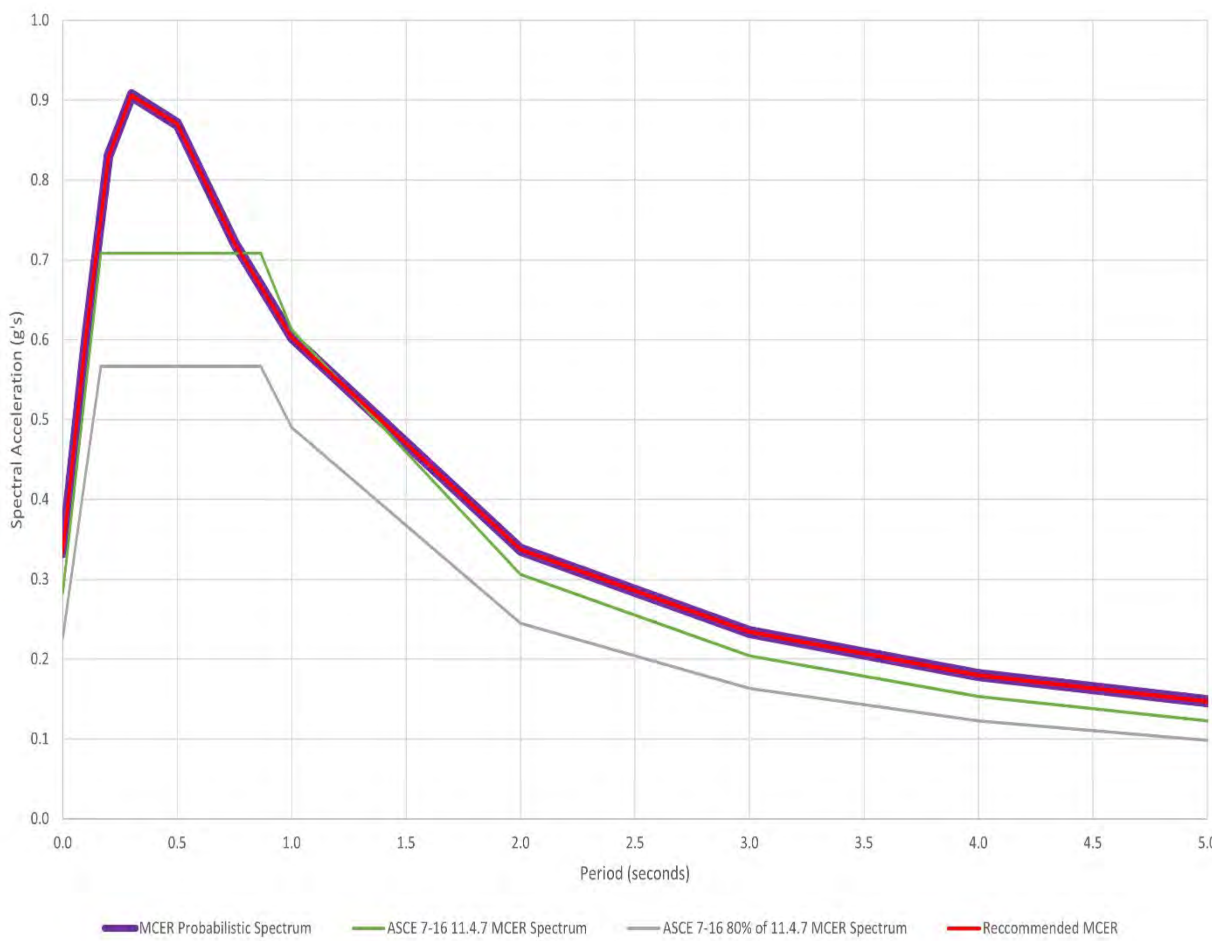


Figure C-6 – Site-Specific Probabilistic MCE_R Spectrum, ASCE 7-16 Section 11.4.7 MCE_R Spectrum, 80% of ASCE 7-16 Section 11.4.7 MCE_R Spectrum, and the recommended MCE_R Spectrum.

Table C-2: Comparison of Recommended and ASCE 7-16 Section 11.4.7 Spectra				
Period	**Site-Specific Recommended MCE_R Spectrum**	**ASCE 7-16 11.4.7 MCE_R Spectrum**	**80% of the ASCE 7-16 11.4.7 MCE_R Spectrum**	**Recommended MCE_R Spectrum**
0	0.335	0.283	0.227	0.335
0.1	0.600	0.539	0.431	0.600
0.166	0.760	0.708	0.567	0.760
0.2	0.830	0.708	0.567	0.830
0.3	0.906	0.708	0.567	0.906
0.5	0.870	0.708	0.567	0.870
0.75	0.722	0.708	0.567	0.722
0.865	0.660	0.708	0.567	0.660
1	0.603	0.613	0.490	0.603
2	0.337	0.306	0.245	0.338
3	0.234	0.204	0.163	0.234
4	0.180	0.153	0.123	0.180
5	0.147	0.123	0.098	0.147

For this site the site-specific probabilistic spectra controls the site response for all periods.

ASCE 7-16 Section 21.3 defines the design response spectrum (DE) as 2/3 times the site-specific MCE_R spectrum. The design spectral response acceleration at any period is not taken as less than 80% of spectral acceleration determined in accordance with ASCE 7-16, Section 11.4.6, where F_a is determined using Table 11.4-1 and F_v is determined using Section 21.3. Figure C-7 and Table C-3 present the calculated DE response spectra, the ASCE 7-16 section 11.4.6 Spectrum, and 80% of the ASCE 7-16 11.4.6 Spectrum. The site-specific design response spectrum is greater than the response spectrum calculated using ASCE 7-16 Section 11.4.6 for all periods and therefore governs the recommended design response spectrum.

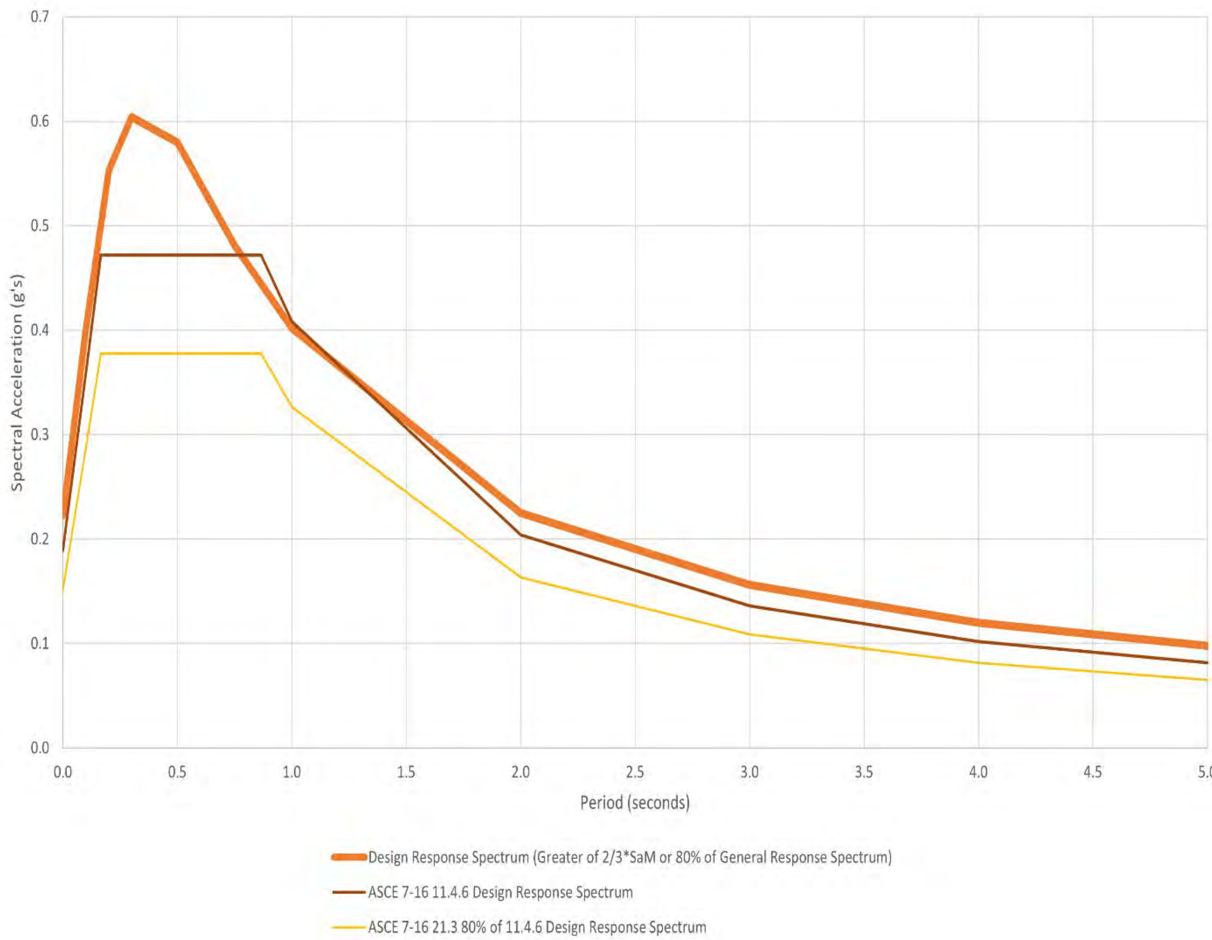


Figure C-7 – Design Response Spectrum (Greater of 2/3*SaM or 80% of General Response Spectrum), ASCE 11.4.6 Design Response Spectrum, and 80% of 11.4.6 Design Response Spectrum.

Table C-3: Comparison of Recommended and ASCE 7-16 Section 11.4.6 Spectra			
Period	**Recommended Design Response Spectrum**	**ASCE 7-16 11.4.6 Response Spectrum**	**80% of ASCE 7-16 11.4.6 Response Spectrum**
0	0.223	0.189	0.151
0.1	0.400	0.359	0.288
0.166	0.507	0.472	0.378
0.2	0.553	0.472	0.378
0.3	0.604	0.472	0.378
0.5	0.580	0.472	0.378
0.75	0.481	0.472	0.378
0.865	0.440	0.472	0.378
1.0	0.402	0.408	0.327
2.0	0.225	0.204	0.163
3.0	0.156	0.136	0.109
4.0	0.120	0.102	0.082
5.0	0.098	0.082	0.065

Design Acceleration Parameters

We calculated the site-specific acceleration parameters in Table C-4 in accordance with ASCE7-16, Section 21.4 and 21.5.3.

Table C-4: Design Spectral Acceleration Values and Peak Ground Acceleration	
Parameter	**Acceleration Value (g's)**
S_{MS}	0.544[1]
S_{M1}	0.490[2]
S_{DS}	0.815[3]
S_{D1}	0.735[4]
PGA_M	0.317[5]

[1]S_{MS} 1.5 times the S_{DS} value in Table C-4
[2]S_{M1} 1.5 times the S_{D1} value in Table C-4
[3]S_{DS} 90% of the maximum spectral acceleration from the site-specific spectrum (0.399)
[4]S_{D1} Maximum value of the product of TS_a (time multiplied by spectral acceleration value) for periods of 1 to 2 seconds for sites with V_{S30} of greater than 1,200 ft/s)
[5]The site-specific MCE_G peak ground acceleration (PGA_M) is the lesser of the probabilistic or deterministic mean peak ground acceleration.

Olivehurst Public Utility District Wastewater Treatment Plant Expansion and Upgrade Project Schematic Design—Preliminary Geotechnical Exploration Report

PREPARED FOR: Olivehurst Public Utility District (OPUD)

PREPARED BY: Allen Evans/CH2M HILL

DATE: February 13, 2004

Introduction

This technical memorandum (TM) presents the preliminary results of the geotechnical exploration for the Olivehurst Wastewater Treatment Plant (plant) Phase 1 and 2 expansion and upgrade project. The project includes construction of new facilities and modifications to existing facilities to expand treatment capacity. The geotechnical exploration consisted of observing and testing surface and subsurface soil conditions in areas where new or remodeled facilities are planned. This TM was to provide initial geotechnical recommendations for the preliminary design and construction, and recommendations will be reevaluated when final facility layout and designs are established. To accomplish this, the scope of work includes the following:

- Conduct a site visit to observe site layout and existing surface soil conditions.
- Perform subsurface exploration using soil borings.
- Conduct laboratory testing to evaluate engineering properties of subsurface soils.
- Analyze subsurface conditions for the proposed facilities.
- Recommend preliminary design criteria for foundations, excavation and backfill, and lateral earth pressure for purposes of the preliminary design.

Project Description

The proposed treatment plant expansion is located in Olivehurst, California. The layout of the existing is show on Figure 4-1. New facilities include influent screening and grit removal facilities, influent pump station, primary effluent distribution box, potential headworks expansion, primary clarifier, oxidation ditches, secondary clarifiers, flow equalization basin, filter influent pump station, tertiary filters, chemical storage/feed building, anaerobic digesters, and solids handling building. In addition, modifications to change the chlorine contact basin to an ultraviolet disinfection system, and modifications to the control building will be made. To accommodate the facility expansion, a new levee will be constructed on the northwest side of the plant. The new levee will extend approximately 200 feet north of the existing levee.

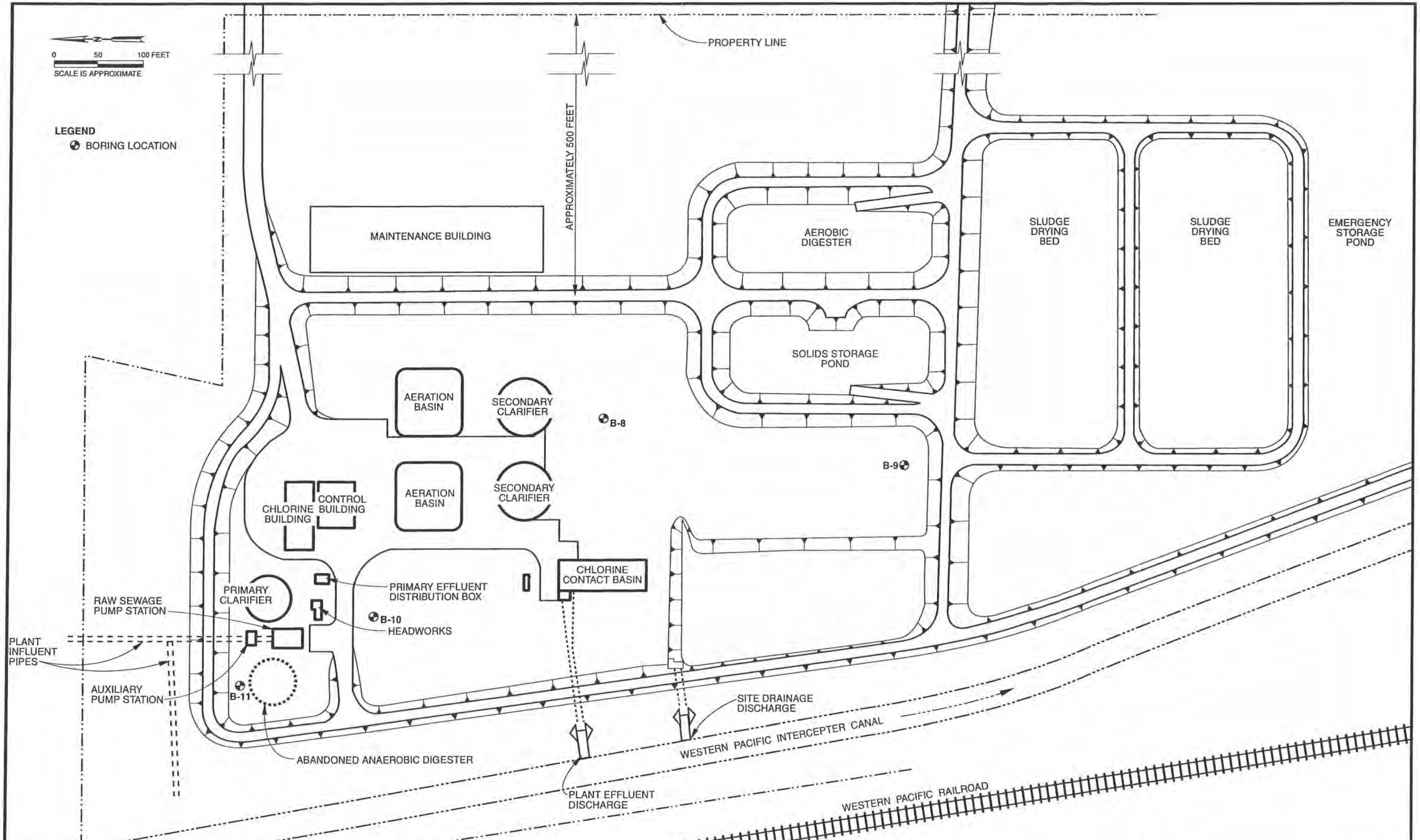


FIGURE 4-1
GEOTECHNICAL BORING LOCATIONS
OPUD WASTEWATER TREATMENT PLANT EXPANSION
OLIVEHURST, CALIFORNIA
CH2MHILL

The area proposed for anaerobic digesters and solids handling building is occupied by the existing solids storage ponds. The area proposed for the flow equalization basin is currently a portion of the emergency storage pond. Locations of the influent screening and grit removal facilities, influent pump station, primary effluent distribution box, and primary clarifiers are proposed for the area north of the plant's north levee into the a portion of the farm field north of the plant. All other facilities are proposed for areas unoccupied by structures. Yard piping may be present in these areas.

Previous Geotechnical Exploration

The previous geotechnical exploration report prepared by CH2M HILL was reviewed. The geotechnical investigation was performed in 1975 for the expansion and modernization of the plant.

Field Exploration

The field exploration was performed on January 12 and 13, 2004, and consisted of a site reconnaissance and subsurface exploration. The site reconnaissance was conducted to observe existing site conditions, topography, and surface soil and water conditions. The subsurface exploration consisted of drilling four borings at the locations shown in Figure 4-1. Soil borings were performed by using a CME-550 track-mounted drill rig equipped with an 8-inch OD hollow-stem auger. The borings were advanced to depths between 25 and 40 feet below ground surface (bgs).

In situ testing and soil sampling were performed in the borings using the Standard Penetration Test (SPT) in accordance with ASTM D1586 at approximately 5-foot intervals throughout the depth of each boring. The SPT provides a disturbed sample of the soil and an empirical indication (N-value) of the soil density. Additional sampling was performed by driving modified California samplers lined with 2.5-inch-diameter sleeves and by hydraulically pushing 3-inch-diameter, thin-walled steel Shelby tubes into the soil at various depths in the borings.

The field exploration was directed by CH2M HILL geotechnical personnel. The soils encountered were visually classified in approximate accordance with ASTM D2488 (visual-manual procedure for description of soils). Soil boring logs are included in Attachment 4-1. Upon completion of drilling, the soil borings were backfilled with cement gout to the ground surface using the hollow-stem auger to tremmie the grout to the bottom of the boring.

Geology

The plant is located in the Great Valley geologic province. The plant is underlain by the Victor Formation of Pleistocene age. The Victor Formation is composed of interbedded sand, silt, and clay with lenses of gravel. The formation includes some meandering stream channel deposits of poorly sorted cobble, gravel and sand. Shallow materials typically contain hardpan. Infiltration rates are very low.

Subsurface Conditions

The general area around the site is a very flat, poorly drained plain used primarily for farmland. The plant facilities are surrounded by 6 to 10 feet tall levees, with the levee road at Elevation 63. The elevation inside the levees varies between Elevations 52 and 59.

The upper 3 to 5 feet of subsurface material consists of sandy clay. The sandy clay was soft and saturated in the unpaved areas around the existing structures. The grassy area at B-10 did not have a saturated upper layer due to drainage provided by underdrains from the old sludge drying bed. Under this upper layer, a hard, sandy clay that compromises the Victor Formation hardpan was encountered up to 8 feet bgs. Pocket penetrometer readings in the hardpan were greater than 4.5 tons per square foot (tsf), the maximum reading on the instrument. Penetration was less than 0.1 inch. The hardpan was underlain by layers of medium dense to dense clayey sand, and stiff to very stiff sandy clay. Pocket penetrometer readings in these soils were all greater that 3 tsf. In Borings B-8 and B-9, a 6- to 7-foot-thick gravely sand and sandy gravel layer was encountered at Elevation 31 . At Boring B-10, a gravely sand layer was encountered from elevation from 42 to 39 feet, and no similar layer was encountered at Boring B-11. In Borings B-8 and B-9 the gravel layer was underlain by multiple layers of clayey sand and sandy clay. The gravel layer in B-10 was underlain by clayey sand to Elevation 29. Under this clayey sand, a sandy silt was encountered. At Boring B-11, clayey sand layer was found from the surface to 23 feet bgs that was underlain by silty sand.

Groundwater was encountered in all borings at approximately Elevation 33. These water levels were taken at the time of drilling inside of the hollow-stem auger. Drilling was paused for 10 minutes before measuring the water level, however, it should be noted that the water levels on the boring logs were not allowed enough time to reach equilibrium. Site groundwater levels may also vary depending on the season. Surface water was encountered in the first soil layer and it is believed this water is perched on the hardpan layer.

Laboratory Testing

A testing program was developed to provide classification and engineering properties of the soils. Particle-size Analysis of Soils (ASTM D422), Particles Passing the No. 200 sieve (ASTM C1140), Moisture Content (ASTM D2216), Atterberg Limits (ASTM D4318), Unit Weight (ASTM D2937), Direct Shear Testing (ASTM D3080), and Modified Proctor (ASTM D1557) tests were conducted on selected soil samples. Test results are summarized and included in Attachment 4-2.

Site Seismicity

Probabilistic Seismicity

A probabilistic assessment of the peak ground acceleration of the site was obtained from published U.S. Geological Survey (USGS) and California Geological Survey (CGS) sources. As part of the National Seismic Hazard Mapping Project (2002), a peak ground acceleration of 0.12g was obtained, with the probability of exceedance of 10 percent in 50 years.

Using the probabilistic 1996 Caltrans California Seismic Hazard Map, the maximum credible earthquake (MCE) is magnitude 6.5 produced by the Prairie Creek-Spencerville-Dentman fault estimated to be approximately 12 miles east of the site. Based on this map, the estimated peak ground acceleration (PGA) is 0.2 g.

1997 UBC Design Criteria

Table 4-1 presents UBC seismic coefficients and factors for the plant. The subsurface material is stiff to hard sandy clay and medium to dense clayey sand.

TABLE 4-1
UBC 1997 Seismic Coefficients and Factors
Olivehurst Waste Water Treatment Plant Phase 1 and 2 Expansion and Upgrade Schematic Design

Factor or Coefficient	Value	UBC Table Number
Soil Profile Type	S_D	16-J
Z	0.30	16-I
C_a	0.36	16-Q
C_v	0.54	16-R
Seismic Source Type	B	16-U
N_a	1.0	16-S
N_V	1.0	16-T

Recommendations

Excavation

All anticipated structures are listed in Table 4-2, together with their estimated excavation depths. Some structures require deep excavations up to approximately 21 feet bgs. As described previously, subsurface materials consist of sandy clay, clayey sand, and gravel. The subsurface materials are anticipated to be excavatable with conventional equipment. Highly organic, soft surface soils should be stripped a minimum of 3 feet outside structure foundation areas. It is anticipated that soils other that highly organic soils can be stockpiled for use backfill. Softer near surface soil may be stockpiled for use in the levee after vegetation and roots are removed.

The final excavation bottom for any structure should be cleared of loose material and compacted to at least 90 percent of its maximum dry density in accordance with ASTM D1557 before placing any concrete. The base of all excavations should be approved by a geotechnical specialist to verify its capability to support the overlying structure without unacceptable settlement.

Where excavations are required adjacent to existing structures, excavations should not be carried below the base of the existing footings unless there is a stable slope 1:1 or flatter that will not ravel or cause loss of support to the existing structure.

TABLE 4-2
Excavation and Foundation Depths for Structures Requiring Deep Excavation
Olivehurst Waste Water Treatment Plant Phase 1 and 2 Expansion and Upgrade Schematic Design

Structure	Existing Ground Surface Elevation	Estimated Depth to Bottom of Lowest Foundation (ft)	Elevation at Bottom of Excavation
Influent Pump Station	56	20	35
Headworks	56	21	34
Primary Effluent Distribution Box	56	11	44
Primary Clarifiers	57	12	43
Oxidation Ditch	57	13	42
Secondary Clarifier	55	20	33
Flow Equalization Basins	53	12	39.5
Filter Influent Pump Station	56	19.5	34.5
Filtration	55	Slab On Grade	52
Chemical Storage	55	Slab On Grade	52
RAS/WAS Pump Station	57	Slab on Grade	53
Anaerobic Digesters	53	5	46
Solids Handling Building	53	Slab on Grade	51
Levee	56	56	52

Fill and Backfill

Imported granular fill should be used as backfill under below grade structures. Granular fill should be placed in loose lifts not exceeding 8 inches, moisture conditioned as necessary, and compacted to at least 95 percent of its maximum dry density in accordance with ASTM D1557 within influence zones of structures unless otherwise recommended below. The influence zone is defined as the area beneath a structure within planes sloped downward and outward at a 60° angle from the horizontal measured from the outermost footing element. A minimum of 12 inches of imported granular fill should be placed under shallow foundations. A minimum of 6 inches of granular fill should be placed below floating slabs. Granular fill should be placed in loose lifts not exceeding 8 inches, moisture conditioned as necessary, and compacted to at least 95 percent of its maximum dry density in accordance with ASTM D1557.

Native soil obtained from onsite excavations, blended to provide a homogeneous mixture, and free of soft surface soils and organic material and debris, may be used as backfill around structures. It may also be used as backfill in areas of over-excavation for shallow foundations not requiring granular fill. Native soil backfill should be placed in loose lifts not exceeding 8 inches, and compacted to at least 90 percent of its maximum dry density and within 2 percent of optimum moisture content in accordance with ASTM D1557. The backfill should be placed and compacted in even lifts around the structure perimeter.

Processed native material including softer near surface soils may be used as fill for construction of levee expansions. Fill should be placed in loose lifts not exceeding 8 inches, moisture conditioned as necessary, and compacted to at least 90 percent of its maximum dry density in accordance with ASTM D1557. The levee slopes should be constructed at a maximum slope of 2:1, horizontal to vertical, to match existing slopes.

Groundwater Design Considerations

Multiple excavations will extend near the top of the estimated groundwater level found at the time of drilling; therefore, some dewatering may be required. Depending on the season, surface water perched on the hardpan layer may drain into the excavation and will require additional control measures to prevent inflow.

Review of previous geotechnical explorations performed at the site provide limited information on the variability of groundwater elevations at the site. No regular monitoring using peizometers has been performed to determine the response of groundwater levels to the filling of Western Pacific Interceptor Canal. The 100-year flood elevation of 60 is higher that the site elevation. Unknown gravel layers that could connect the area outside the levee to the structures inside the levee may exist. Because of these uncertainties, design of below-grade structures should use the ground surface as the static water level.

Lateral Earth Pressures

Restrained structure exterior walls should be designed to resist at-rest earth pressures. Walls free to move about the top should be designed to resist active pressures. Passive pressures may be used to resist lateral forces. Walls should be designed to resist the static lateral equivalent fluid pressures shown in Table 4-3 plus any equipment or earth surcharge loads. Concrete footings and slabs cast against undisturbed soil may use a sliding friction factor of 0.4 in resisting lateral loads.

TABLE 4-3
Lateral Earth Pressures
Olivehurst Public Utility District Wastewater Treatment Plant Expansion and Upgrade Project Schematic Design

	Equivalent Fluid Pressures (pcf)		
Soil Type—Drainage Condition	**Active**	**At-rest**	**Passive**
Native—Drained	40	60	350
Native—Undrained	90	100	200
Imported Granular Backfill – Drained	40	60	400
Imported Granular Backfill – Undrained	80	90	275

Note: Assumed Values: Native γ : 114 pcf; φ: 30 °, γ_{sat} : 130 pcf; Imported γ_{sat} : 140 pcf; φ: 35 °

Ground motion during earthquakes tends to increase the earth pressure above static levels. Retaining walls should be designed to resist a dynamic active lateral force increase of 16^*H^2 pounds per linear foot of wall, which acts at a height of 0.6*H above the base of the wall (H = height of wall). The dynamic lateral force increase should be used in addition to the static active earth pressure force.

Foundations

The proposed structures should be supported on foundations similar to those that have been successfully used for similar facilities at this plant. Based on a visual reconnaissance of the existing facilities, there is no evidence of significant settlement, either total or differential. New facilities should be supported on strip footings, mat foundations, rectangular column footings, or combinations as required to provide support.

The shallow foundations for the filtration building, RAS/WAS pump station, anaerobic digesters, and solids handling building should be designed for a maximum allowable net bearing pressure of 2,000 pounds per square foot (psf). Total post-construction settlement for these near-grade structures is expected to be less than 0.75 inch. Footings should be placed a minimum of 1.5 feet below finish grade. Mat foundations should be keyed a minimum of 1 foot below finish grade. All other belowgrade structures should be designed for a maximum allowable net bearing pressure of 2,500 pounds per square foot (psf). Loads from these structures are not expected to be significantly greater than the current overburden pressures, therefore, total post-construction settlement is expected to be less than 0.5 inch. An increase of up to one-third of the allowable bearing pressure may be used for short-term loading such as wind, seismic, or equipment loading.

Construction Observation and Testing

If any unusual conditions are encountered at the footing locations, a geotechnical specialist should review the excavation bottom and determine if revisions are needed. Compaction testing and periodic fill observations should be performed during placement of engineered fill. Photos should be taken to document specific conditions.

References

California Geological Survey/U.S. Geological Survey, *Probabilistic Seismic Hazards Assessment (PSHA) Model, 2002 (Revised April 2003).*

CH2M HILL. 1975. *Geotechnical Exploration Report* for *Olivehurst Public Utility District*

Mualchin, Lalliana. July 1996. *THE CALTRANS CALIFORNIA SEISMIC HAZARD MAP 1996.*

Limitations

This technical memorandum has been prepared for the exclusive use of the Olivehurst Public Utility District for specific application to Phase 1 and 2 plant expansion and upgrade schematic design. It has been prepared in accordance with generally accepted geotechnical engineering practice. No other warranty, express or implied, is made.

The analyses and preliminary recommendations contained in this report are based on the data obtained from our exploratory borings for the proposed structures. These borings indicate subsurface conditions only at specific locations and times, and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between such locations. Subsurface conditions and water levels at other locations may differ from conditions occurring at these indicated locations. The passage of time may result in a change in the conditions at these locations. If variations in subsurface conditions from those described are noted during construction, recommendations in this report must be re-evaluated.

In the event that any changes in the nature, design, or location of the facilities are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by CH2M HILL. CH2M HILL is not responsible for any claims, damages, or liability associated with the interpretation of subsurface data or reuse of the subsurface data or engineering analyses without the express written authorization of CH2M HILL.

Attachment 4-1
Soil Boring Logs

BORING AND TEST PIT LOG LEGEND:

SAMPLE TYPE:

Bulk - BAG SAMPLE
SS - SPLIT BARREL (ASTM D1586 UNLESS OTHERWISE NOTED)
MC - MODIFIED CALIFORNIA DRIVEN SLEEVE SAMPLE
SH - SHELBY TUBE SAMPLE

STANDARD PENETRATION TEST:

6"-6"-6" – THE NUMBER OF BLOWS FOR THREE 6-INCH INCREMENTS REQUIRED FROM A 140-LB HAMMER FALLING 30 INCHES TO DRIVE A STANDARD 2-INCH O.D. SPLIT-BARREL SAMPLER (ASTM D1586)

(N) – THE NUMBER OF BLOWS FOR THE SECOND AND THIRD 6-INCH INCREMENTS

NOTES:

1. THE BORING AND/OR TEST PIT LOGS AND RELATED INFORMATION DEPICT SUBSURFACE CONDITION AND WATER LEVELS ONLY AT THE SPECIFIC LOCATIOINS AND DATES INDICATED. SOIL CONDITIONS AND WATER LEVELS OCCURING AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THESE BOING AND/OR TEST PIT LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THESE LOCATIONS.
2. BORING LOCATIONS AND ELEVATIONS ARE APPROXIMATE. ELEVATIONS WERE ESTIMATED FROM 1975 MAPPING. LOCATIONS WERE ESTIMATED FROM MAJOR STRUCTURES
3. BORINGS AND WERE DIRECTED BY CH2M HILL GEOTECHNICAL PERSONEL. THE SUBSURFACE MATERIALS WERE CLASSIFIED IN APROXIMATE ACCORDANCE WITH ASTM D2488 (VISUAL-MANUAL PROCEDURE FOR DESCRIPTION OF SOILS).
4. IN THE COMMENTS SECTION OF THE SOIL BORING LOGS, PP STANDS FOR POCKET PENETROMETER TEST (UNCONFINED COMPRESSIVE STRENGTH.

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
186380	B-8	SHEET 1 OF 2

SOIL BORING LOG

PROJECT Olivehurst WWTP Expansion **LOCATION** Clarifier Location

ELEVATION 54' est. **DRILLING CONTRACTOR** Taber

DRILLING METHOD AND EQUIPMENT CME-550 Track Rig

WATER LEVELS 20.7' bgs 1/12/04 **START** 1/12/04 8:20 **FINISH** 1/12/04 12:00 **LOGGER** Allen Evans

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	1.5	SS-1	12"	1-2-2 (4)	SANDY CLAY (CL), reddish/orange brown, moist, soft	0.5 tsf - Pocket Pen (PP) Difficulty setting up on soft ground, outrigger sinking
					-Transition	
5.0	5					
	6.5	SS-2	18"	12-15-18 (33)	SANDY CLAY (CL), orange brown to brown, dry, hard, probably hardpan layer	9:07 >4.5 tsf on PP (maxed out)
10.0	10					
	11.5	SS-3	18"	5-12-13 (25)	CLAYEY SAND (SC), light brown with some black coarse sand, dry, medium	4.25 tsp - PP
15.0	15					
	16.5	MC-4	9"	4-5-6 (11)	SANDY CLAY (CL), orangeish light brown, moist, stiff	1 - Sleeve
20.0	20					
	22	SH-5	2.0'		SANDY CLAY/CLAYEY SAND (CL), light brown, moist, firm to stiff	425 psi down pressure @ 21.5' ∇ Groundwater @ 20.7' @ time of drilling
	23.5	SS-6	18"	21-43-40 (83)	CLAYEY/SAND (SC), brown, moist fine sand -Very dense	
					SANDY GRAVEL (GP), bluish gray, wet, very dense, small to medium	
25.0	25					
	26.5	SS-7	18"	13-23-23 (46)	Similar, dense, 1 - 2" gravels Now (GW)	
					- Transition	
	30					

CH2M HILL

PROJECT NUMBER	BORING NUMBER
186380	B-8 SHEET 2 OF 2

SOIL BORING LOG

PROJECT Olivehurst WWTP Expansion **LOCATION** Clarifier Location

ELEVATION 54' est. **DRILLING CONTRACTOR** Taber

DRILLING METHOD AND EQUIPMENT CME-550 Track Rig

WATER LEVELS 20.7' bgs 1/12/04 **START** 1/12/04 8:20 **FINISH** 1/12/04 12:00 **LOGGER** Allen Evans

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30–31.5	SS-8	2"	6-15-17 (32)	SANDY CLAY (CL), yellowish light brown, moist, hard	Very little recovery
					Transition	
35.0	35–36.5	SS-9	18"	8-18-21 (39)	SILTY CLAY w/some SAND zones (CL), light brown with orange stains, moist, hard coarse sands	2.57 tsf – PP fractured sample
	37–39	SH-10	1.1'		Same	750 psi down pressure, stopped after 1.3' push, end slightly crushed
40.0	40–41.5	SS-11	12"	12-17-22 (39)	SANDY CLAY (CL), light brown with rusty colored zones, moist, hard	PP > 4.5 tsf Finish drilling 12:00 Backfilled with neat cement, grout 13:10, some cuttings fell in hole while pulling auger.
					End Boring @ 41.5'	
45.0						
50.0						
55.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
186380	B-9	SHEET 1 OF 2

SOIL BORING LOG

PROJECT Olivehurst WWTP Expansion LOCATION Extreme South Portion of Property

ELEVATION 54' est. DRILLING CONTRACTOR Taber

DRILLING METHOD AND EQUIPMENT 8" HSA, CME-550 Track Rig

WATER LEVELS 23.7' bgs 1/12/04 START 1/12/04 13:30 FINISH 1/12/04 14:40 LOGGER Allen Evans

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	1.5	SS-1	12"	2-2-2 (4)	SANDY CLAY (CL), yellowish brown, moist, soft	1.25 tsf - Pocket Pen (PP)
					Similar, color reddish brown	
					-Transition	
5.0	5					
	6.5	SS-2	18"	11-18-26 (44)	SANDY CLAY (CL), yellowish brown to brown, dry, hard, sand medium grained and black, probably local hardpan layer	>4.5 tsf - PP maxed out
10.0	10					
	11.5	SS-3	18"	6-9-13 (22)	CLAY SAND (SC), light brown-gray, moist, medium	>4.5 tsf - PP maxed out
15.0	15				CLAYEY SAND (SC), reddish brown, moist, very stiff	
	17	SH-4	2'			
	18.8	SS-5	18"	5-10-14 (24)	Same	3 tsf - PP
20.0	20					
	21.5	SS-6	18"	5-8-8 (16)	CLAYEY SAND (SC), reddish brown, moist, medium, fine grained	
					-Transition	▽ Groundwater @ 23.7' @ time of drilling
25.0	25					Grinding
	26.5	SS-7	18"	15-26-32 (58)	SANDY GRAVEL (GW), blueish gray, wet, very dense, well graded with maximum size ~2"	
	30					

CH2M HILL

PROJECT NUMBER	BORING NUMBER
186380	B-9

SOIL BORING LOG

PROJECT Olivehurst WWTP Expansion **LOCATION** Extreme South Portion of Property

ELEVATION 54' est. **DRILLING CONTRACTOR** Taber

DRILLING METHOD AND EQUIPMENT 8" HSA, CME-550 Track Rig

WATER LEVELS 23.7' bgs 1/12/04 **START** 1/12/04 13:30 **FINISH** 1/12/04 14:40 **LOGGER** Allen Evans

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30 31.5	SS-8	18"	8-24-32 (56)	Same	
					End Boring @ 30'	Grout to surface
35.0						
40.0						
45.0						
50.0						
55.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
186380	B-10	SHEET 1 OF 2

SOIL BORING LOG

PROJECT Olivehurst WWTP Expansion **LOCATION** ORBAL Process Area

ELEVATION 57.5' est. **DRILLING CONTRACTOR** Taber

DRILLING METHOD AND EQUIPMENT 8" HSA CME-550 Track Rig

WATER LEVELS 24.8' bgs **START** 1/13/04 8:20 **FINISH** 1/13/04 11:30 **LOGGER** Allen Evans

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	1.5	SS-1	18"	2-7-14 (21)	SANDY CLAY (CL), light yellowish gray, moist, very stiff	2.5 tsf - Pocket Pen (PP)
	5				-Transition	Bulk-1 Sampled (5' - 17') >4.5 tsf on PP (maxed out on penetration)
5.0	6.5	SS-2	18"	11-21-33 (54)	CLAYEY SAND (SC), orangeish brown, dry, hard, hardpan	
	10					
10.0	10.5	SH-3	6"		CLAYEY SAND (SC), orangeish brown, moist, dense, fine grained	750 psi down pressure PP >4.5 tsf
	12	SS-4	18"	13-20-21 (41)		
	15					
15.0	16.5	SS-5	18"	6-8-16 (24)	CLAYEY SAND (SC), orangeish brown, moist, medium, fine to medium grained	
					GRAVELLY SAND (SW), light brown-gray, moist, dense, well graded sand, small to medium gravel	
						Harder grinding
	20				-Transition	
20.0	21.5	SS-6	18"	10-15-21 (36)	CLAYEY SAND (SC), orangeish brown, moist, dense, fine to medium grained	3.25 tsf - PP
	25					▽ 27.8 @ time of drilling
25.0	26.5	MC-7	9"	7-8-11 (19)	Similar, higher % clay, medium	2.5 tsf - PP 1 - Sleeve
	30					

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
186380	B-10	SHEET 2 OF 2

SOIL BORING LOG

PROJECT Olivehurst WWTP Expansion **LOCATION** ORBAL Process Area

ELEVATION 57.5' est. **DRILLING CONTRACTOR** Taber

DRILLING METHOD AND EQUIPMENT 8" HSA CME-550 Track Rig

WATER LEVELS 24.8' bgs **START** 1/13/04 8:20 **FINISH** 1/13/04 11:30 **LOGGER** Allen Evans

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30 – 31.5	SH-8	21"		SANDY SILT (ML), orangeish brown to yellow brown, wet, very stiff layered system with some very thin sand lenses	Pushed 1.5' 900 psi down pressure PP - 3.75 tsf
	31.5 – 33	SS-9	18"	6-9-17 (26)		PP - 4.5 tsf
	33 – 35					
35.0	35 – 37	SH-10	1.9'		SANDY SILT with SAND lenses (ML), orangeish brown, moist to wet, stiff to hard, end of Shelby sample very hard	1100 psi down pressure >4.5 tsf - PP maxed out
	37 – 38.5	SS-11	18"	7-8-11 (19)		
	38.5 – 40					
40.0	40 – 41.5	SS-12	18"	6-7-11 (18)	SANDY SILT (ML), orangeish brown, wet, stiff to very stiff	PP - 2.25 - 2.75 tsf
					End Boring @ 41.5'	Grout to surface
45.0						
50.0						
55.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER
186380	B-11 SHEET 1 OF 1

SOIL BORING LOG

PROJECT Olivehurst WWTP Expansion **LOCATION** NW Corner of Plant

ELEVATION 57.5' est. **DRILLING CONTRACTOR** Taber

DRILLING METHOD AND EQUIPMENT 8" HSA CME-550 Track Rig

WATER LEVELS 27.7' bgs 1/13/04 **START** 1/13/04 11:49 **FINISH** 1/13/04 13:08 **LOGGER** Allen Evans

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	1.5	SS-1	18"	0-1-3 (4)	SANDY CLAY (CL), brown, wet, soft	0.25 tsf - Pocket Pen (PP)
					-Transition	
5.0	5 6.5	SS-2	18"	8-9-11 (12)	CLAYEY SAND (SC), yellowish brown, moist, medium	Unable to Pocket Pen, sand
10.0	10 10.5	SH-3	8"		CLAYEY SAND (SC), orangeish brown, moist, medium	1500 psi end crushed Pocket Pen >4.5 tsf
	12	SS-4	18"	10-10-13 (23)		
15.0	15 16.5	SS-5	18"	3-7-5 (12)	Similar, some gravel, small size	
20.0	20 21.5	MC-6	18"	11-20-41 (61)	CLAYEY SAND (SC), light brown with orange stains, moist, very dense	Catcher used
25.0	25 27	SH-7	2.1'		SILTY SAND (SM), orangeish and light yellow brown, wet, medium	900 psi down pressure
	28.5	SS-8	18"	8-8-10 (18)		1.25 PP -27.7 ⊻ WT at time of drilling
					End Boring @ 28.5'	Grout to surface

Attachment 4-2
Laboratory Testing

Materials Testing, Inc.

8798 Airport Road
Redding, California 96002
(530) 222-1116, fax 222-1611

865 Cotting Lane, Suite A
Vacaville, California 95688
(707) 447-4025, fax 447-4143

CLIENT: CH2M Hill
2525 Airpark Drive
Redding, CA 96001-2443

CLIENT NO: 0103-003
REPORT NO: 0300-008
DATE: 01/26/04

PROJECT: Olivehurst Public Utilities District
186380.A1.01

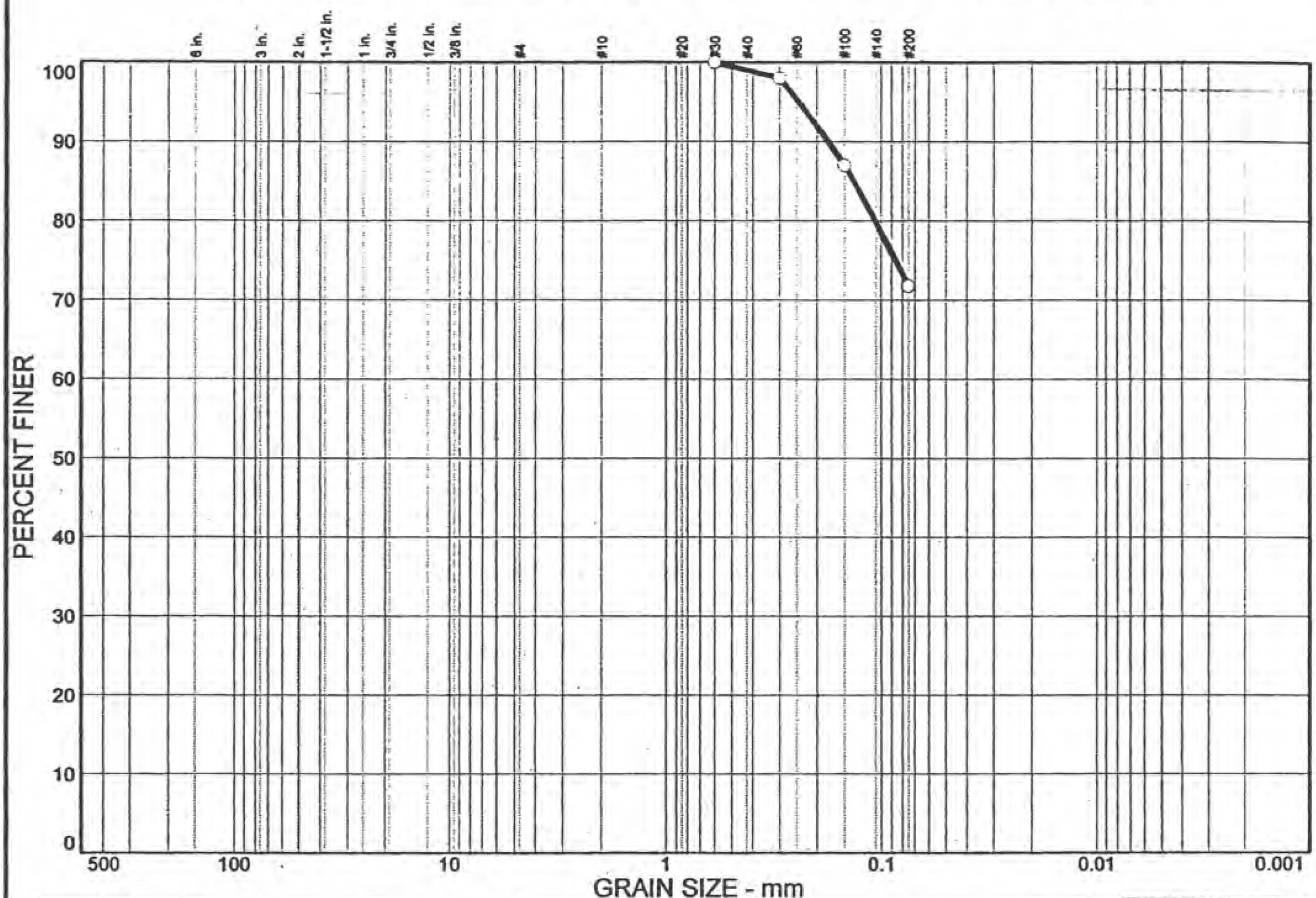
SUBMITTED BY: Client

DENSITY OF IN PLACE SOIL BY THE DRIVE TUBE METHOD (ASTM D2937) LIQUID LIMIT, PLASTIC LIMIT & PLASTICITY INDEX OF SOILS (ASTM D4318) AND PERCENT MOISTURE (ASTM D-2216) DATA SHEET

Sample #	Description	Dry Density pcf.	Moisture Content %	Liquid Limit %	Plastic Limit %	Plastic Index %	Percent Moisture
B-8 (SS-1) @ 0'		----	----				25.2
B-8 (SS-2) @ 5'	~~Brown Clayey Sand~~ (Visual)	----	----	36	17	19	----
B-8 (SH-5) @ 20'	Brown Clayey Sand (Visual)	95.9	27.2	----	----	----	----
B-8 (SH-10) @ 35'	Brown Sandy Clay (Visual)	90.9	38.8	----	----	----	----
B-9 (SS-2) @ 5'	Brown Sandy Clay (Visual)	----	----	50	22	23	19.5
B-10 (SH-3) @10'	Brown Clayey Sand (Visual)	105.0	18.9	----	----	----	
B-10 (SH-10) @ 35'	Brown Sandy Clay (Visual)	89.8	36.6	31	29	2	
B-11 (SH-3) @ 10'	Brown Clayey Sand (Visual)	89.0	18.3	----	----	----	
B-11 (SH-7) @ 25'	Brown Clayey Sand (Visual)	94.1	32.6	56	32	24	
B-9 (SH-4) @ 15'	Brown Clayey Silt (Visual)	74.9	31.5	----	----	----	

98.5

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	28.2	71.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#50	98.0		
#100	87.0		
#200	71.8		

* (no specification provided)

Soil Description

Brown Sandy Clay (Visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.135 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

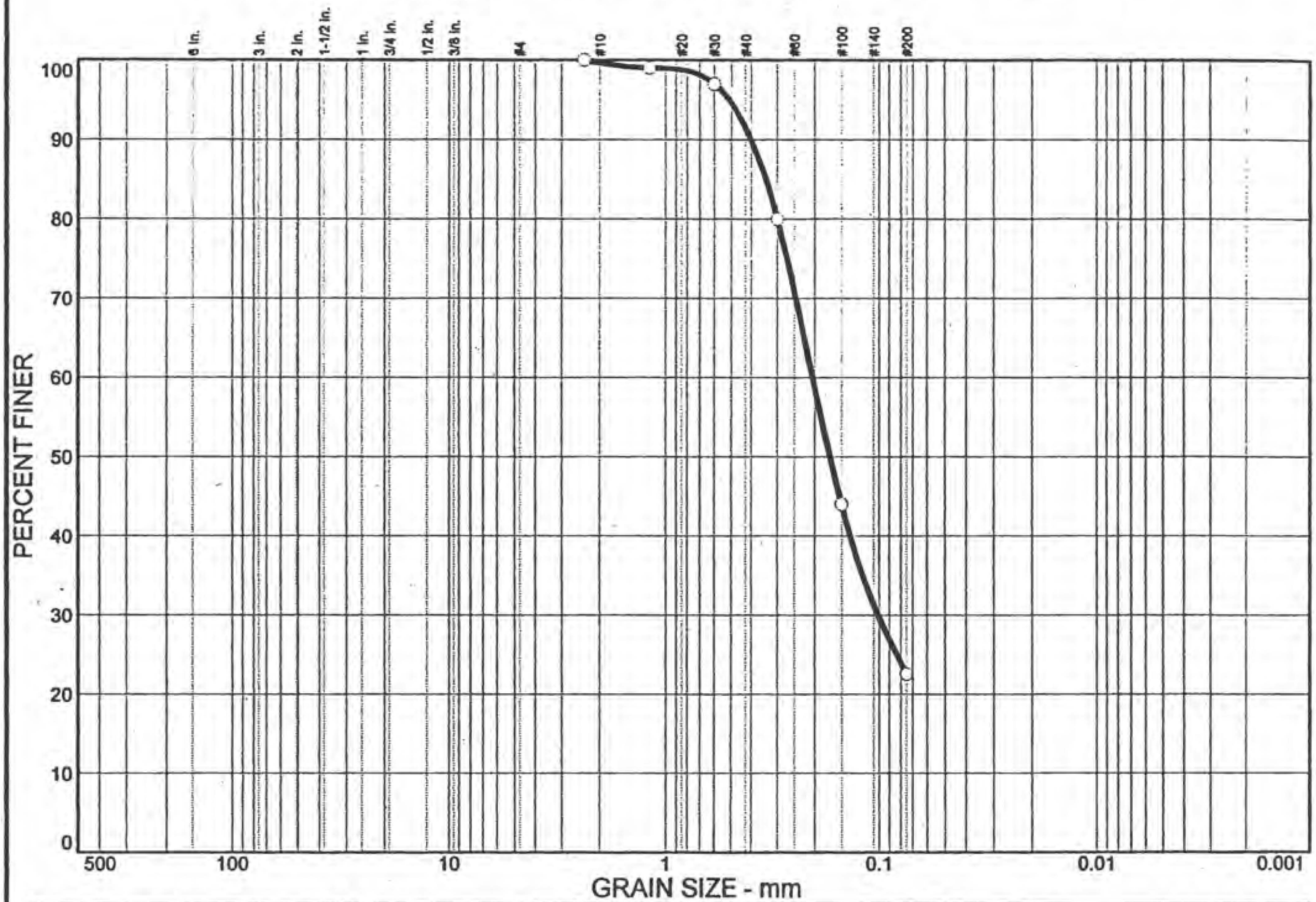
ASTM C-136/C-117

Sample No.: B-8 (SS-2) **Source of Sample:** Olivehurst Public Utility District **Date:** 01/23/04
Location: **Elev./Depth:** 5'

Materials Testing, Inc.

Client: CH2M Hill
Project: Olivehurst Public Utility District
Project No: 0103-001 **Plate** 0400-001

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	77.5	22.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.0		
#30	97.0		
#50	80.0		
#100	44.0		
#200	22.5		

* (no specification provided)

Soil Description

Brown Clayey Sand (Visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.340 D_{60}= 0.204 D_{50}= 0.170
D_{30}= 0.101 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

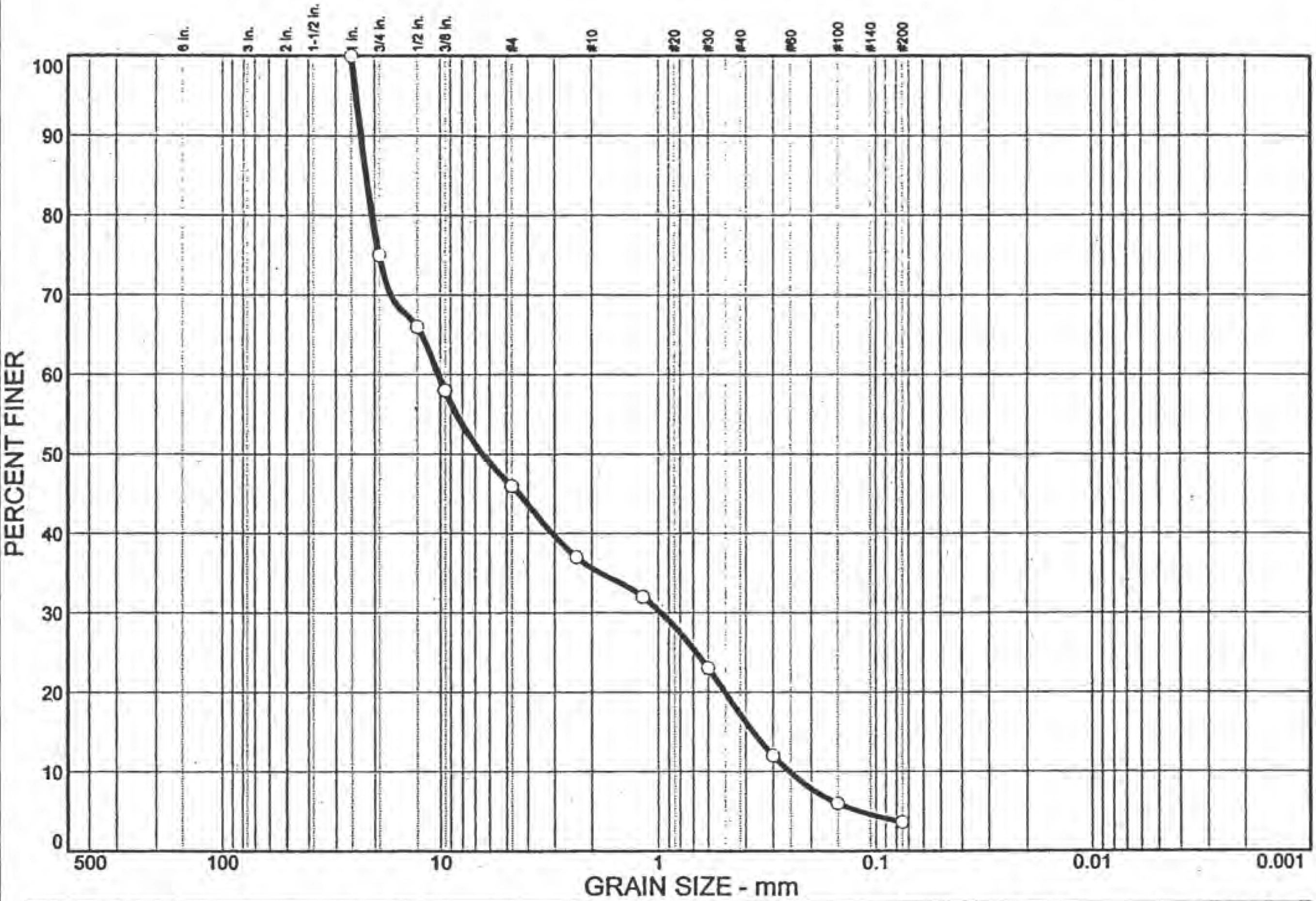
ASTM C-136/C-117)

Sample No.: B-8 (SS-5) **Source of Sample:** Olivehurst Public Utility District **Date:** 01/23/04
Location: **Elev./Depth:** 20'

MTI Materials Testing, Inc.

Client: CH2M Hill
Project: Olivehurst Public Utility District
Project No: 0103-001 **Plate** 0400-002

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	54.0	42.4	3.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	75.0		
1/2 in.	66.0		
3/8 in.	58.0		
#4	46.0		
#8	37.0		
#16	32.0		
#30	23.0		
#50	12.0		
#100	6.0		
#200	3.6		

* (no specification provided)

Soil Description

Brown Sandy Gravel (Visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 21.8 D_{60}= 10.2 D_{50}= 6.45
D_{30}= 0.974 D_{15}= 0.370 D_{10}= 0.253
C_u= 40.21 C_c= 0.37

Classification

USCS= GW AASHTO=

Remarks

ASTM C-136/C-117

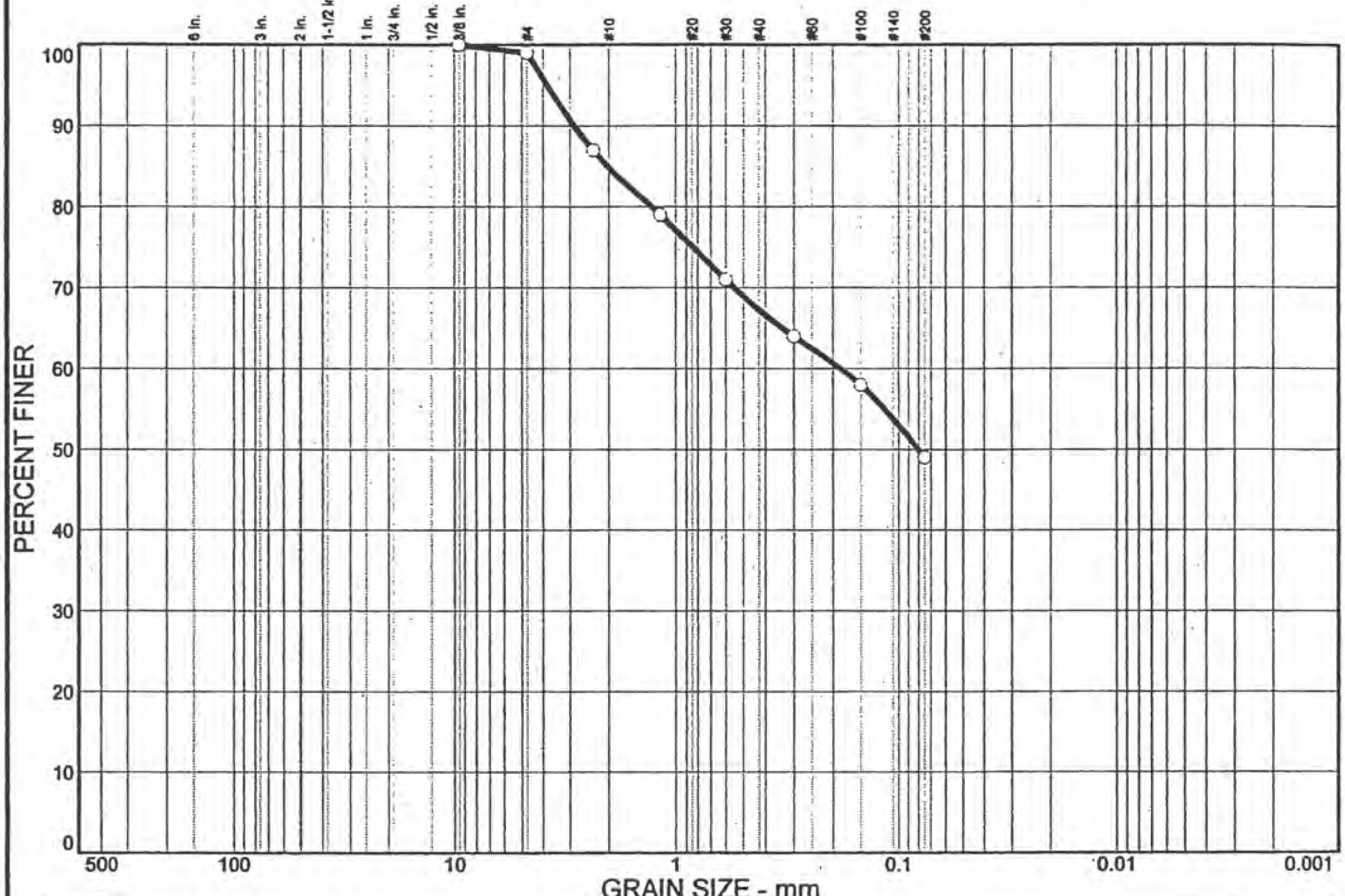
Sample No.: B-8 (SS-7) **Source of Sample:** Olivehurst Public Utility District **Date:** 01/23/04
Location: **Elev./Depth:** 25'

MTI Materials Testing, Inc.

Client: CH2M Hill
Project: Olivehurst Public Utility District

Project No: 0103-001 **Plate** 0400-003

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.0	50.0	49.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	99.0		
#8	87.0		
#16	79.0		
#30	71.0		
#50	64.0		
#100	58.0		
#200	49.0		

* (no specification provided)

Soil Description

Brown Clayey Sand (Visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 2.03 D_{60}= 0.185 D_{50}= 0.0805
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

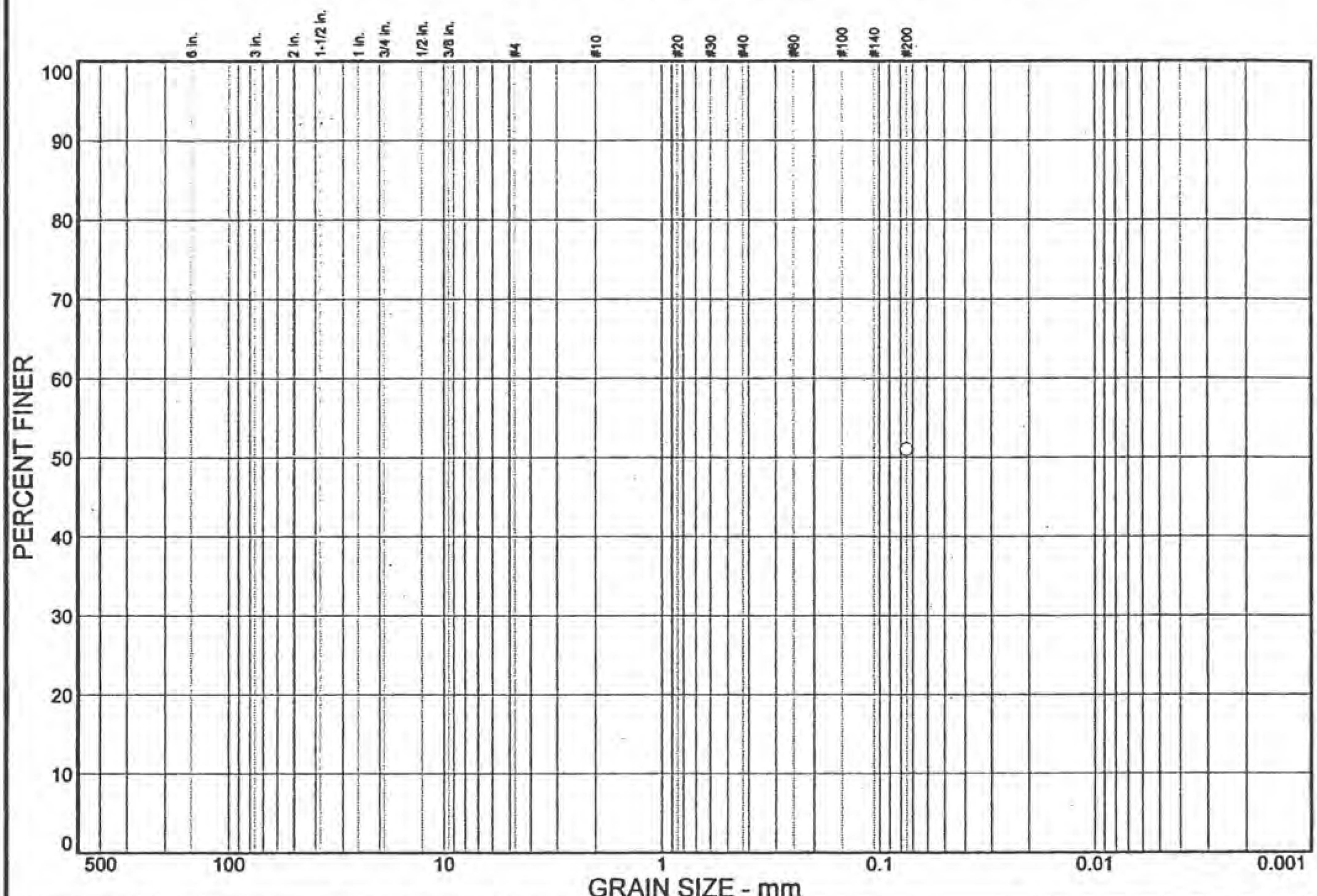
ASTM C-136/C-117

Sample No.: B-9 (SS-5) **Source of Sample:** Olivehurst Public Utility District **Date:** 01/23/04
Location: **Elev./Depth:** 17'

MTI Materials Testing, Inc.

Client: CH2M Hill
Project: Olivehurst Public Utility District
Project No: 0103-001 **Plate** 0400-004

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			51.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	51.0		

* (no specification provided)

Soil Description

Brown Sandy Clay (Visual)

Atterberg Limits

PL= 29 LL= 31 PI= 2

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

200 Wash (ASTM C-117)

Sample No.: B-10 (SH-10) **Source of Sample:** Olivehurst Public Utility District **Date:** 01/23/04
Location: **Elev./Depth:** 35'

Materials Testing, Inc.

Client: CH2M Hill
Project: Olivehurst Public Utility District
Project No: 0103-001 **Plate** 0400-005

PARTICLE SIZE DISTRIBUTION TEST REPORT

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	51.4	48.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	98.0		
#16	97.0		
#30	94.0		
#50	90.0		
#100	72.0		
#200	48.6		

* (no specification provided)

Soil Description

Brown Clayey Sand (Visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.234 D_{60}= 0.105 D_{50}= 0.0781
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

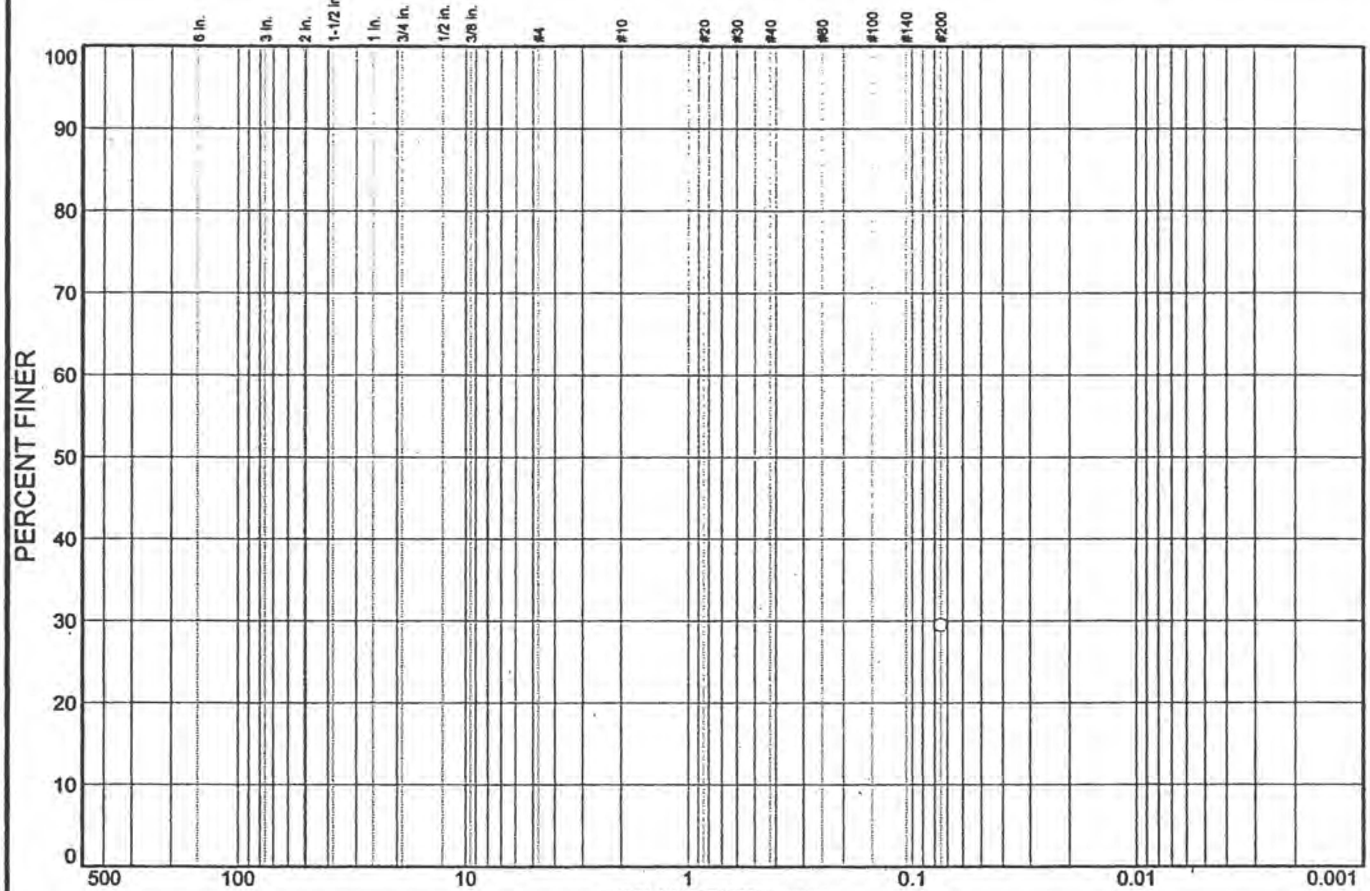
ASTM C-136/C-117

Sample No.: B-11 (SS-4) **Source of Sample:** Olivehurst Public Utility District **Date:** 01/23/04
Location: **Elev./Depth:** 10.5'

Materials Testing, Inc.

Client: CH2M Hill
Project: Olivehurst Public Utility District
Project No: 0103-001 **Plate** 0400-006

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			29.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	29.5		

* (no specification provided)

Soil Description

Brown Clayey Sand (Visual)

Atterberg Limits

PL= 32 LL= 56 PI= 24

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

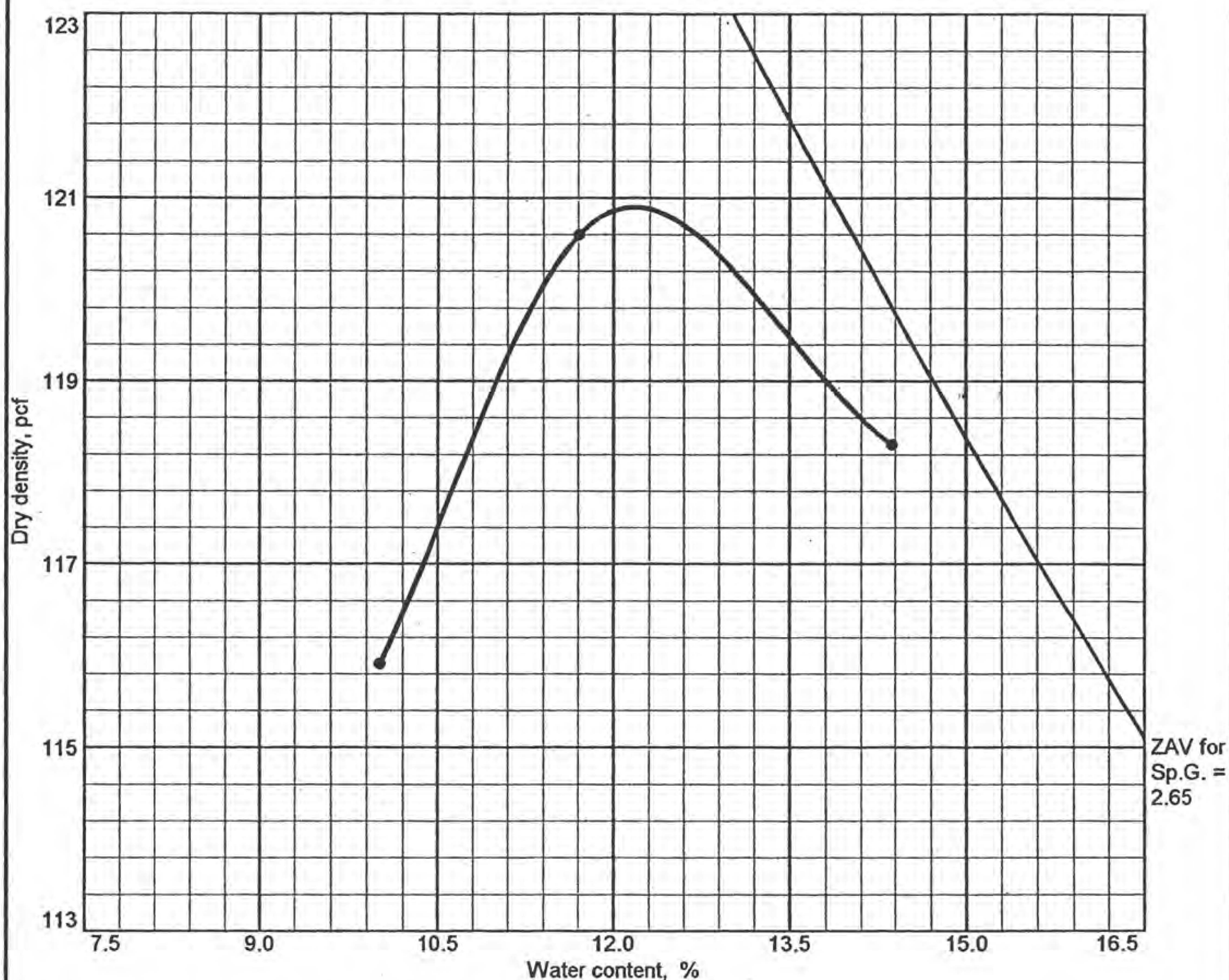
200 Wash (ASTM C-117)

Sample No.: B-11 (SH-7) **Source of Sample:** Olivehurst Public Utility District **Date:** 01/23/04
Location: **Elev./Depth:** 25'

Materials Testing, Inc.

Client: CH2M Hill
Project: Olivehurst Public Utility District
Project No: 0103-001 **Plate** 0400-007

COMPACTION TEST REPORT



Test specification: ASTM D 1557-91 Procedure A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
5'-17'	CL							

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 120.9 pcf Optimum moisture = 12.2 %	Brown Sandy Clay

Project No. 103 **Client:** CH2M Hill

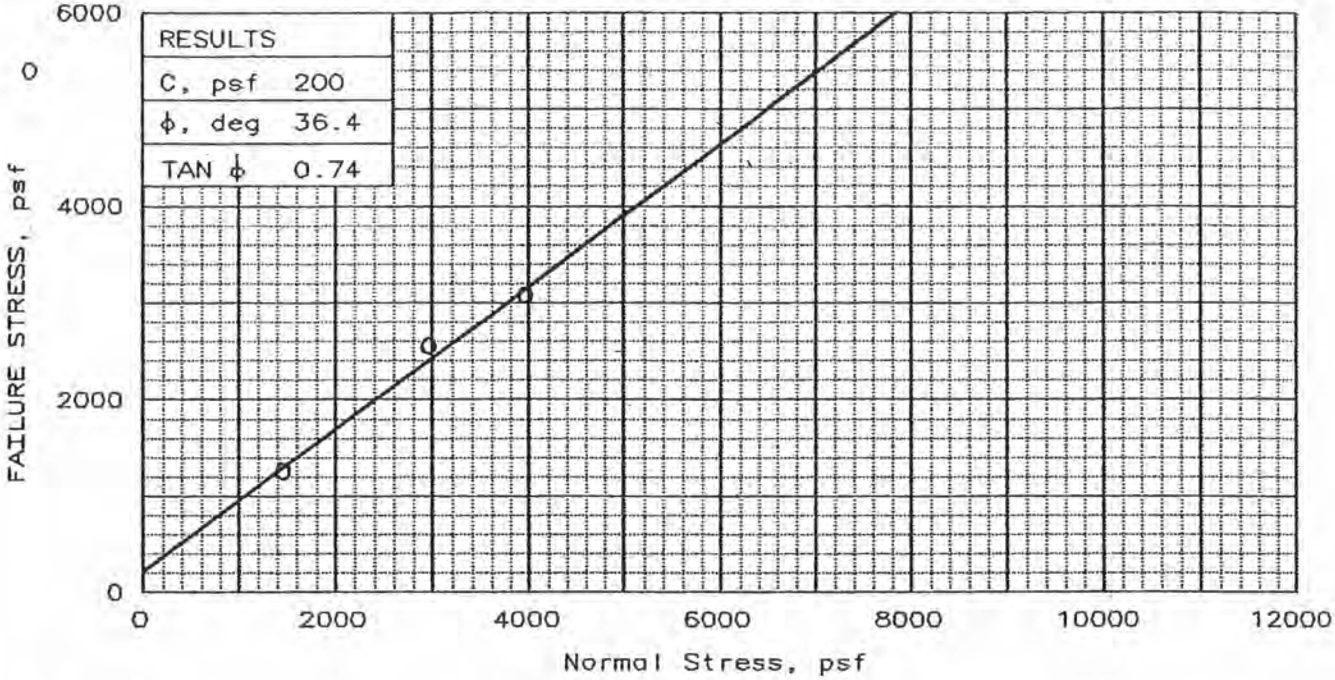
Project: OPUD WWTP Expansion

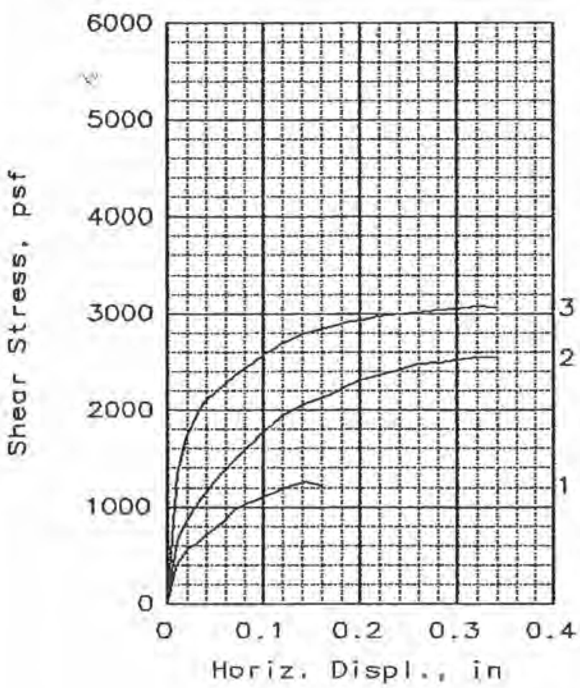
• **Source:** B-10 Bulk-1@5'-17' **Sample No.:** B-10 **Elev./Depth:** 5'-17'

Remarks:
1-23-04

MTI Materials Testing, Inc.

Report Number:





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	31.5	31.5	31.5
	DRY DENSITY, pcf	75.5	73.2	76.3 ← need to re calc
	SATURATION, %	73.8	69.5	75.4
	VOID RATIO	1.068	1.134	1.045
	DIAMETER, in	2.410	2.410	2.410
	HEIGHT, in	1.000	1.000	1.000
AT TEST	WATER CONTENT, %	38.2	38.8	38.4
	DRY DENSITY, pcf	76.8	77.4	79.4
	SATURATION, %	92.6	95.4	99.3
	VOID RATIO	1.032	1.016	0.966
	DIAMETER, in	2.410	2.410	2.410
	HEIGHT, in	0.982	0.945	0.961
NORMAL STRESS, psf		1500	3000	4000
FAILURE STRESS, psf		1253	2547	3072
DISPLACEMENT, in		0.15	0.32	0.32
ULTIMATE STRESS, psf				
DISPLACEMENT, in				
Strain rate, %/min				

SAMPLE TYPE: Tube
DESCRIPTION: Brown Clayey Silt

SPECIFIC GRAVITY= 2.5
REMARKS:

Report No.:

CLIENT: CH2M Hill

PROJECT: OPUD WWTP Expansion
188380.A1.01
SAMPLE LOCATION: B9 SH4@15'

PROJ. NO.: 103 DATE: 1-23-04

DIRECT SHEAR TEST REPORT

MATERIALS TESTING, INC.

UPDATED DRAFT PRELIMINARY GEOTECHNICAL BASIS OF DESIGN REPORT

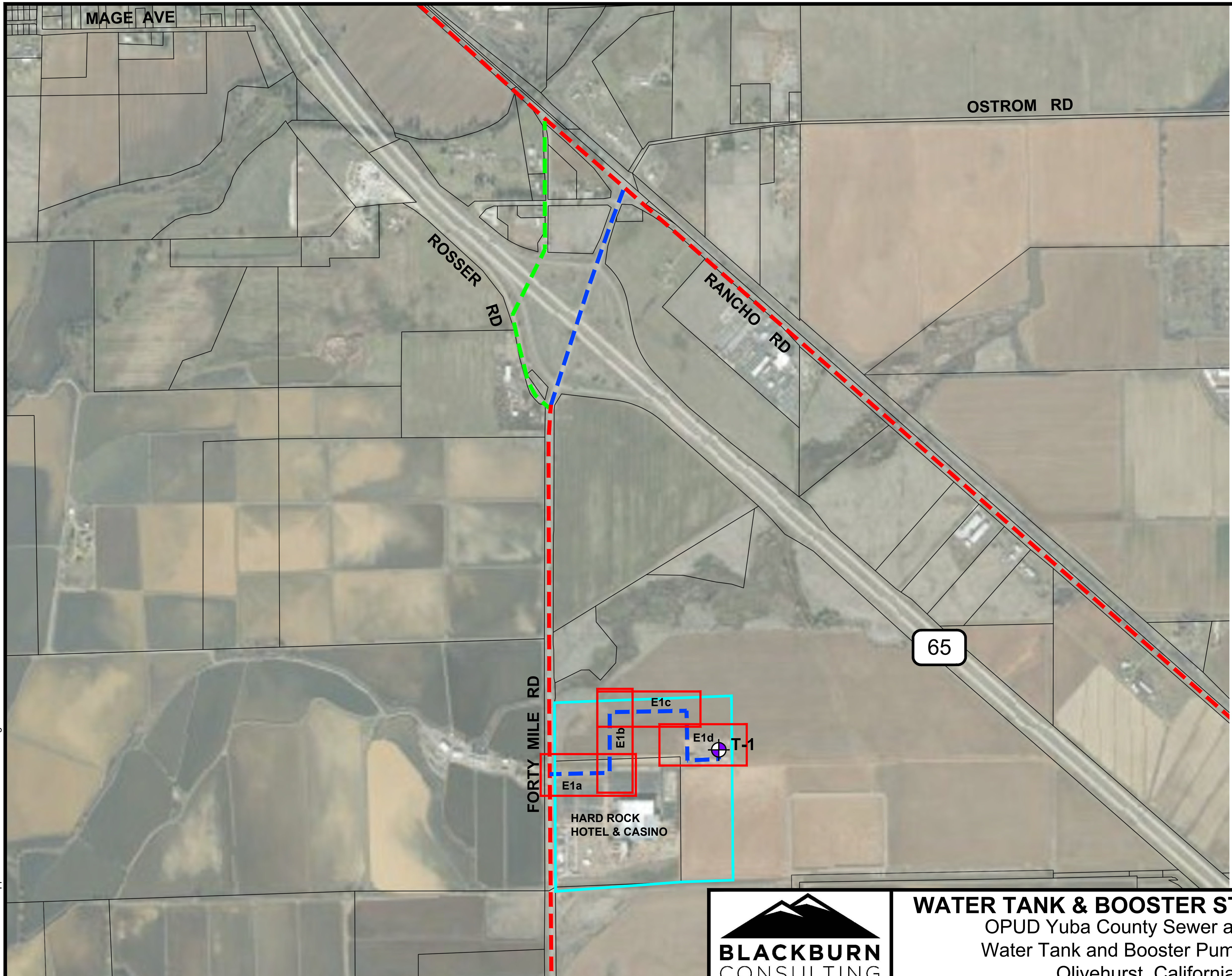
Olivehurst Public Utilities District

South Yuba Sewer and Water Infrastructure Project

Olivehurst, CA

APPENDIX E: Water Tank and Booster Station

E1: Site Plan
E2: Boring and Test Pit Logs Legend
Boring and Test Pit Logs
E3: Laboratory Test Results



N

SCALE 1" = 1,000'

LEGEND

Approximate Pipeline Water Only

Approximate Pipeline Sewer Only

Approximate Pipeline Sewer and Water

T-X Proposed Tank and Booster Pump Boring Locations

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

4/30/2021 3842.x AppE1 OPUD South Yuba Sewer.dwg

BLACKBURN CONSULTING

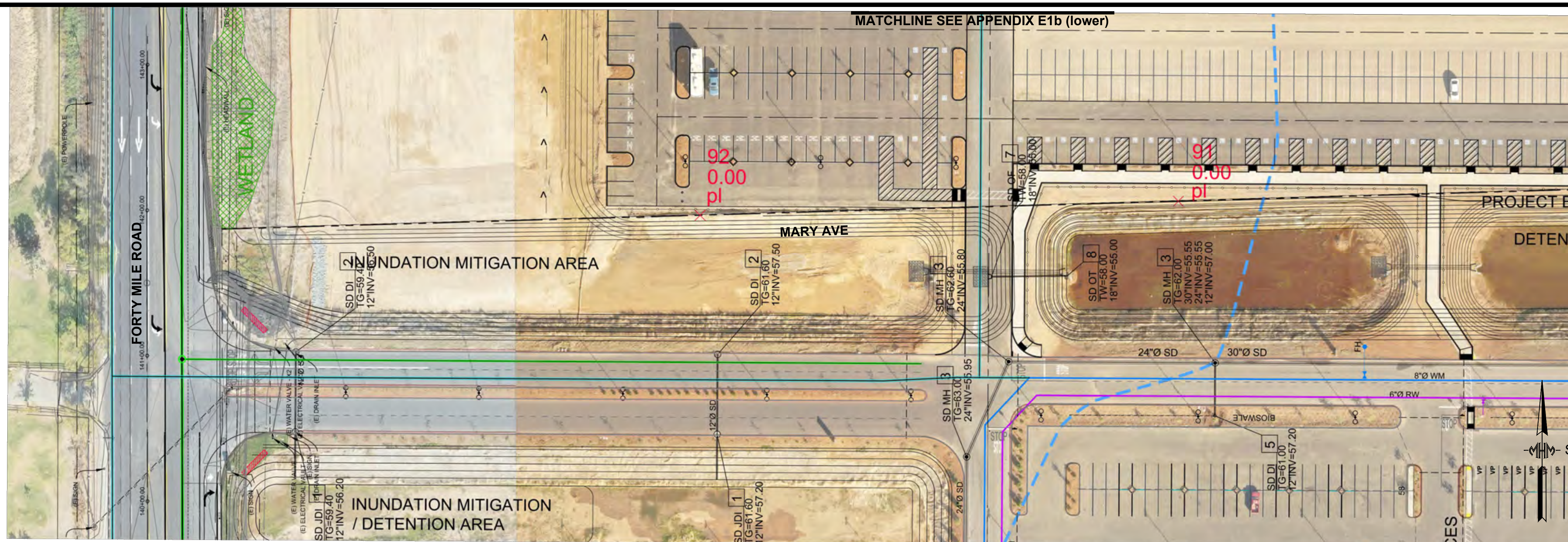
WATER TANK & BOOSTER STATION PLAN

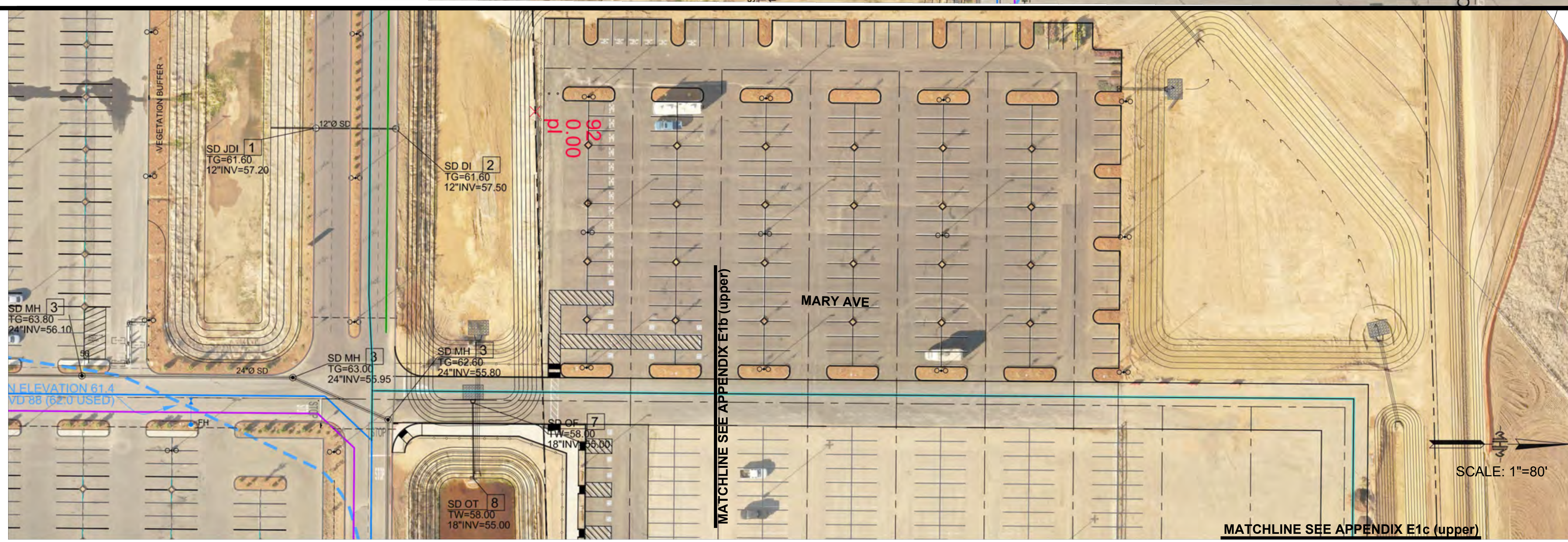
OPUD Yuba County Sewer and Water
Water Tank and Booster Pump Station
Olivehurst, California

File No. 3842.x

April 2021

Appendix E1a





LEGEND

- Approximate Pipeline Water Only
- Approximate Pipeline Sewer Only
- T-X Proposed Tank and Booster Pump Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

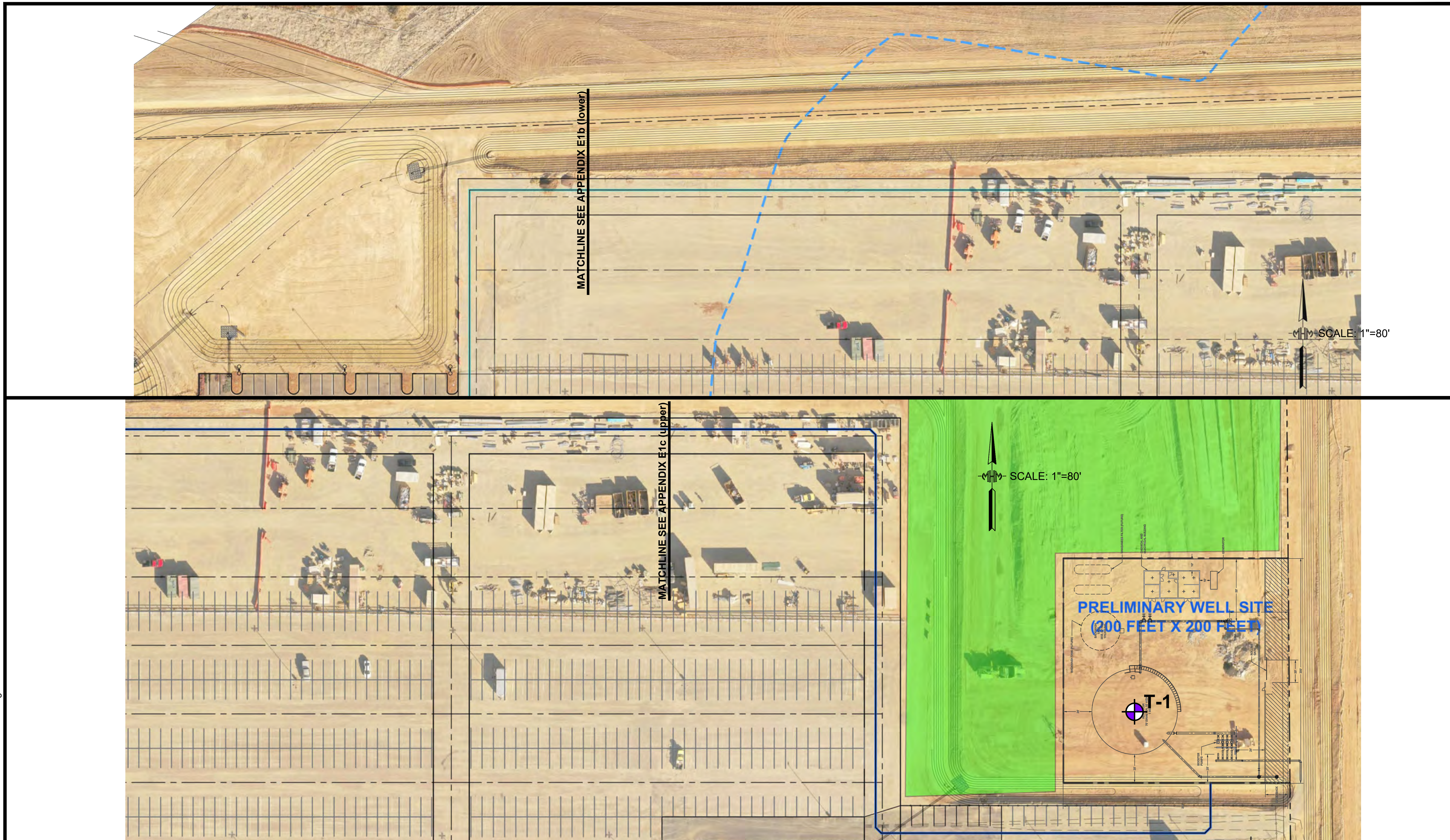
BLACKBURN CONSULTING

WATER TANK & BOOSTER STATION PLAN

OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x	
April 2021	
Appendix E1b	

4/30/2021 3842.x AppE1 OPUD South Yuba Sewer.dwg



LEGEND

- Approximate Pipeline Water Only
- Approximate Pipeline Sewer Only
- T-X Proposed Tank and Booster Pump Boring Location

Source: South County Sewer and Water Project, Volume 2 plans created by Jacobs, dated October 2020. Alignment Package Admin Draft 10-12-2020.

BLACKBURN CONSULTING

WATER TANK & BOOSTER STATION PLAN

OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

File No. 3842.x

April 2021

Appendix E1c

4/30/2021 3842.x AppE1 OPUD South Yuba Sewer.dwg

Appendix E2: Exploratory Borings for Water Tank and Booster Station not complete at the time of this Report

Appendix E3: Laboratory Tests for Water Tank and Booster Station not complete at the time of this Report

UPDATED DRAFT PRELIMINARY GEOTECHNICAL BASIS OF DESIGN REPORT

Olivehurst Public Utilities District

South Yuba Sewer and Water Infrastructure Project

Olivehurst, CA

APPENDIX F

Blackburn Response to Jacobs Comments on December 11, 2020 Draft Preliminary Geotechnical Basis of Design Report

Comment Number	Subject	Page Label	Status	Author	Date	Comments	2/3/2021 Blackburn Response
1	Text Box	18	✓	mtwede	14/01/2021	Suggest including pipeline borings with total depths and "not encountered" in depth to water column.	The previous table (3.1) includes all borings and the depth to ground water. Table 3.2 is intended to pull out and focus only on the borings in which we encountered ground water to show the information concisely in one location/table. We will revise the wording in the ground water column of table 3.1 to say "Not Encountered" rather than "NA" for borings that did not encounter ground water.
2	Text Box	22		mtwede	13/01/2021	Not sure how native soil can be used when it consists mostly of clay? see next comment.	See response to comment #4 below.
3	Text Box	22		mtwede	13/01/2021	Please provide estimated E' of native soil in case the trench width requires a composite E' to be used.	Our borings show the pipe zone will be withing stiff to hard clays. We will recommend a E' of 3,000 psi for the native, undisturbed soils.
4	Text Box	22		mtwede	13/01/2021	Was this meant to say if native soil meets these requirements, it is okay to use as fill? It would be difficult to separate out suitable material, and more reasonable to abide by Class 2 AB requirements for fill within roadways.	We are revising our report to recommend that native soil can be used for intermediate backfill provided it is free of debris and observable concentrations of organics. We are revising our report to recommend that if import fill is required for pipeline backfill, the import fill must meet the following: 100% passing the 1-inch sieve, 75% to 100% passing the #4 sieve, at least 12% passing the #200 seive, and a Plasticity Index not greater than 20.
5	Callout	23	✓	mtwede	14/01/2021	12" Seems excessive for trench compaction equipment	We will reword to state: "To protect the pipe, use a maximum loose lift thickness of 12 inches for the first lift of fill placed above the top of the pipe. Use a maximum thickiness of 8 inches for subsequent lifts."
6	Text Box	23		mtwede	13/01/2021	In roadways, 1 inch of settlement for 15 foot deep trench is not likely to be acceptable. Can this be reduced using Class 2 AB instead of the specified imported fill?	Agreed. We will reword to state: "The magnitude of potential trench backfill settlement will be largely dependent on the degree and uniformity of compaction; therefore, it is important that recommend backfill methods are perfromed and compaction checked at frequent intervals to limit potential settlement**.**" This is regardless of whether the backfill is AB or soil.
7	Text Box	44	✓	mtwede	14/01/2021	Can drained EFW values be used above some maximum depth?	The EFWs we recommended are valid for buoyant soil conditons or near-saturated soil and consider the range of backfill materials that could be used. Rereading this section, we now think that using the word "undrained" could be misleading/misunderstood. Therefore, we will replace "undrained EFW" with simply "EFW". We are performing additonal evalution of these values and may update them in our Revised Draft Preliminary Report.
8	Callout	48		KELLOGJA	08/01/21	Please verify that the design groundwater elevation for facilities at the WWTP is 15 feet below finish grade. Can the design groundwater be defined with a specific elevation as the finish grade across the site varies? a.It is assumed that the new EQ basin will be constructed at roughly the same elevations as the existing EQ basin which has a maximum depth of approximately 24 feet. It is assumed that the center of the new secondary clarifier will be approximately 19 feet below finish grade. Please provide groundwater design considerations/mitigations for structures founded below the design groundwater elevation.	We will updated ground water information and refer to design ground water elevations rather than depths. Jacobs informed us last year that the new EQ basin would be about be 10 to 11 feet deep and therfore about 5 to 7 ft deeper than the depth of the current basin at that loation. Based on that depth, we understood that it will not be below groundwater. We will address ground water conditions at the new for clarifier after we drill the exploations for the clarifer.
9	Callout	50		KELLOGJA	08/01/21	Please provide the site-specific response analysis. The clarifier structure design base shear is calculated per ASCE 7-16 section 15.7, and thus, the exceptions from ASCE 7 section 11.4.8 are not applicable.	We can complete a site-specific analysis. Is site-specific analysis requested at the water tank site also?
10	Callout	53	✓	KELLOGJA	08/01/21	The secondary clarifier will not be constructed 20 deep. The top of the circumferential perimeter foundation will likely be around 14ft minimum below finish grade, with the perimeter foundation bottom around 15.5ft below finish grade. Please revise the section as required.	We will provide recommendations appropriate to whatever depth is used. Please note, comment on page 48 says clarifier will be 19' below grade
11	Callout	60	✓	KELLOGJA	08/01/21	Joint spacing will be greater than 12ft and associated reinforcing will be selected to exceed the requirements of ACI 350-06 Table 7.12.2.1 to accommodate the joint spacing utilized. Please revise this section to not limit the joint spacing. If desired, the joint spacing criteria of ACI 350-06 can be referenced, or the joint spacing criteria can be deferred on the structural engineer.	We will remove limits and reference ACI 350-06
12	Callout	60	✓	KELLOGJA	08/01/21	Two different minimum slab and subgrade thicknesses are listed, 4" over 6" and 6" over 8". Note that the slab will have a 6" minimum thickness to provide proper cover over the reinforcing and clearances for waterstop, so the reference to the 4" minimum thickness can be deleted to avoid confusion. Please clarify if expansive soil is required to be considered.	Will replace 4" concrete over 6" AB with 6" concrete over 8" AB
13	Callout	120	✓	mtwede	13/01/2021	Clayey Sand (SC)	We will correct log P-06 to say "CLAYEY SAND (SC); very loose" instead of "SANDY Lean CLAY (CL); soft"
14	Callout	121	✓	mtwede	13/01/2021	Clayey Sand (SC)	We will correct log P-07 to say "CLAYEY SAND (SC); medium dense" instead of "SANDY Lean CLAY (CL); hard"
15	Callout	135	✓	mtwede	13/01/2021	(SP-SM)	We will correct log P-26 to say "(SP-SM)" instead of "(SP)"

UPDATED DRAFT PRELIMINARY GEOTECHNICAL BASIS OF DESIGN REPORT

Olivehurst Public Utilities District

South Yuba Sewer and Water Infrastructure Project

Olivehurst, CA

APPENDIX G

Important Information about This Geotechnical Engineering Report, Geoprofessional Business Association, 2019

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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e-mail: info@geoprofessional.org www.geoprofessional.org

Appendix F
Phase 1 Initial Site Assessment
(June 2021)

PHASE 1 INITIAL SITE ASSESSMENT

OPUD Yuba County Sewer and Water Infrastructure Project

Olivehurst, CA

June 2021

Prepared for:

Jacobs

2485 Natomas Park Drive, Ste. 600
Sacramento, CA 95833

Prepared by:

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File No. 3842.x
June 28, 2021

Mr. Steve DeCou
Vice President and Principal Program Manager
Jacobs Engineering Group
2485 Natomas Park Drive, Ste. 600
Sacramento, CA 95833

Subject: **PHASE 1 INITIAL SITE ASSESSMENT**
OPUD Yuba County Sewer and Water Infrastructure Project
Olivehurst, California

Mr. DeCou,

Blackburn Consulting (Blackburn) prepared this Phase 1 Initial Site Assessment (ISA) for the OPUD Sewer and Water Infrastructure Project located in Yuba County, California. The purpose of the ISA is to identify hazardous and potentially hazardous materials issues that may significantly impact the Project. Blackburn prepared this ISA in accordance with our May 14, 2020 proposal.

As always, Blackburn appreciates the opportunity to be part of your team. Please call if you have questions or require additional information.

Sincerely,

BLACKBURN CONSULTING

Laura Long
On behalf of

Matthew Kinney
Project Geologist II

Laura Long

Laura Long
Environmental Project Manager

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EXECUTIVE SUMMARY

Blackburn Consulting (Blackburn) prepared this Initial Site Assessment (ISA) for Jacobs Engineering Group (Jacobs) for the Olivehurst Public Utilities District (OPUD) Yuba County Sewer and Water Infrastructure Project (Project) in Olivehurst and unincorporated areas of Yuba County, California. Figure 1 presents the Vicinity Map. Jacobs, in cooperation with OPUD and Yuba County, proposes to construct new water and sewer utility infrastructure. All work is planned within existing right-of-way, except for the pump and lift station locations which have not been determined.

The purpose of this ISA is to identify Recognized Environmental Conditions[1] (RECs), Historical Recognized Environmental Conditions (HRECs), and potential RECs, collectively referred to herein as RECs, that may be present within or adjacent to the Project limits. We prepared this ISA in general conformance with the American Society of Testing and Materials (ASTM) Standard E1527-13, "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process".

The following section summarizes the RECS identified within and adjacent to the Project limits. Blackburn further discusses these conditions in the body of this ISA.

<u>RECs Located Within the Project Limits</u>

APN 014-270-002: OPUD Wastewater Treatment Facility - Public Utilities District 3908 Mary Avenue

A 2,500-gallon diesel above ground tank (AST) is located at this facility. There are no indications of a release of diesel to soil or groundwater.

Recommendation: No additional assessment.

<u>RECs Located Adjacent to the Project Limits</u>

Four sites located immediately adjacent to the project alignment were identified with high risk RECs. These sites are listed in Section 3.2.2 and are identified on Figures 2a-c. Documented impacts to soil or groundwater are present on or have been remediated at these adjacent parcels. There is a potential that impacts from these parcels extend into the right-of-way (ROW) adjacent to the parcel. There is a potential to encounter residual contamination during excavation.

Recommendation: If excavation is planned within the right-of-way (ROW) adjacent to these parcels, conduct a Phase II screening of the soil within the area of excavation to assess the presence of potential hazardous materials.

[1] Blackburn uses the term Recognized Environmental Condition (REC) in general compliance with ASTM E1527-13, which defines the meaning as *"The presence or likely presence of any hazardous substances or petroleum products in, on, or at a property (1) due to any release to the environment, (2) under conditions indicative of a release to the environment or (3) under conditions that pose a material threat of a future release to the environment. The term is not intended to include de minimus conditions that generally do not present a threat to human health or the environment and generally would not be the subject of an enforcement action if brought to the attention of the appropriate regulatory agencies. Conditions determined to be de minimus are not recognized environmental conditions*."

- **APN 014-143-026: Tower Mart #60/Cheaper #60**, 1976 McGowan Parkway

  Two single-walled 10,000-gallon gasoline underground storage tanks (USTs) tanks were removed in 1986. One 8,000-gallon diesel and three 12,000-gallon gasoline tanks were installed in 2004. A release of gasoline and diesel to soil and groundwater occurred sometime before 2003. Groundwater monitoring in April 2005, did not identify detectable amounts of constituents. The regulatory case was closed in 2008. Potential contaminants of concern (COC) include total petroleum hydrocarbons (TPH) as diesel (TPH-d), gas (TPH-g) and motor oil (TPH-mo), metals, and benzene/toluene/ethylbenzene/xylene (BTEX).
- **APN 014-510-033: Marysville Forest Products/Erickson Group Limited**, 4083 Rancho Road

  Two USTs were reportedly removed after a leak was detected. A reported release of diesel to soil was recorded in 1992. Documentation was not found to verify impacted soil was excavated. The regulatory case was closed on July 14, 1993. The site was formerly occupied by a wood treating facility. Pentachlorophenol (PCP) was used as an anti-fungal wood treatment. PCP was released to soil during site operations. Site soil is also impacted with volatile organic compounds (VOCs) from the maintenance shop and dioxins at the ash disposal and burn areas. The horizontal and vertical extent of impacts is unknow. The Regional Water Quality Control Board (RWQCB) regulatory case is currently open. Potential COCs include TPH-d, TPH-g, TPH-mo, metals, BTEX, VOCs, dioxins, and PCP.
- **APN 014-280-065: PG&E North Valley Materials**, 3736 Rancho Road

  One 10,000-gallon AST of unknown contents, one 8,000-gallon gasoline UST, and one 12,000-gallon diesel UST are located at this facility. This facility operates as a staging area for PG&E operations throughout the area. A release of diesel to soil from a UST was reported on November 3, 1992. Contaminated soil was removed from the facility, and a No Further Action Letter was issued on March 1, 1993. Potential COCs include TPH-d, TPH-g, TPH-mo, metals, and BTEX
- **APN 014-270-079: Flying U Ranch**, 3718 Forty Mile Road

  A 13,500-gallon AST of unknown fuel type is identified at the site. The location of the AST was not identified during site reconnaissance. Potential COCs include TPH-d, TPH-g, TPH-mo, metals, and BTEX.

Five sites located immediately adjacent to the project alignment were identified with medium risk RECs. These sites are listed in Section 3.2.2 and are identified on Figures 2a-c. Fuel storage tanks are present on these adjacent parcels. There is no evidence in the records review to suggest releases have occurred from the tanks or hazardous material issues from these sites will impact the Project, however, there is a potential to encounter residual contamination at these sites. If plans for acquisition change to include one or more of these sites, a Phase II Environmental Site Assessment to further investigate potential hazardous materials within the acquisition areas will be necessary.

- **APN 014-280-046: Alfaro Farms/Jean Pierre Alfaro**, 3374 Forty Mile Road

  This farm is listed in the searched databases as having a 15,000-gallon AST of unknown contents. Violations were reported for failure to properly label hazardous waste containers, and failure to properly store and label used batteries.

- **APN 014-360-014: Frank Hofman Ranch**, 3002 Forty Mile Road

  This business is listed as a hazardous waste generator. A UST of unknown contents and volume was located at the site. The Yuba UST database lists the UST status as closed. No spills or leaks were reported at this facility.
- **APN 014-510-018: Livingston Concrete**, 2571 Rosser Road

  This facility is listed in the searched databases as operating an AST. Violations are reported and include failure to provide training to oil-handling personnel.
- **APN 014-510-021: Roger L. Murray**, 3938 Shimer Road

  This facility is listed as having a 5,000-gallon AST storing an unknown fuel type. The AST is located at the southeast corner of the parcel, adjacent to the project. The AST had secondary containment, but the AST is within twenty feet of the project limits.
- **APN 015-060-075: Tollcrest Dairy,** 3355 Virginia Road, Wheatland

  A 10,200-gallon AST is located at this facility. The AST is not located on the west side of the parcel near the project alignment. No additional information is provided in the records search.

Three sites located north of the project alignment on Olivehurst Avenue were identified with high risk RECs. The project limits do not currently extend to these sites. These sites are listed in Section 3.2.2 and are identified on Figures 2a-c. Documented impacts to soil or groundwater are present on or have been remediated at these parcels. There is a potential that impacts from these parcels extend into the right-of-way (ROW) adjacent to the parcel. There is a potential to encounter residual contamination during excavation.

Recommendation: If the project limits are extended to include excavation within the ROW adjacent to these parcels, conduct a Phase II screening of the soil within the area of excavation to assess the presence of potential hazardous materials. Potential COCs include TPH-d, TPH-g, TPH-mo, metals, and BTEX.

- **APN 013-072-011: Gee Property**, 4880 Olivehurst Avenue

  The site is currently vacant but was formerly occupied by a fueling station. Two gasoline underground storage tanks (USTs) were removed in 1988 and one UST removed in 2019. Soil samples from the UST excavation indicated a release had occurred. Low levels of total petroleum hydrocarbons (TPHs) were detected in groundwater. The regulatory case was closed on January 10, 2020.
- **APN 013-081-015: AGV Corner Market**, 4881 Olivehurst Avenue

  The site is an active gas station. Currently a 20,000-gallon compartmentalized gasoline and diesel tank is in the same excavation area as the former UST. A release of gasoline to soil and groundwater occurred at this facility sometime prior to 2001. The most recent groundwater monitoring event conducted at the facility occurred in May 2011 and demonstrated that groundwater beneath the facility has residual impacts from gasoline related constituents. The regulatory case was closed on June 25, 2012.
- **APN 013-130-060: Former E-Z Serve**, 4867 Olivehurst Avenue

  Three USTs were removed in 1989 and a release of gasoline was discovered. Soil and groundwater were impacted. Groundwater monitoring was conducted from sometime before 2004 until 2017.

A No further Action letter was issued by the CVRWQCB and the regulatory case was closed on November 22, 2019.

General Contamination Issues

The following general contamination issues were identified within the Project limits.

Yellow traffic stripes
Yellow traffic stripes are known to contain heavy metals, such as lead and chromium, at concentrations in excess of the hazardous waste thresholds established by the *California Code of Regulations* and may produce toxic fumes when heated.

Recommendation: If the Project includes removal of yellow traffic striping, remove and dispose of in accordance with Caltrans Standard Special Provisions for Hazardous Waste.

Aerially Deposited Lead (ADL)
ADL has been found to occur in soils adjacent to highways and high use roadways. The lead is presumably from the historical use of leaded gasoline and subsequent exhaust emissions. There is potential for encountering ADL during construction and grading activities within the proposed Project limits along its entirety. Some of these roadways have been present in various alignments since at or before 1910 and, therefore, have the potential to be impacted with ADL.

Recommendation: A soil screening to evaluate the potential presence of ADL within the Project limits should be performed. An appropriate soil management plan will need to be developed for soil containing significant concentrations of ADL.

Southern Pacific Railroad

An active railroad is adjacent to the east side of Rancho Road. Soils located adjacent to railroad tracks may be impacted by on-going railroad operations. Potential contaminants at these locations commonly include petroleum hydrocarbons, semi-volatile organic compounds (SVOCs), heavy metals, and pesticides.

Recommendation: Conduct a limited subsurface soil screening for potential contaminants in the upper 1.5 feet where soil will be disturbed adjacent to the railroad.

Asbestos Containing Material (ACM) and Lead in Buildings Materials
Structures constructed pre-1989 have the potential to contain ACM/Lead materials. Aerial photographs identify structures along the project alignment as developed prior to 1989.

Recommendation: If parcels are acquired as part of the Project any structures on those parcels should be evaluated for the presence of lead and asbestos containing materials. Any structure to be modified or demolished as part of the Project must be surveyed for the presence of ACM and Lead by a certified Asbestos Inspector prior to building demolition/modification.

Transformers
Our scope did not include an inventory of past and present transformers. We observed pole-mounted transformers and power lines within the existing right-of-way.

Recommendation: If the relocation of power facilities or high voltage power lines is required, existing transformers should be checked for the presence of PCBs or other hazardous materials by the utility owner, and if present, properly remediated and disposed. Identification and remediation of old transformers is the responsibility of the utility owner.

<u>Organochlorine Pesticides (OCPs)</u>
Historical topographic maps from 1947 and 1949 depict an orchard in the southeastern ½-mile alignment of Rancho Road and the eastern 1/3-mile alignment of Morrison Road.

Recommendation: Conduct a shallow soil screening to evaluate the potential presence of OCPs within the footprint of the former orchard in the Project limits.

1 INTRODUCTION

Blackburn completed this Phase 1 Initial Site Assessment (ISA) for the OPUD Sewer and Water Infrastructure Project (Project) located in Yuba County California. The purpose of the ISA is to identify Recognized Environmental Conditions[2] (RECs), Historical Recognized Environmental Conditions (HRECs), and potential RECs, collectively referred to herein as RECs, that may be present within and/or adjacent to the Project limits.

To conduct this ISA, Blackburn:

- Reviewed historical aerial photographic coverage and topographic map coverage for the Project area and surrounding properties for indications of potential sources of contamination.
- Performed federal, state, and county records review for indications of the use, misuse, or storage of hazardous and/or potentially hazardous materials on or near the Project area.
- Conducted a site inspection on September 9, 2020 to observe current land use and indications of potential contamination, as well as hazardous and potentially hazardous waste issues for the Project area.
- Performed state records review of the on-line regulatory databases GeoTracker and EnviroStor, to determine if known site impacts and/or previous environmental work exist for the Project area.
- Reviewed the general site geology, groundwater, and soil conditions through published maps and literature.

Blackburn prepared this report for Jacobs Engineering Group (Jacobs) and the project design team to use during design and construction. This report shall not be used or relied upon by others, or for different locations or improvements without the written consent of Blackburn.

2 PROJECT LOCATION AND DESCRIPTION

2.1 Location and Description

The Project spans approximately 12.2 miles within the town of Olivehurst and surrounding areas. The Project alignment includes the OPUD Wastewater Treatment Plant located on Mary Avenue, and portions of the following alignments:

- Olivehurst Avenue from 7th Avenue to approximately 170 feet south of 11th Avenue;
- Mary Avenue from OPUD wastewater treatment plant to McGowan Parkway;
- McGowan Parkway from Mary Avenue to Rancho Road;

[2] BCI uses the term Recognized Environmental Condition (REC) in general compliance with ASTM E1527-13, which defines the meaning as "*The presence or likely presence of any hazardous substances or petroleum products in, on, or at a property (1) due to any release to the environment, (2) under conditions indicative of a release to the environment or (3) under conditions that pose a material threat of a future release to the environment. The term is not intended to include de minimus conditions that generally do not present a threat to human health or the environment and generally would not be the subject of an enforcement action if brought to the attention of the appropriate regulatory agencies. Conditions determined to be de minimus are not recognized environmental conditions.*"

- Olive Avenue from McGowan Parkway to approximately 100 feet to the north, then east crossing under Highway 65 to the northern terminus of Rancho Road;
- Rancho Road from its northern end to Morrison Road;
- Morrison Road from Highway 65 to Forty Mile Road;
- Forty Mile road from the Toyota Amphitheater to Rancho Road;
- Slaughterhouse Road from Forty Mile Road to northwest for approximately 0.4 miles, crossing Highway 65 to the western terminus of Plute Road;
- Plute Road from its westernmost extent to Shimer Road; and
- Shimer Road from Plute Road to Rancho Road.

Pump and lift stations locations will be installed on privately owned parcels, however these locations have not been finalized.

The Project location with Project limits is shown on Figure 1, Vicinity Map. Site-specific features are shown on Figures 2a-e.

2.2 Geology and Physical Setting

The site lies within the Great Valley Geomorphic Province of California, which is a large, elongated, northwest-trending structural trough. The Province is subdivided into two major divisions designated as the Sacramento and San Joaquin Valleys. These valleys have been filled to their present elevation with thick sequences of sediment, ranging in age from Jurassic to present day, creating a nearly flat-lying alluvial plain that extends from the Tehachapi Mountains in the south to the Klamath Mountains in the north. The western and eastern boundaries of this province are formed by the California Coast Ranges and the Sierra Nevada, respectively.

The study area is located on an alluvial plain in the Sacramento Valley located approximately 2.2 miles east of the Feather River at its closest point. The underlying deposits are mapped by Saucedo, G.J. and Wagner D.L. (1981) as alluvium, natural levee and channel deposits, basin deposits, Modesto Formation, and the Riverbank Formation. This formation is composed of fine-grained soils such as clay, silts, sand and gravel.

The site topography is generally flat, except near Highway 65 and Highway 70, where the topography slopes toward the highways. The site elevations, excluding areas near the Highways, range between 55 feet above mean sea level (msl) in the western portion of the Project and 75 feet above msl in the easternmost portion of the Project.

2.3 Surface Water, Groundwater, Wells

The Site lies within the South Yuba Subbasin where groundwater flow direction is generally to the southwest toward the Feather River, though flow directions vary both locally and seasonally. The study area is east of the Feather River, south of the Yuba River, and north of the Bear River. Blackburn reviewed groundwater level data made available at California Department of Water Resources (DWR) website www.water.ca.gov/waterdatalibrary. The groundwater beneath the site rises to within approximately 40 feet of the ground surface for up to six months of the year. Depth to groundwater during the rest of the year is approximately 45 feet below ground surface. Surface/storm water is directed by sidewalk curb, gutter and drains. The general flow direction is to the south and west towards the Feather River, except in area in proximity to Hutchison Creek and Reed Creek, which transect the Project in multiple areas flowing southwest toward the Feather River.

2.4 Current Land Use

Most of the Project area consists of roadways which traverse rural areas of Yuba County, with a portion of the project limits transecting the town of Olivehurst. Land adjacent to the Project along Rancho Road is zoned as agricultural industrial and light industrial. Land along Morrison Road is designated as sports entertainment district and employment center district. Land adjacent to Forty Mile Road is designated for agricultural use and sports entertainment. Land near the OPUD Wastewater treatment Facility on Mary Road is designated for use as public utilities land as well as single-family residential.

2.5 Historic Land Use

Land use adjacent to the project limits varies throughout the project alignment. Blackburn reviewed historical aerial photography, topographic maps, and Sanborn maps to identify conditions that may indicate potential hazardous materials issues within the Project limits.

2.5.1 Aerial Photograph Review

Blackburn reviewed the following historic aerial photography to identify conditions that may indicate potential hazardous materials issues within or adjacent to the Project area. The listing includes aerial photo flight year, source, scale, and a brief description of observed conditions. Copies of aerial photographs are provided in Appendix A.

Aerial Photograph Review

The following aerial photos were reviewed:

1947 Photo by Agriculture and Soil Conservation Service, Scale 1" =2,000'
1954 Photo by Army Mapping Service, Scale 1" =2,000'
1977 Photo by USGS, Scale 1" =2,000'
1987 Photo by USGS, Scale 1" =2,000'
1998 Photo by USGS, Scale 1" =2,000'
2005 Photo by National Agriculture Information Program (NAIP), Scale 1" =2,000'
2009 Photo by NAIP, Scale 1" =2,000'
2014 Photo by NAIP, Scale 1" =2,000'
2018 Photo by NAIP, Scale 1" =2,000'

Areas of the Project limits south of Morrison Road along Forty Mile Road are not shown on Aerial Photographs. This includes the area that is now the Toyota Amphitheater.

1947: Improved roads, Rancho Road, Forty Mile Road, Morrison Road, and McGowan Road are depicted in their present-day alignments. The town of Olivehurst is visible north of the Project limits. Agricultural use is visible along the alignment. Rural residences are visible near the project alignment. Hutchinson Creek and Reed Creek transect the project alignment in multiple locations similar to present day. A large industrial facility is adjacent to the north side of Rancho Road in the location that is currently the Marysville Forest Products/Erikson Group Limited facility.

1954: Additional development of roads and residences in the south portion of Olivehurst. Olivehurst is generally in its present-day footprint.

1977: Highway 65 transects the project limits. Highway 70 appears under construction and transects the project limits. What is now a PG&E facility is adjacent to the south of the Project limits on Rancho Road. Mary Road appears on the map, along with the OPUD wastewater treatment facility. Additional residences appear along Morrison Road. A commercial/industrial facility is at the intersection of Slaughterhouse Road and Forty Mile Road. A mobile home park is at the intersection of Olive Avenue and McGowan Parkway. Additional residences and commercial businesses appear along the Project alignment within the town of Olivehurst.

1987: The OPUD wastewater Treatment Facility appears to expand to the south.

1998: No significant changes.

2005: An additional commercial facility is adjacent to the south of Rancho Road southeast of the PG&E facility.

2009: No significant changes.

2014: No significant changes.

2018: The Project alignment and surrounding area appear as they are today.

2.5.2 Topographic Map Review

Blackburn reviewed the following topographic maps for features that may indicate an impact to the Project. This summary includes noted changes within and adjacent to the Project location as recorded on the maps. Copies of the topographic maps are provided in Appendix B.

1910 Wheatland 7.5-minute Quad, Scale 1:24,000,
1911 Ostrom 7.5-minute Quad, Scale 1:24,000,
1947 Wheatland 7.5-minute Quad, Scale 1:24000,
1949 Wheatland 7.5- and 15-minute Quad, Scale 1:24000,
1952 Olivehurst 7.5-minute and Marysville 15-minute Quads, Scale 1:24,000
1973 Olivehurst and Wheatland 7.5-minute Quads, Scale 1:24000, and
2015 Olivehurst and Wheatland 7.5-minute Quads, Scale 1:24000.

1910 and 1911: Western Pacific Railroad and the Marysville Line of the Southern Pacific Railroad are depicted on the map near the project alignment. The development of Ostrom is depicted near the present-day intersection of Highway 65 and Forty Mile Road. Structures are depicted sparsely near the project alignment along present-day Forty Mile Road, Morrison Road, and Rancho Road. Hutchinson Creek and Reed Creek are depicted near their present-day alignments transecting the Project. Plumas Lake is depicted approximately one mile south and west of the Project limits.

1947, 1949, and 1952: The town of Olivehurst, including Olivehurst Avenue, what is now Mary Road, and McGowan Road (Parkway) are depicted, as are residences and structures along their alignments. A commercial or industrial facility is depicted to the north of what is now Rancho Road between Reed Creek and Hutchinson Creek. This facility is in the same location as the present-day Marysville Forest Products/Erikson Group Limited facility. An orchard is depicted in the southeastern portion of the project alignment encompassing the intersection of present-day Highway 65, Morrison Road, and Rancho Road.

1973: The OPUD wastewater treatment facility is depicted in its present-day location. Several additional structures are depicted at the Marysville Forest Products/Erikson Group Limited facility. Highways 65 and 70 are depicted in their present-day alignments. A mobile home park is depicted at the intersection of Olive Drive and McGowan Parkway. The orchard is no longer depicted near the southeastern corner of the Project alignment. Additional commercial/industrial facilities are depicted in the area between Rancho Road and Highway 65. Additional roads and residential structures are depicted within the town of Olivehurst in the vicinity of Olivehurst Avenue and McGowan Parkway.

2015: Structures and land uses are not depicted on this map. The town of Olivehurst is depicted as it is today.

2.5.3 Sanborn® Map Review

Environmental Risk Information Services (ERIS) searched the Sanborn Maps Library for the Site and surrounding area. The ERIS search did not return Sanborn Maps (fire insurance) covering the Site or the surrounding area. Appendix C contains ERIS's Sanborn Map Report.

3 RECORDS REVIEW

3.1 County, State and Federal Records Review

ERIS, a commercial data base search firm, performed a radius search for the study area on August 20, 2020. The search includes a review of county, state, federal and ERIS proprietary databases. The maximum search radius is 1 mile from the outline of the Project area. Sites with adequate address information are plotted on ERIS's site plan "Map: 1.0 Mile Radius". ERIS lists sites with inadequate address information in their "Unplottable Summary" and does not provide mapped locations. Blackburn reviewed the 13 "unplottable sites" identified by ERIS and determined that only the PG&E facility, which is located on Rancho Road though identified on Morrison Road in the report, is located adjacent to the Project area. The complete EDR report is included in Appendix D.

3.2 Summary of Records Search

Blackburn reviewed the databases for facilities within ½-mile of the Project alignment with a potential to impact project operations. Our review of records identified the following sites with potentially hazardous material conditions at, adjacent to, or considered close enough to the project site to potentially impact the project. 50 facilities within a ½-mile radius of the Project are listed in the Records Search. Below, we summarize the database records.

3.2.1 RECs Within the Project Alignment

APN 014-270-002: OPUD Wastewater Treatment Facility/Olivehurst Public Utilities District/Western Water Constructors, Inc., 3908 Mary Avenue, Olivehurst, CA

Databases: Yuba CUPA, AST, FINDS, HAZNET, HIST Manifest, ICIS, YUBA UST, CERS TANK, RCRA NonGen
A 2,500-gallon diesel AST is located at this facility. No additional information is provided in the records search.

3.2.2 RECs Adjacent to the Project Alignment (Medium and High Risk)

The following sites have conditions such as above ground or underground fuel storage tanks that are considered RECs to the project. The RECs include releases of petroleum hydrocarbons or other hazardous materials that may have resulted in residual impacts within the Project alignment.

APN 013-072-011: Gee Property, 4880 Olivehurst Avenue, Olivehurst, CA
Database: GeoTracker

Formerly occupied by a fueling station. Two gasoline USTs were removed in 1988. Soil samples from the UST excavation indicated a release had occurred. An additional UST was excavated in 2019. Low levels of TPH as diesel was detected in groundwater. Low concentrations of motor oil were detected in stockpile sampling. The regulatory case was closed on January 10, 2020. The site is within the service area of OPUD.

APN 013-081-015: AGV Corner Market, 4881 Olivehurst Avenue, Olivehurst, CA
Database: GeoTracker

The site is an active gas station. Currently a 20,000 gallon compartmentalized gasoline and diesel tank is in the same excavation area as the former UST. A release of gasoline to soil and groundwater occurred at this facility sometime prior to 2001. The most recent groundwater monitoring event conducted at the facility occurred in May 2011 and demonstrated that groundwater beneath the facility has residual impacts from gasoline related constituents. The regulatory case was closed on June 25, 2012.

APN 013-130-060: Former E-Z Serve, 4867 Olivehurst Avenue, Olivehurst, CA
Databases: GeoTracker, LUST

On August 30, 1989, three USTs were removed, and a release of gasoline was discovered. Soil and groundwater were impacted. Groundwater monitoring was conducted from sometime before 2004 until 2017. A No further Action letter was issued by the CVRWQCB and the regulatory case was closed on November 22, 2019.

APN 014-143-026: Tower Mart #60/Colonial Energy CE/Fred and Liquor 60/Cheaper #60, 1976 McGowan Parkway, Olivehurst, CA
Databases: Delisted TNK, Emissions, GeoTracker, FINDS/FRS, Yuba CUPA, LUST, HHSS, HAZNET, Yuba UST, CERS TANK, UST, Emissions, HIST TANK, RCRA NonGen

In 1986, two single-walled 10,000-gallon fuel tanks were removed from the site. In 2004 four USTs were installed including one 8000-gallon diesel and three 12,000-gallon gasoline tanks. This fueling station is a hazardous waste generator. A release of gasoline and diesel to soil and groundwater occurred sometime before 2003. Groundwater monitoring in April 2005, did not identify detectable amounts of constituents. The regulatory case was closed on January 31, 2008.

APN 014-270-079: Flying U Ranch, 3718 Forty Mile Road, Olivehurst, CA
Databases: Yuba CUPA, AST, CERS TANK

A 13,500-gallon AST of unknown fuel type is identified at the site. The CERS TANK database identifies violations including failure to dispose of hazardous waste within 180 days, and failure to inspect hazardous waste storage areas weekly.

APN 014-280-046: Alfaro Farms/Jean Pierre Alfaro, 3374 Forty Mile Road, Olivehurst, CA
Databases: AST, RCRA NonGen, Yuba CUPA, CERS TANK

This farm is listed in the searched databases as having a 15,000-gallon AST of unknown contents. Violations were reported for failure to properly label hazardous waste containers, and failure to properly store and label used batteries.

APN 014-280-065: PG&E North Valley Materials, 3736 Rancho Road, Olivehurst, CA
Databases: Yuba CUPA, Delisted TNK, AST, HHSS, Yuba UST, HIST TANK, Delisted CTNK, RCRA SQG, CHMIRS, LUST

One 10,000-gallon AST of unknown contents, one 8,000-gallon gasoline UST, and one 12,000-gallon diesel UST are located at this facility. This facility operates as a staging area for PG&E operations throughout the area. A release of diesel to soil from a UST was reported on November 3, 1992. Contaminated soil was removed from the facility, and a No Further Action Letter was issued on March 1, 1993. The CHMIRS database lists this facility as having a leak of 5-10 gallons of insulating oil (no PCB content).

APN 014-360-014: Frank Hofman Ranch, 3002 Forty Mile Road, Olivehurst, CA
Databases: Yuba CUPA, HHSS, Yuba UST, HIST TANK

This business is listed as a hazardous waste generator. A UST of unknown contents and volume was located at the site. The Yuba UST database lists the UST status as closed. No spills or leaks were reported at this facility.

APN 014-510-018: Livingston Concrete, 2571 Rosser Road, Olivehurst, CA
Databases: Yuba CUPA, CERS TANK, Emissions

This facility is listed in the searched databases as operating an AST. Violations are reported and include failure to provide training to oil-handling personnel.

APN 014-510-021: Roger L. Murray, 3938 Shimer Road, Olivehurst, CA
Databases: Yuba CUPA, AST, Delisted CTNK

This facility is listed as having a 5,000-gallon AST storing an unknown fuel type. No additional information is provided in the records search.

APN 014-510-033: Marysville Forest Products/Erickson Group Limited/Sun Gro Horticulture/Berdex Forest Products, Inc., 4083 Rancho Road, Olivehurst, CA
Databases: RCRA SQG, Yuba CUPA, Cleanup Sites, LUST, EnviroStor, HHSS, Yuba UST, Delisted HAZ, Emissions, HIST TANK, RCRA NonGen

Marysville Forest Products is a hazardous waste generator that reported a release of diesel to soil on June 18, 1992. Impacted soil was excavated and the regulatory case was closed on July 14, 1993.

Erickson Group Limited is a former wood treating facility. Pentachlorophenol (PCP) was released to soil during site operations. Soil remediation occurred and groundwater monitoring indicates that groundwater was not impacted by the release. The regulatory case is currently open. As of June 18, 2020, a Phase 1 ESA was requested by a potential buyer of the property.

APN 015-060-075: Tollcrest Dairy, 3355 Virginia Road, Wheatland, CA
Databases: Yuba CUPA, AST, CERS TANK

A 10,200-gallon AST is located at this facility. The AST is not located on the west side of the parcel near the project alignment. No additional information is provided in the records search.

3.2.3 Sites identified Adjacent to the Project Alignment (Low Risk)

The following sites are listed in the searched database for storage and handling of hazardous materials and other hazardous materials conditions that are not considered RECs to the project. If these parcels are acquired as part of the project, additional assessment should be conducted.

Frankenstein Motors/McCinskey's Frankenstein Motors, 3906 Shimer Road, Olivehurst, CA
Databases: Yuba CUPA, CERS HAZ, RCRA NonGen

This facility is identified in the Yuba CUPA and CERS HAZ databases as a hazardous waste generator. This database identifies a violation on September 27, 2016 for failure to manage used oil and/or fuel filters, label portable tanks appropriately, and submit an emergency response plan for hazardous materials release.

JS West Propane-Marysville Storage, 2698 Plute Road, Olivehurst, CA
Databases: Yuba CUPA, CERS HAZ

No information regarding this facility is provided in the listed databases.

Livingston's Concrete, 2572 Rosser Road, Olivehurst, CA
Database: FINDS/FRS

This facility is identified as a ready-mix concrete business. No additional information is provided in the records search.

AT&T California, Ostrom Road and Rancho Road, Olivehurst, CA
Database: CERS HAZ

This facility is identified as a chemical storage facility. No additional information is provided in the records search.

3948 Shimer Road, Olivehurst, CA
Databases: NCDL, CDL
This facility was identified on February 1, 2006 as being an illegal drug lab where hazardous materials were stored.

C**enturylink Olivehurst**, 3365 Rancho Road, Olivehurst, CA
Databases: Yuba CUPA, CERS HAZ

This facility is identified in the CERS HAZ database as a chemical storage facility. No additional information is provided in the records search.

Verizon Wireless Olivehurst, 3359 Forty Mile Road, Olivehurst, CA
Database: Yuba CUPA

No information is listed in the searched database.

Yetter Steel Corp., 3548 Rancho Road, Olivehurst, CA
Databases: Yuba CUPA, Delisted Haz

This business is listed as a hazardous waste generator. No additional information is provided in the records search.

Sprint Nextel, 3516 Rancho Road, Olivehurst, CA
Database: Yuba CUPA

No information regarding this site is in the searched database.

United Truck Dismantlers/ Rocliff Enterprises, Inc., 2488 McGowan Parkway, Olivehurst, CA
Databases: FINDS/FRS, Yuba CUPA, HAZNET, HIST Manifest, CERS HAZ, RCRA NonGen

This facility is a hazardous waste generator that operates an oil/water separator and disposes of oil-containing waste.

Verizon Wireless McGowan Parkway, 4404 Rancho Road, Marysville, Ca
Databases: FINDS/FRS, Yuba CUPA, CERS HAZ

This facility is listed in the CERA HAZ database as being a chemical storage facility. No regulatory action, spills, or leaks are identified in the records search.

2352 McGowan Parkway/Highway 65 & McGowan Parkway, Olivehurst, CA
Database: CDL

This address is listed in the searched database as an illegal drug lab that was reported in May 2000.

Rocking S Livestock, 3380 Rancho Road, Wheatland, CA
Database: Yuba CUPA

No information is provided in the records search.

Via Grande Way, Space 19, Olivehurst, CA
Database: CDL

This listing is a residence in a mobile home park located at the intersection of Olive Avenue and McGowan Parkway that was reported to be an illegal drug lab in March 2003.

Highway 70 & McGowan Parkway, Olivehurst, CA
Database: CDL

This location is the location of a vehicle that contained illegal drug lab equipment.

NRC/UPRR, Virginia Road & Rancho Road, Wheatland, CA
Database: CHMIRS

This location is listed in the searched databases as the location of a natural gas line leak, and an auto vs. train collision that resulted in the spill of an unknown amount of an undisclosed fluid. No regulatory action was documented regarding the spill.

Dollar General #14976, 1990 McGowan Parkway, Olivehurst, CA
Databases: Yuba CUPA, HAZNET, FINDS/FRS, CERS HAZ, RCRA NonGen

This business generates hazardous waste that is transported offsite.

Burrow Garage, 1909 McGowan Parkway, Olivehurst, CA
Databases: FINDS/FRS, Yuba CUPA, HAZNET, Delisted HAZ

This business is listed in the searched records as a hazardous waste generator that disposes of liquids with halogenated organic compounds. No violations, spills, or regulatory actions are documented in the records search.

Verizon Wireless Olivehurst, 3076 Rancho Road, Wheatland, CA
Databases: CERS HAZ, Yuba CUPA

This facility is listed as a chemical storage facility. No additional information is provided in the records search.

AT&T Corp, 4242 Deaton Drive, Olivehurst, CA
Database: CERS HAZ

This business is listed in the searched database as a chemical storage facility. No regulatory violations, spills, or leaks are documented for this facility.

Kubich Lumber, 1630 Rancho Road, Marysville, CA
Database: HAZNET

This business is listed in the HAZNET database. No additional information is identified in the records search.

3.2.4 RECs at Facilities identified within ½-mile of the Project alignment

Marysville Army Airfield/Yuba County Airport/G.N. Dibble, Inc./Public Works Airport Shop, 1300 and 1364 Sky Harbor Drive, Olivehurst, CA (1/2-mile west)

This facility is listed in the GeoTracker and EnviroStor online databases.

This 972-acre facility was constructed in 1941 and served as both a staging area for aircraft that applied herbicides and insecticides to surrounding agricultural properties, as well as a military installation that facilitated firearms training, aircraft storage, and aircraft refueling. In 1999, seven USTs and 790 tons of contaminated soil were removed from this facility. In 2014 A&M, a consultant working on behalf of the Central Valley Regional Water Quality Control Board (CVRWQCB), conducted a soil and groundwater investigation at the Site. Analysis of soil and groundwater samples collected during the investigation indicated that no contamination was present from petroleum hydrocarbons or volatile organic compounds (VOCs). The regulatory case was closed on July 21, 2015.

Two open regulatory cases are ongoing at this facility in relation to pesticide and herbicide releases to soil that occurred because of past uses. This facility is approximately 1/2 -mile west and downgradient of the Project alignment and is therefore not a REC for the Project.

3.3 City Directory Review

Blackburn reviewed the historical city directory. The City Directory review did not identify any conditions that are not already identified in other sections of this ISA. The City Directory Image Report is provided in Appendix E.

3.4 Title Documents Review

Title documents were not provided for this assessment.

4 RECONNAISSANCE INFORMATION

Blackburn completed a site reconnaissance on September 9, 2020. The purpose of the visual survey is to collect information regarding potential hazardous material contamination including identification of evidence of current and/or past use, evident storage of toxic or hazardous materials, the presence of onsite ponds, landfills, drywells, waste streams or other disposal units, visible soil contamination, above ground or underground storage tanks, drums, barrels and other storage containers. Photos from the site visit are in Appendix F. Observations were made from accessible portions of the study area.

The observations generally support the descriptions and background data above. Additional observations are presented in Section 3.2.1.

5 OWNER INTERVIEWS

Per ASTM, past owners, operators, and/or occupants of the subject property who are likely to have material information regarding the potential for contamination at the subject property shall be contacted to the extent that they can be identified and that the information likely to be obtained is not duplicative of information already obtained from other sources.

Blackburn did not conduct interviews with property owners. Lack of contact with the owners of property adjacent to the Project is a data gap but is not expected to change the conclusions of this ISA.

6 DATA GAPS

In accordance with ASTME E1527-13, this section discusses data gaps in the documents we obtained and reviewed as part of this ISA and discusses the significance. ASTM E1527-13 defines a data gap as “a lack of or inability to obtain information required by this practice despite good faith efforts by the environmental professional to gather such information.” In our opinion, we did not observe a data gap significant enough to change the conclusions of this ISA.

7 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The scope of this ISA was directed at:

- Determining if hazardous materials exist at or near the Project area at concentrations likely to warrant mitigation pursuant to regulations;
- Identifying sites RECs and/or potential RECs within and adjacent to the proposed Project area which could affect the design, constructability, feasibility, and/or the cost of the proposed Project; and
- Identify potential site contamination issues.

The assessment identified the following environmental conditions that should be considered for present and future planning for the proposed Project.

<u>RECs Located Within the Project Limits</u>

APN 014-270-002: OPUD Wastewater Treatment Facility - Public Utilities District 3908 Mary Avenue

A 2,500-gallon diesel above ground tank (AST) is located at this facility. There are no indications of a release of diesel to soil or groundwater.

Recommendation: No additional assessment.

<u>RECs Located Adjacent to the Project Limits</u>

Four sites located immediately adjacent to the project alignment were identified with high risk RECs. These sites are listed in Section 3.2.2 and are identified on Figures 2a-c. Documented impacts to soil or groundwater are present on or have been remediated at these adjacent parcels. There is a potential that impacts from these parcels extend into the right-of-way (ROW) adjacent to the parcel. There is a potential to encounter residual contamination during excavation.

Recommendation: If excavation is planned within the right-of-way (ROW) adjacent to these parcels, conduct a Phase II screening of the soil within the area of excavation to assess the presence of potential hazardous materials.

- **APN 014-143-026: Tower Mart #60/Cheaper #60**, 1976 McGowan Parkway

  Two single-walled 10,000-gallon gasoline underground storage tanks (USTs) tanks were removed in 1986. One 8,000-gallon diesel and three 12,000-gallon gasoline tanks were installed in 2004. A release of gasoline and diesel to soil and groundwater occurred sometime before 2003. Groundwater monitoring in April 2005, did not identify detectable amounts of constituents. The regulatory case was closed in 2008. Potential contaminants of concern (COC) include total petroleum hydrocarbons (TPH) as diesel (TPH-d), gas (TPH-g) and motor oil (TPH-mo), metals, and benzene/toluene/ethylbenzene/xylene (BTEX).

- **APN 014-510-033: Marysville Forest Products/Erickson Group Limited**, 4083 Rancho Road

  Two USTs were reportedly removed after a leak was detected. A reported release of diesel to soil was recorded in 1992. Documentation was not found to verify impacted soil was excavated. The regulatory case was closed on July 14, 1993. The site was formerly occupied by a wood treating facility. Pentachlorophenol (PCP) was used as an anti-fungal wood treatment. PCP was released to soil during site operations. Site soil is also impacted with volatile organic compounds (VOCs) from the maintenance shop and dioxins at the ash disposal and burn areas. The horizontal and vertical extent of impacts is unknow. The Regional Water Quality Control Board (RWQCB) regulatory case is currently open. Potential COCs include TPH-d, TPH-g, TPH-mo, metals, BTEX, VOCs, dioxins, and PCP.

- **APN 014-280-065: PG&E North Valley Materials**, 3736 Rancho Road

  One 10,000-gallon AST of unknown contents, one 8,000-gallon gasoline UST, and one 12,000-gallon diesel UST are located at this facility. This facility operates as a staging area for PG&E operations throughout the area. A release of diesel to soil from a UST was reported on November 3, 1992. Contaminated soil was removed from the facility, and a No Further Action Letter was issued on March 1, 1993. Potential COCs include TPH-d, TPH-g, TPH-mo, metals, and BTEX

- **APN 014-270-079: Flying U Ranch**, 3718 Forty Mile Road

  A 13,500-gallon AST of unknown fuel type is identified at the site. The location of the AST was not identified during site reconnaissance. Potential COCs include TPH-d, TPH-g, TPH-mo, metals, and BTEX.

Five sites located immediately adjacent to the project alignment were identified with medium risk RECs. These sites are listed in Section 3.2.2 and are identified on Figures 2a-c. Fuel storage tanks are present on these adjacent parcels. There is no evidence in the records review to suggest releases have occurred from the tanks or hazardous material issues from these sites will impact the Project, however, there is a potential to encounter residual contamination at these sites. If plans for acquisition change to include one or more of these sites, a Phase II Environmental Site Assessment to further investigate potential hazardous materials within the acquisition areas will be necessary.

- **APN 014-280-046: Alfaro Farms/Jean Pierre Alfaro**, 3374 Forty Mile Road

  This farm is listed in the searched databases as having a 15,000-gallon AST of unknown contents.

  Violations were reported for failure to properly label hazardous waste containers, and failure to properly store and label used batteries.

- **APN 014-360-014: Frank Hofman Ranch**, 3002 Forty Mile Road

  This business is listed as a hazardous waste generator. A UST of unknown contents and volume was located at the site. The Yuba UST database lists the UST status as closed. No spills or leaks were reported at this facility.

- **APN 014-510-018: Livingston Concrete**, 2571 Rosser Road

  This facility is listed in the searched databases as operating an AST. Violations are reported and include failure to provide training to oil-handling personnel.

- **APN 014-510-021: Roger L. Murray**, 3938 Shimer Road

  This facility is listed as having a 5,000-gallon AST storing an unknown fuel type. The AST is located at the southeast corner of the parcel, adjacent to the project. The AST had secondary containment, but the AST is within twenty feet of the project limits.

- **APN 015-060-075: Tollcrest Dairy,** 3355 Virginia Road, Wheatland

  A 10,200-gallon AST is located at this facility. The AST is not located on the west side of the parcel near the project alignment. No additional information is provided in the records search.

Three sites located north of the project alignment on Olivehurst Avenue were identified with high risk RECs. The project limits do not currently extend to these sites. These sites are listed in Section 3.2.2 and are identified on Figures 2a-c. Documented impacts to soil or groundwater are present on or have been remediated at these parcels. There is a potential that impacts from these parcels extend into the right-of-way (ROW) adjacent to the parcel. There is a potential to encounter residual contamination during excavation.

Recommendation: If the project limits are extended to include excavation within the ROW adjacent to these parcels, conduct a Phase II screening of the soil within the area of excavation to assess the presence of potential hazardous materials. Potential COCs include TPH-d, TPH-g, TPH-mo, metals, and BTEX.

- **APN 013-072-011: Gee Property**, 4880 Olivehurst Avenue

  The site is currently vacant but was formerly occupied by a fueling station. Two gasoline underground storage tanks (USTs) were removed in 1988 and one UST removed in 2019. Soil samples from the UST excavation indicated a release had occurred. Low levels of total petroleum hydrocarbons (TPHs) were detected in groundwater. The regulatory case was closed on January 10, 2020.

- **APN 013-081-015: AGV Corner Market**, 4881 Olivehurst Avenue

  The site is an active gas station. Currently a 20,000-gallon compartmentalized gasoline and diesel tank is in the same excavation area as the former UST. A release of gasoline to soil and groundwater occurred at this facility sometime prior to 2001. The most recent groundwater monitoring event conducted at the facility occurred in May 2011 and demonstrated that groundwater beneath the facility has residual impacts from gasoline related constituents. The regulatory case was closed on June 25, 2012.

- **APN 013-130-060: Former E-Z Serve**, 4867 Olivehurst Avenue

Three USTs were removed in 1989 and a release of gasoline was discovered. Soil and groundwater were impacted. Groundwater monitoring was conducted from sometime before 2004 until 2017. A No further Action letter was issued by the CVRWQCB and the regulatory case was closed on November 22, 2019.

General Contamination Issues

The following general contamination issues were identified within the Project limits.

<u>Yellow traffic stripes</u>
Yellow traffic stripes are known to contain heavy metals, such as lead and chromium, at concentrations in excess of the hazardous waste thresholds established by the *California Code of Regulations* and may produce toxic fumes when heated.

Recommendation: If the Project includes removal of yellow traffic striping, remove and dispose of in accordance with Caltrans Standard Special Provisions for Hazardous Waste.

<u>Aerially Deposited Lead (ADL)</u>
ADL has been found to occur in soils adjacent to highways and high use roadways. The lead is presumably from the historical use of leaded gasoline and subsequent exhaust emissions. There is potential for encountering ADL during construction and grading activities within the proposed Project limits along its entirety. Some of these roadways have been present in various alignments since at or before 1910 and, therefore, have the potential to be impacted with ADL.

Recommendation: A soil screening to evaluate the potential presence of ADL within the Project limits should be performed. An appropriate soil management plan will need to be developed for soil containing significant concentrations of ADL.

<u>Southern Pacific/Union Pacific Railroad</u>

An active railroad is adjacent to the east side of Rancho Road. Soils located adjacent to railroad tracks may be impacted by on-going railroad operations. Potential contaminants at these locations commonly include petroleum hydrocarbons, semi-volatile organic compounds (SVOCs), heavy metals, and pesticides.

Recommendation: Conduct a limited subsurface soil screening for potential contaminants in the upper 1.5 feet where soil will be disturbed adjacent to the railroad.

<u>Asbestos Containing Material (ACM) and Lead in Buildings Materials</u>
Structures constructed pre-1989 have the potential to contain ACM/Lead materials. Aerial photographs identify structures along the project alignment as developed prior to 1989.

Recommendation: If parcels are acquired as part of the Project any structures on those parcels should be evaluated for the presence of lead and asbestos containing materials. Any structure to be modified or demolished as part of the Project must be surveyed for the presence of ACM and Lead by a certified Asbestos Inspector prior to building demolition/modification.

<u>Transformers</u>
Our scope did not include an inventory of past and present transformers. We observed pole-mounted transformers and power lines within the existing right-of-way.

Recommendation: If the relocation of power facilities or high voltage power lines is required, existing transformers should be checked for the presence of PCBs or other hazardous materials by the utility owner, and if present, properly remediated and disposed. Identification and remediation of old transformers is the responsibility of the utility owner.

<u>Organochlorine Pesticides (OCPs)</u>
Historical topographic maps from 1947 and 1949 depict an orchard in the southeastern ½-mile alignment of Rancho Road and the eastern 1/3-mile alignment of Morrison Road.

Recommendation: Conduct a shallow soil screening to evaluate the potential presence of OCPs within the footprint of the former orchard in the Project limits.

8 QUALIFICATIONS

This ISA was prepared by Laura Long. I declare that, to the best of my professional knowledge and belief, I meet the definition of an environmental professional as defined in Section 312.10 of 40 Code of Federal Regulations (CFR) 312 and have the specific qualifications based on education, training, and experience to assess a property of its nature, history, and setting of the subject property. I have performed all appropriate inquiries in general conformance with the standards and practice set forth in 40 CFR 312.

9 LIMITATIONS

The accompanying ISA summarizes the findings and opinions of Blackburn, with regard to the potential for hazardous materials to be present on the properties at concentrations likely to warrant mitigation under current statutes and guidelines. Our findings and opinions are based on information obtained on given dates or provided by specified individuals, through records review, site review, and related activities. Conditions can change after we have made our observations. We cannot warrant or guarantee that hazardous materials do not exist at the described site. To further reduce your risk, an extensive invasive exploration may be necessary.

Blackburn prepared this ISA for the specific use of our client and applies only to the Project area. We are not responsible for interpretations by others of data presented in this ISA. This ISA does not represent a legal opinion. No warranty is expressed or implied. We base our conclusions in this ISA on judgment and experience. We performed this work in accordance with generally accepted standards of practice existing in northern California at the time of the assessment.

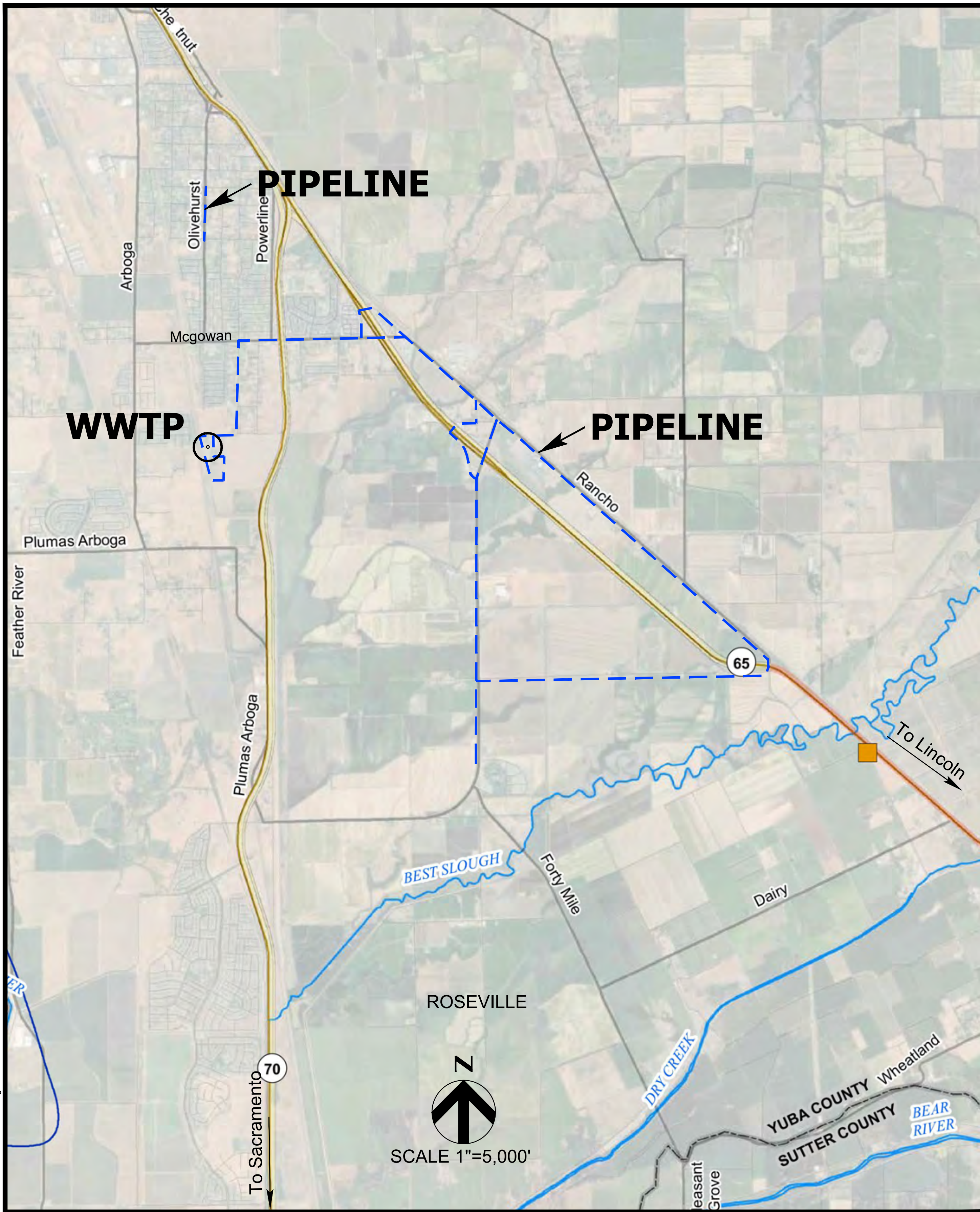
The governmental records portion of this ISA is derived from public records and is updated on a continual basis. For this reason, we do not advise you to use this information to base a decision after one (1) year of the issue date of this ISA. Also, conditions at the site can and will change over time. Please contact Blackburn to revise this ISA to reflect new information.

PHASE 1 INITIAL SITE ASSESSMENT

OPUD Yuba County Sewer and Water Infrastructure Project

Olivehurst, CA

FIGURES



10/13/2020 3842.x Fig1 OPUD South Yuba Sewer ENV.dwg

BLACKBURN CONSULTING

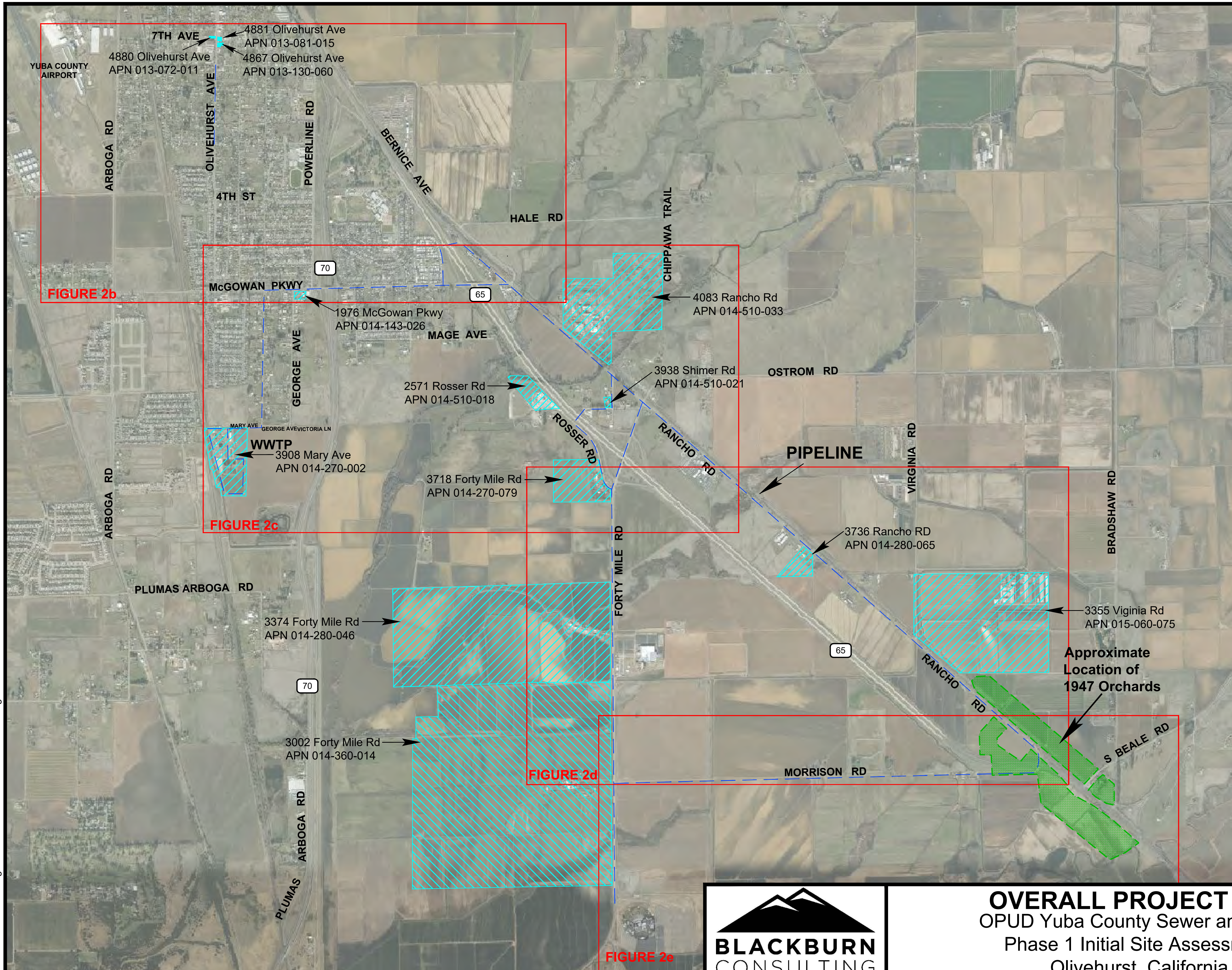
VICINITY MAP

OPUD Yuba County Sewer and Water
Phase 1 Initial Site Assessment
Olivehurst, California

File No. 3842.x

June 2021

Figure 1



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SCALE 1" = 2,500'

LEGEND

- Approximate Pipeline Alignment
- Approximate Parcel Limits with REC's Adjacent to Project Limits

10/14/2020 3842.x Fig2a OPUD South Yuba Sewer ENV.dwg

BLACKBURN CONSULTING

OVERALL PROJECT MAP

OPUD Yuba County Sewer and Water
Phase 1 Initial Site Assessment
Olivehurst, California

File No. 3842.x	
June 2021	
Figure 2a	

LEGEND

Approximate Pipeline Alignment

Approximate Parcel Limits with REC's Adjacent to Project Limits

N

SCALE 1" = 900'

BLACKBURN CONSULTING

PROJECT MAP

OPUD Yuba County Sewer and Water

Phase 1 Initial Site Assessment

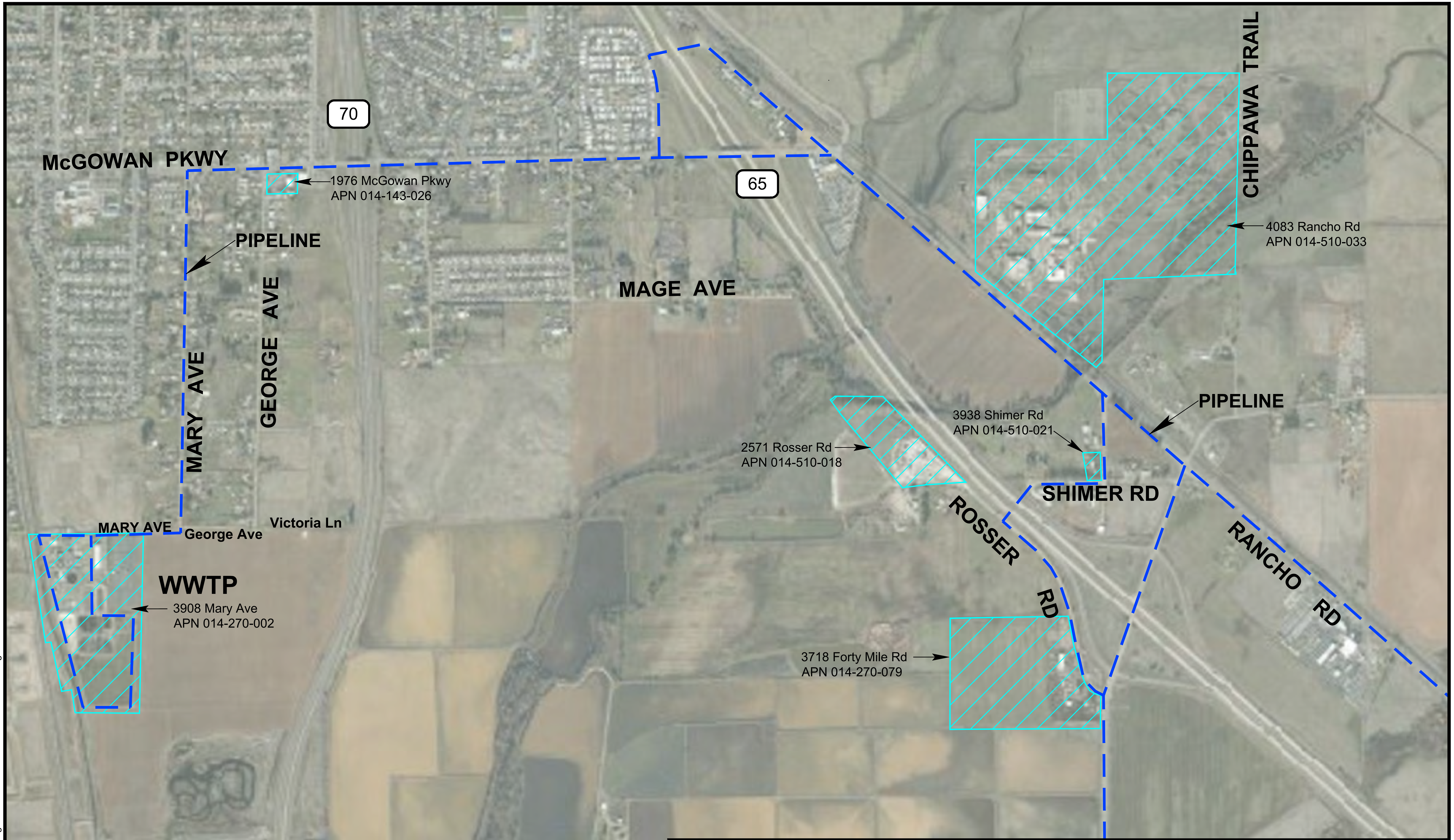
Olivehurst, California

File No. 3842.x

June 2021

Figure 2b

10/14/2020 3842.x Fig2b-e OPUD South Yuba Sewer ENV.dwg



LEGEND

Approximate Pipeline Alignment

Approximate Parcel Limits with REC's Adjacent to Project Limits

N

SCALE 1" = 900'

BLACKBURN CONSULTING

PROJECT MAP

OPUD Yuba County Sewer and Water

Phase 1 Initial Site Assessment

Olivehurst, California

File No. 3842.x	
June 2021	
Figure 2c	

10/14/2020 3842.x Fig2b-e OPUD South Yuba Sewer ENV.dwg

LEGEND

Approximate Pipeline Alignment

Approximate Parcel Limits with REC's Adjacent to Project Limits

N

SCALE 1" = 900'

BLACKBURN CONSULTING

PROJECT MAP

OPUD Yuba County Sewer and Water
Phase 1 Initial Site Assessment
Olivehurst, California

File No. 3842.x

June 2021

Figure 2d

10/14/2020 3842.x Fig2b-e OPUD South Yuba Sewer ENV.dwg

LEGEND

Approximate Pipeline Alignment

Approximate Parcel Limits with REC's Adjacent to Project Limits

N

SCALE 1" = 900'

BLACKBURN CONSULTING

PROJECT MAP

OPUD Yuba County Sewer and Water
Phase 1 Initial Site Assessment
Olivehurst, California

File No. 3842.x

June 2021

Figure 2e

10/14/2020 3842.x Fig2b-e OPUD South Yuba Sewer ENV.dwg

PHASE 1 INITIAL SITE ASSESSMENT

OPUD Yuba County Sewer and Water Infrastructure Project

Olivehurst, CA

APPENDIX A

Aerial Photographs

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

HISTORICAL AERIALS

Project Property: OPUD Sewer and Water
n/a
Olivehurst CA

Requested By: Blackburn Consulting

Order No: 20281800434

Data Completed: August 24,2020

Environmental Risk Information Services
A division of Glacier Media Inc.
1.866.517.5204 | info@erisinfo.com | erisinfo.com

Date	Source	Source Scale	Comments
2018	National Agriculture Information Program	1" to 2000'	
2014	National Agriculture Information Program	1" to 2000'	
2009	National Agriculture Information Program	1" to 2000'	
2005	National Agriculture Information Program	1" to 2000'	
1998	US Geological Survey	1" to 2000'	
1987	US Geological Survey	1" to 2000'	Best Copy Available
1977	US Geological Survey	1" to 2000'	
1954	Army Mapping Service	1" to 2000'	
1947	Agriculture and Soil Conservation Service	1" to 2000'	


9-30-87
GS
7-27-87
GS-VFLL-C
3
36