Prepared for:

Orange County Sanitation District
10844 Ellis Avenue
Fountain Valley, CA 92708-7018
(714) 593-7803

Project Report

PS15-06 Seismic Evaluation of Structures at Plants 1 and 2

Prepared by:

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In Association with:

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Engineers...Working Wonders With Water®

Infra • Terra

Project Number: HL1635

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Geosyntec consultants

APPENDIX D

Seismic Evaluation Criteria

Prepared for:

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10844 Ellis Avenue
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Excerpt From Technical Memorandum 1

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Revised August 14, 2018 (Originally Issued October 31, 2017)

4.3.2 Seismic Evaluation Criteria

Defining the seismic evaluation criteria is the first step in the evaluation process. It sets the stage for the execution of the evaluation work. This step involves the selection of a performance objective, definition of building performance levels, and the definition of the seismic hazard levels. The proposed evaluation criteria are summarized in Table 4.1.

The purpose of the PS15-06 project is to establish an understanding of seismic risk and develop mitigation options that reduce the overall risk. The mitigation options, together with the associated retrofits, will help the District make risk-informed decisions for the implementation of the mitigation projects, and incorporation of these projects within the Facilities Master Plan (FMP). Therefore, the general approach for the PS15-06 project is to use a performance-based assessment methodology (and not a code compliance check) that uses rational engineering concepts, which may or may not strictly meet specific design code and evaluation standard requirements.

The ASCE 41-13 evaluation standard is selected as the overall methodology for this project. The ASCE 41-13 specifically addresses building structures and will be applied directly for the assessment of building structures. Although the assessment methodology for liquid-containing structures is not explicitly included in ASCE41-13, the conceptual methodology from the standard can be applied to such structures. This performance-based assessment methodology, supplemented by ACI 350.3 (for reinforced concrete liquid-containing structures) and API 650 (for the steel gas holders), will be applied.

4.3.2.1 Performance Objective

The structures to be evaluated are categorized as being either Class I or Class II, according to their operational criticality. The following is a description of the facility classes used in this evaluation:

- Class I: Structures that are essential to the maintenance of wastewater flow and treatment. Loss of service would create a major impact on OCSD's ability to operate the treatment plant. Damage to these structures can also result in a health hazard to the public with sewage back-up or spillage. Structural repairs should be minor and not inhibit the occupancy or use of the structure.
- Class II: Structures that are not directly necessary for maintaining wastewater flow through the system. Loss of service would not result in immediate wastewater back-up or spillage. Repairs can be deferred.

The building code uses risk categorization to distinguish criticality. While the building code is not being applied for this evaluation, for the sake of comparison, the Class I structures would be considered to be Risk Category IV, and Class II structures would be considered to be Risk Category II, according to the definitions set forth in the 2016 California Building Code (current building code). A summary of each structure's Class and Risk Category is provided in Table 4.2 and Table 4.3 for Plant 1 and Plant 2, respectively.

ASCE41-13 has a two-fold performance objective that establishes building performance levels for different seismic hazards. For example, a typical two-fold performance objective for a critical building might be meeting the immediate occupancy performance level for the 225-year return period earthquake ground motions and meeting the life safety performance level for the 975-year return period earthquake ground motions. Similarly, the two-fold performance objective for liquid-containing structures is prevention of leakage for the 225-year return period ground motions, and collapse prevention or repairable damage performance level for the 975-year return period ground motions. Selection of a performance objective establishes the building performance levels and the seismic hazard levels that will be applied in the evaluation for each structure, as shown in Table 4-1.

Section 9.4 of ACI 350.3 includes an importance factor (I) for liquid-containing structures to incorporate conservatism depending on use. For example, I = 1.5 is required for tanks containing hazardous materials, I = 1.25 for tanks for post-earthquake emergency, and I = 1.0 for all other tanks. For liquid-containing structures included in this study, consideration to the importance of the structure will be included in the incorporation of projects in the FMP. Therefore, I = 1.0 will be used for the seismic assessment of such structures. Consideration to performance objectives such as crack control will be included in the over-strength and inelastic energy absorption factors (m-factors in ASCE 41-13).

4.3.2.2 Building Performance Levels

Building performance levels include both structural and non-structural performance levels. The structural performance levels defined in ASCE 41-13 are as follows:

- S-1: Immediate Occupancy;
- S-2: Damage Control;
- S-3: Life Safety;
- S-4: Limited Safety; and
- S-5: Collapse Prevention.

A qualitative description of the post-earthquake damage patterns for the various structural performance levels for a selection of a few of the seismic-force resisting systems pertinent to the study are provided in Table 4.4.

Non-structural performance levels defined in ASCE 41-13 are as follows:

- N-A: Operational;
- N-B: Position Retention;
- N-C: Life Safety; and
- N-D: Not considered.

The scope of the seismic evaluation includes a determination of whether the subject structures meet their prescribed structural performance levels for the defined hazard level and whether the nonstructural performance level for a limited set of nonstructural components is met. Those nonstructural components are limited to the following appurtenances:

- Parapets;
- Ornaments;
- Facades; and
- Cantilevered overhangs or canopies.

While other nonstructural components, such as ceilings, pipe supports, and equipment supports are not being evaluated as part of this study in themselves, their contribution to the seismic load and effect on the seismic performance of the structures is being accounted for. For example, the dead load of equipment will contribute to the lateral load demand applied to the structure or a relatively flexible piece of equipment that is sufficiently rigid and heavy may impart impact loads to a building wall. Such effects will be considered in the evaluation of the structures.

4.3.2.3 Seismic Hazard Level

Earthquake ground motion levels BSE-1E and BSE-2E, which represent 20% probability of exceedance in 50 years (equivalent return period of 225 years) and 5% probability of exceedance in 50 years (equivalent return period of 975 years), respectively, will be used for the assessment of all structures included in this study. The use of a consistent hazard level for the assessment of all plant structures included in this study will provide a consistent assessment for risk reduction. For a more detailed discussion regarding the seismic hazard levels considered for this evaluation, refer to Section 2.1.2 of this report.

4.3.2.4 Liquid Containing Structures Performance Levels

The selected performance levels for liquid containing structures are also presented in Table 4-1. As performance levels for liquid containing structures are not identified in ASCE 41-13, descriptions of these performance levels were developed and are presented below.

- Seismic Hazard Level BSE-1E – 20% in 50 Years

  Structural Performance Level – Immediate Occupancy: This performance level is similar to Immediate Occupancy Structural Performance Level (S-1) of ASCE 41-13. This performance level means that post-earthquake damage is minor. The structure maintains most of its pre-earthquake strength and stiffness and its primary function of water retention. Although some post-earthquake repair might be needed, these repairs would not be such as to prevent the primary function of the structure.

  Non-Structural Performance Level – Position Retention: This performance level is similar to the Position Retention performance level as described in ASCE 41-13. This performance level means that in the post-earthquake damage state damage to piping and mechanical systems is such that they cannot immediately function. However, damage is such that primary objective of water retention is maintained (for example, flexible piping connection or valves). The overall impact of damage to piping and mechanical systems is not being addressed as part of this study.

- Seismic Hazard Level BSE-2E – 5% in 50 Years

  Structural Performance Level – Life Safety: This performance level is generally similar to the Enhanced Safety Structural Performance Range of ASCE 41-13 and refers to a damage state between Immediate Occupancy Structural Performance Level and Life Safety Structural Performance Level (closer to Life Safety Performance Level). This performance level means that in the post-earthquake state there is significant damage to the structure, which could result in significant leakage, but the damage is not such that it results in complete loss of containment. Post-earthquake damage may need immediate attention (reduction in water level and crack repair) to minimize environmental impact from significant release of wastewater. However, damage is not such that the structure is at a risk of imminent collapse.

Non-Structural Performance Level – Not Considered: At the BSE-2E seismic level there could be substantial damage to piping and wastewater conveyance systems. The overall impact of damage to piping and mechanical systems is not being addressed as part of this study.

TABLES

Table 4.1. Seismic Evaluation Criteria
OCSD PS15-06
Huntington Beach, California

Structure Type	Class	Seismic Hazard Level	Structural Performance Level	Non-structural Performance Level
Building	I	BSE-1E (20% in 50 yrs)	Immediate Occupancy (S-1)	Position Retention (N-B)
		BSE-2E (5% in 50 yrs)	Life Safety (S-3)	Not considered (N-D)
Building	II	BSE-1E (20% in 50 yrs)	Life Safety (S-3)	Life Safety (N-C)
		BSE-2E (5% in 50 yrs)	Collapse Prevention (S-5)	Not considered (N-D)
Non-building (liquid-containing structures)	I	BSE-1E (20% in 50 yrs)	Immediate Occupancy (S-1)	Position Retention (N-B)
		BSE-2E (5% in 50 yrs)	Life Safety (S-3)	Not considered (N-D)

Table 4.2. Structure Classes for Plant 1 [(1)]
OCSD PS15-06
Fountain Valley, California

ID Number	Structure Name	Plant	Structure Group[(2)]	Class	Risk Category
1-1	Waste Sludge Thickeners (DAFT) Pump Room	1	B	I	IV
1-2	Blower Building (AS1) and PEPS	1	B	I	IV
1-3	Plant Water Pump Station and Power Building 6	1	B	I	IV
1-4	City Water Pump Station	1	B	I	IV
1-5	Power Building 2	1	B	I	IV
1-6	Power Building 4	1	B	I	IV
1-7	Power Building 5	1	B	I	IV
1-8	Control Center	1	B	I	IV
1-9	12 kV Service Center	1	B	I	IV
1-10	Central Power Generation Building	1	B	I	IV
1-11	Aeration Basins 1-10	1	LCS	I	IV
1-12	Secondary Clarifiers 1-26	1	LCS	I	IV
1-13	Digester 5	1	LCS	I	IV
1-14	Digester 5 Pump Room	1	B	I	IV
1-15	Digester 6	1	LCS	I	IV
1-16	Digester 7	1	LCS	I	IV
1-17	Digester 7 Pump Room	1	B	I	IV
1-18	Digester 8	1	LCS	I	IV
1-19	Digester 9-10	1	LCS	I	IV
1-20	Digester 9-10 Pump Room	1	B	I	IV
1-21	Digesters 11-16	1	LCS	I	IV
1-22	Digesters 11-16 Pump Room 1	1	B	I	IV
1-23	Digesters 11-16 Pump Room 2	1	B	I	IV
1-24	Gas Holder	1	GST	I	IV
1-25	Effluent Junction Box	1	LCS	I	IV
1-26	Solids Storage Facility	1	B	II	II
1-27	Chiller Building	1	B	II	II
1-28	Warehouse Building	1	B	II	II
1-29	Shop Building A	1	B	II	II
1-30	Shop Building B and Building 3	1	B	II	II
1-31	Buildings 5 and 6	1	B	II	II
1-32	Auto Shop	1	B	II	II
1-33	PEDB2	1	LCS	I	IV
1-34	Central Laboratory	1	B	I	IV

NOTES: [(1)] Table was updated after the issuance of Technical Memorandum 1.

[(2)] Structure Groups are as follows:

B = Building
LCS = Liquid-Containing Structure
GST = Gas Storage Tank

Table 4.3. Structure Classes for Plant 2[(1)]
OCSD PS15-06
Huntington Beach, California

ID Number	Structure Name	Plant	Structure Group[(2)]	Class	Risk Category
2-1	DAFT A, B, & C Gallery	2	B	I	IV
2-2	DAFT D Gallery & WSSPS	2	LCS	I	IV
2-3	RAS PS East	2	B	I	IV
2-4	RAS PS West	2	B	I	IV
2-5	PEPS & MAC	2	B	I	IV
2-6	Operations/Control Center Bldg	2	B	I	IV
2-7	12 kV Service Center	2	B	I	IV
2-8	Power Building B	2	B	I	IV
2-9	Power Building C	2	B	I	IV
2-10	Power Building D	2	B	I	IV
2-11	City Water Pump Station	2	B	I	IV
2-12	12 kV Distribution Center B	2	B	I	IV
2-13	12 kV Distribution Center D	2	B	I	IV
2-14	Headworks Power Bldg A	2	B	I	IV
2-15	Headworks Power Bldg B	2	B	I	IV
2-16	Headworks Standby Power Building	2	B	I	IV
2-17	Central Power Generation Building	2	B	I	IV
2-18	Aeration Basins A-H	2	LCS	I	IV
2-19	Gas Holder	2	GST	I	IV
2-20	Secondary Clarifiers A-L	2	LCS	I	IV
2-21	DAFTs A-C	2	LCS	I	IV
2-22	DAFT D	2	LCS	I	IV
2-23	Surge Tower No. 1	2	LCS	I	IV
2-24	Surge Tower No. 2	2	LCS	I	IV
2-25	NOT USED	2			
2-26	Truck Loading	2	B/LCS	II	II
2-27	Maintenance Building	2	B	II	II
2-28	Boiler Building	2	B	II	II
2-29	OOBS	2	B	I	IV
2-30	12kV Distribution Center A	2	B	I	IV
2-31	SEJB - Geotechnical Only	2	LCS	I	IV
2-32	JBC - Geotechnical Only	2	LCS	I	IV

NOTES: [(1)] Table was updated after the issuance of Technical Memorandum 1.

[(2)] Structure Groups are as follows:

B = Building
LCS = Liquid-Containing Structure
GST = Gas Storage Tank

Table 4.4. Structural Performance Levels and Illustrative Damage
OCSD PS15-06
Huntington Beach, California

Seismic Force Resisting System	Type	Structural Performance Levels		
		Collapse Prevention (S-5)	Life Safety (S-3)	Immediate Occupancy (S-1)
Concrete Walls	Primary elements	Major flexural or shear cracks and voids. Sliding at joints. Extensive crushing and buckling of reinforcement. Severe boundary element damage.	Some boundary element cracking and spalling and limited buckling of reinforcement. Some sliding at joints. Damage around openings. Some crushing and flexural cracking.	Minor diagonal cracking of walls.
	Drift	Transient drift sufficient to cause extensive nonstructural damage. Extensive permanent drift.	Transient drift sufficient to cause nonstructural damage. Noticeable permanent drift.	Transient drift that causes minor or no nonstructural damage. Negilgilbe permanent drift.
Reinforced Masonry Walls	Primary elements	Crushing; extensive cracking. Damage around openings and at corners. Some fallen units.	Major cracking distributed throughout wall. Some isolated crushing.	Minor cracking. No out-of-plane offsets.
	Drift	Transient drift sufficient to cause extensive nonstructural damage. Extensive permanent drift.	Transient drift sufficient to cause nonstructural damage. Noticeable permanent drift.	Transient drift that causes minor or no nonstructural damage. Negilgilbe permanent drift.
Precast Concrete Walls	Primary elements	Some wall connection failures, but no wall elements dislodged.	Local crushing and spalling at wall connections, but no gross failure of connections.	Minor working and cracking at connections.
	Drift	Transient drift sufficient to cause extensive nonstructural damage. Extensive permanent drift.	Transient drift sufficient to cause nonstructural damage. Noticeable permanent drift.	Transient drift that causes minor or no nonstructural damage. Negilgilbe permanent drift.
Foundations	General	Significant settlement and tilting of buildings with shallow foundations or buildings on liquefiable soils.	Localized settlement of buildings with shallow foundations.	Minor settlement and neglibilble tilting.

APPENDIX E

Structure Summary Sheets

WASTE SLUDGE THICKENERS (DAFT) PUMP ROOM

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-1	1	I	IV	BUILDING

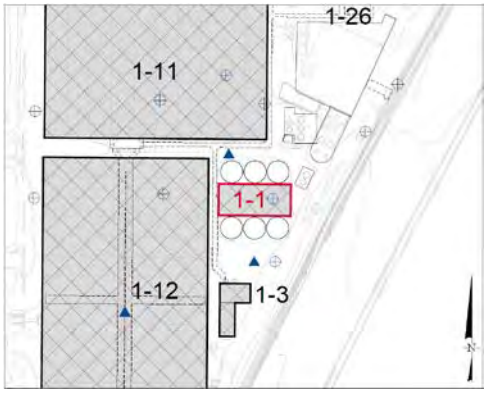
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

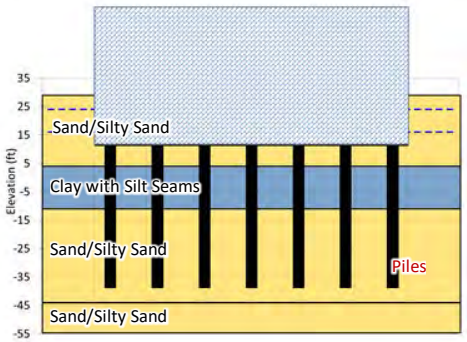
structural components

Foundation Type: Basement at 11.33' elev. (17.67' embedment); driven – PPC piles (12" SQ, 50' total)
Structure Dimensions: 150 ft x 64 ft
# of Stories: 1 above grade, 1 below grade
Date of Original Construction: 1973
Retrofit (if any): Remodeled in 1994
Projects: P1-16, P1-36-2

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+24 ft-MSL
AWL	13 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 8	7 to 8
Lateral Spread (near river, inches)	31 to 56	27 to 46
Lateral Spread (far from river, inches)	15 to 27	13 to 22

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 2: Wall anchorage to the roof at east and west walls of the north building	T1	Check of the eave beam to span horizontally across the width of the building. The actual roof connections will have DCR's > 1.0. It is recommended that wall anchorage be added to the east and west walls.
PFM 3: Roof diaphragm shear at the north building	T2	Excessive shear demands at the north building, which has a 4.5-inch deep steel deck (low shear capacity).
PFM 4: Discontinuous shear walls at the interior of the south building in the north-south direction (@ grid lines 3 and 5)	T1	The transverse CMU walls at grid lines 4 and 5 of the north building and walls at grid lines 3 and 5 of the south building are discontinuous. Provide ties to adjacent concrete walls that occur between grids C and D.

PFM 7: Bending/shear failure of piles due to lateral spread (surface PGD = 27-inches)	T1/2	23.3" (estimate of spread at pile head) lateral spread toward the Santa Ana River. DCR is the near pile top displacement over pile top displacement at yield (3.5").

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 7: Standard Geotechnical Mitigation A2	See Note 3	Mitigation is required to reduce lateral spread by 70% (surface PGD = 8-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 2: Standard Structural Mitigation A1	$150,000	N/A
PFM 3: Standard Structural Mitigation B1	$560,000	Existing roof deck is 4.5-inch deep diaphragm with no concrete topping. Replace entire roof diaphragm.
PFM 4: Provide steel beam or channel ties for the full width of the building (40-ft) that are epoxied into the bottom side of the first floor to drag loads into the existing shear walls between grid lines C and D.	$130,000	N/A
Total Geotechnical and Structural Mitigation Cost	**$840,000**	**(excluding lateral spread mitigation, see Note 3)**

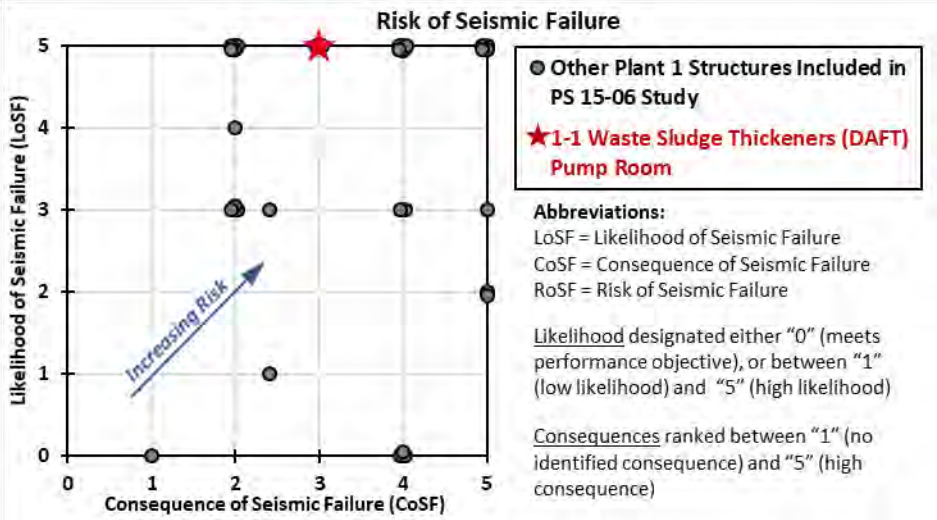
Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:
LoSF Rating: 5
CoSF, Weighted Score : 3
Overall RoSF = LoSF x CoSF = 15



comments and clarifications

N/A

Next Planned Project and Date: X-043 (07/01/2029)

BLOWER BUILDING (AS1) AND PEPS

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-2	1	I	IV	BUILDING

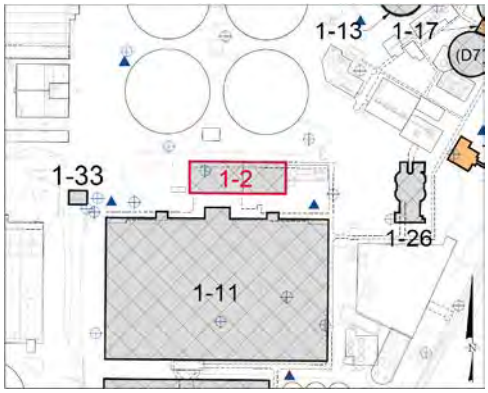
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

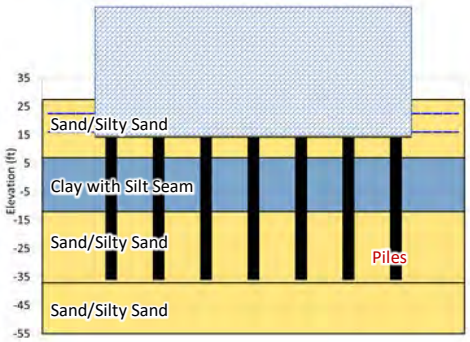
structural components

Foundation Type: Basement at 14.17' elev. (13.33' embedment); driven – PPC piles (12" SQ, 50' total)
Structure Dimensions: 201 ft x 66 ft
# of Stories: 1 above grade, 1 below grade
Date of Original Construction: 1973
Retrofit (if any): Remodeled in 1993, 1995, and 1998; 1998: Strengthening of roof-to-wall anchorage at the north and south walls of the PEPS roof, lateral bracing of a raised concrete platform at PEPS, and connection of the precast wall panels.
Projects: P1-16 / P1-36-1 / P1-36-2 / P1-44-4

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.5 ft-MSL
AWL	11.5 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	6 to 10	5 to 7
Lateral Spread (near river, inches)	10 to 25	6 to 15
Lateral Spread (far from river, inches)	8 to 19	5 to 11

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 2: Wall anchorage to the roof at the north and south walls of the Blower Building	T1	Check of the W33x connections at pilasters (10 locations). Transfer of wall anchorage force relies on a 1" weld (not clear what kind of weld) every 12 inches. For mitigation, it is assumed the load path in the diaphragm is deficient as well.
PFM 3: Wall anchorage to the roof at the north and south walls of the PEPS Building	T1	The north and south walls of PEPS were retrofit as part of the P1-44-4 project (22 locations).
PFM 4: Wall anchorage to the roof at the east and west walls of the PEPS Building	T1	Check of the W27x connections at pilasters (4 locations). Transfer of loads into the diaphragm appear to be minimal.

PFM 5: Roof diaphragm shear	T2	Excessive shear demands at the 7.5-inch deep steel deck (low shear capacity).

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 2: Standard Structural Mitigation A2 (High)	$650,000	W33x connections at pilasters (10 locations).
PFM 3: Standard Structural Mitigation A1 (SIM)	$400,000	Similar to A1 without the supplemental roof framing (22 locations).
PFM 4: Standard Structural Mitigation A2 (High)	$250,000	W27x connections at pilasters (4 locations).
PFM 5: Standard Structural Mitigation B1	$800,000	Existing roof deck is 7.5-inch deep steel deck without any concrete topping. Applies over the Blower Room only.
Total Geotechnical and Structural Mitigation Cost	**$2,100,000**	

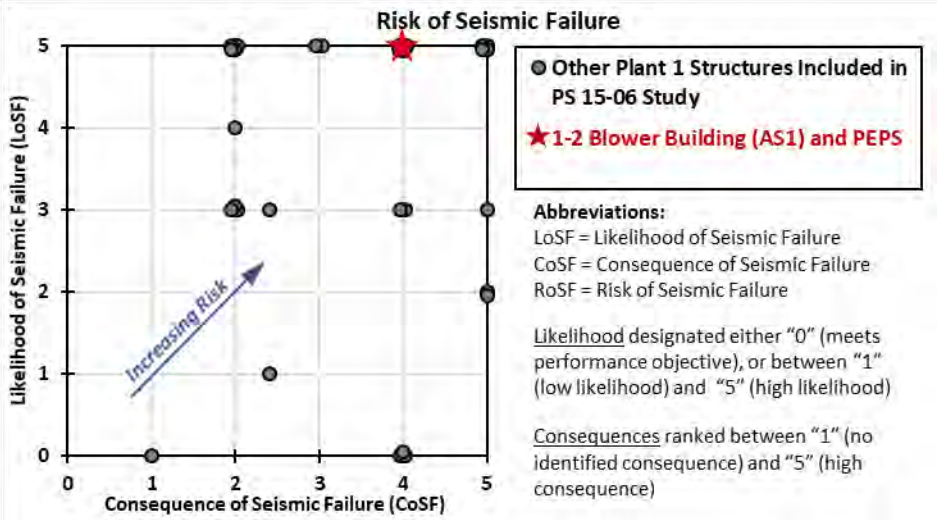
Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:
LoSF Rating: 5
CoSF, Weighted Score : 4
Overall RoSF = LoSF x CoSF = 20



comments and clarifications

N/A

Next Planned Project and Date: X-048 (09/01/2023)

PLANT WATER PUMP STATION AND POWER BLDG 6

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-3	1	I	IV	BUILDING

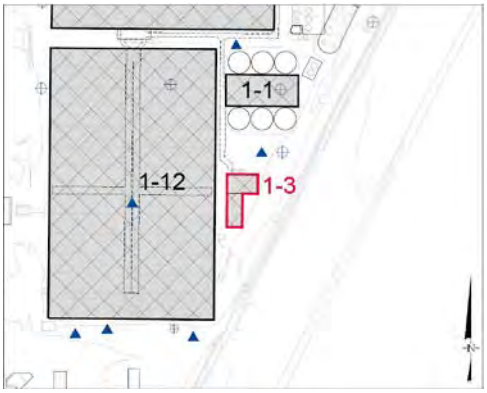
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

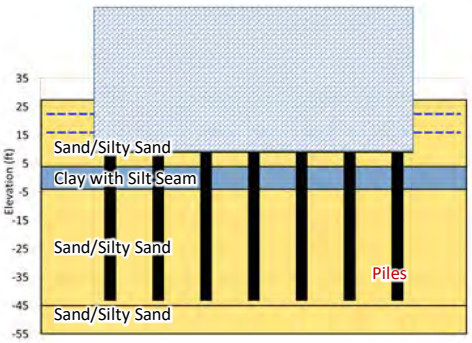
structural components

Foundation Type: Basement at 9' elev. (18.50' embedment); driven – PPC piles (12" SQ, 52' total)
Structure Dimensions: 110 ft x 64 ft
# of Stories: 1 story
Date of Original Construction: 1963
Retrofit (if any): N/A
Projects: P1-34-2

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.5 ft-MSL
AWL	11.5 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	6 to 7	4 to 5
Lateral Spread (near river, inches)	44 to 72	18 to 22
Lateral Spread (far from river, inches)	26 to 42	11 to 13

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 2: Wall anchorage to the roof at east and west walls	T1	Roof beam anchorage at the east and west walls is subject to pullout of the anchors at the tops of the pilasters, which can destabilize the W24x94 roof beams (8 locations).
PFM 3: Drag connection at the re-entrant corner	T1	The W12x35 roof beam connection at the re-entrant corner is not detailed to resist the diaphragm reaction at the shear wall in the north-south direction. This is not a Life Safety check and the beam has bearing within the wall, so collapse of the beam is not anticipated.

PFM 6: Bending/shear failure of piles due to lateral spread (surface PGD = 40-inches)	T1/2	32" (estimate at pile head) lateral spread toward Santa Ana River. DCR is the near pile top displacement over pile top displacement at yield (3.5").

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 6: Standard Geotechnical Mitigation A2	See Note 3	Mitigation is required to reduce lateral spread by 80% (surface PGD = 8-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 2: Standard Structural Mitigation A2 (Medium)	$300,000	Wall anchorage mitigation at W24x94 roof beams (8 locations).
PFM 3: Provision of a steel channel or similar shape that is epoxied into the 10 feet of the existing wall along grid line 2 and tied to the existing steel W12x35 with welded or bolted connections.	$120,000	Assumes that existing steel beam connections to the north are adequate (6) ¾-inch diameter bolts in tension.
Total Geotechnical and Structural Mitigation Cost	**$420,000**	**(excluding lateral spread mitigation, see Note 3)**

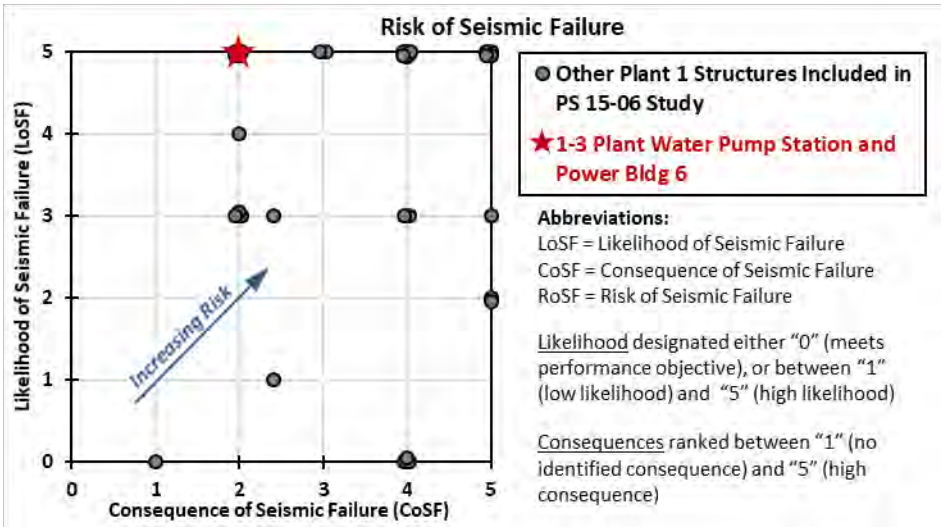
Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:
LoSF Rating: 5
CoSF, Weighted Score : 2
Overall RoSF = LoSF x CoSF = 10



comments and clarifications

N/A

Next Planned Project and Date: X-039 (12/30/2033)

CITY WATER PUMP STATION

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-4	1	I	IV	BUILDING

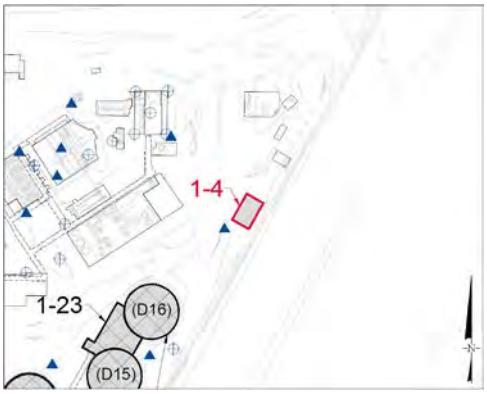
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Shallow spread foundation at-grade
Structure Dimensions: 62 ft x 40 ft
# of Stories: 1 story
Date of Original Construction: 1989
Retrofit (if any): N/A
Projects: P1-34-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

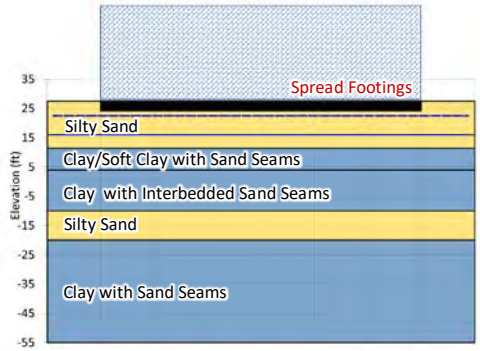
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	6 to 7	4 to 5
Lateral Spread (near river, inches)	44 to 72	18 to 22
Lateral Spread (far from river, inches)	26 to 42	11 to 13

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.5 ft-MSL
AWL	11.5 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Footings move independent of the wall	T1	Walls have no structural tie between the wall and the floor slab. Building wall can move laterally toward the Santa Ana River relative to the rest of the building (204 ft).
PFM 3: Wall anchorage at east and west walls	T1	Anchorage at W24x131 to pilasters (6 locations).
PFM 4: In-plane shear at south pier between louvers	T3	Primarily a ground shaking hazard.
PFM 5: Out-of-plane horizontal bending at east and west walls due to ground shaking	T3	Tier 1 found horizontal wall reinforcing was less than the minimum. Tier 3 findings confirmed that horizontal bending is a vulnerability at pilasters and wall corners (8 locations).
PFM 6: Out-of-plane horizontal bending in east and west walls due to ground deformation	T3	1.4" of differential settlement over 60 feet (8 locations).

PFM 7: Tension failure in the CMU walls due to ground deformation	T3	1.4" of differential settlement over 60 feet. Failures occur at the top of the wall. Governing pattern is transverse pattern with high point centered on building.
PFM 8: Tension failure in the concrete stem wall due to ground deformation	T3	1.4" of differential settlement over 60 feet. Failures occur at the top of the wall. Governing pattern is transverse pattern with high point centered on building.
PFM 9: Lateral spread toward the Santa Ana River (surface PGD = 18-inches)	T1/2	18" (near side) / 11" (far side) lateral spread can pull apart the building east wall/footing relative to the roof and the west wall because the floor slab is not tied to the wall/footing (204 ft). The slab has tensile strength to develop shear friction force across the width of the building.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	**Cost[2]**	**Comments**
PFM 7 & 8: Standard Geotechnical Mitigation B2	$1,200,000	Mitigation required to reduce differential settlement by at least 50% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 3 to 27 ft-bgs.
PFM 9: Standard Geotechnical Mitigation A2 or per **PFM 1**	See Note 3	Mitigation required to reduce lateral spread by at least 50% (surface PGD = 9-inches) or mitigate per **PFM 1**.
Recommended Structural Mitigation[1]	**Cost[2]**	**Comments**
PFM 1: Standard Structural Mitigation C1	$95,000	Walls have no structural tie between the wall and floor slab. Mitigation required for 204 lineal feet.
PFM 3: Standard Structural Mitigation A2 (Low)	$160,000	Anchorage at W24x131 to pilasters (6 locations).
PFM 4: Strengthen the existing wall by addition of a concrete overlay that is doweled into the interior face of the wall and extended above the wall pier as required. Wall overlay may be limited to 6 inches in thickness to accommodate one layer of reinforcing. Shotcrete or form and pour in place are both viable techniques.	$130,000	N/A
PFM 5 & 6: Standard Structural Mitigation D	$205,000	To be applied at a spacing that reduces the horizontal wall span by 50%.
Total Geotechnical and Structural Mitigation Cost	**$1,790,000**	**(excluding lateral spread mitigation, see Note 3)**

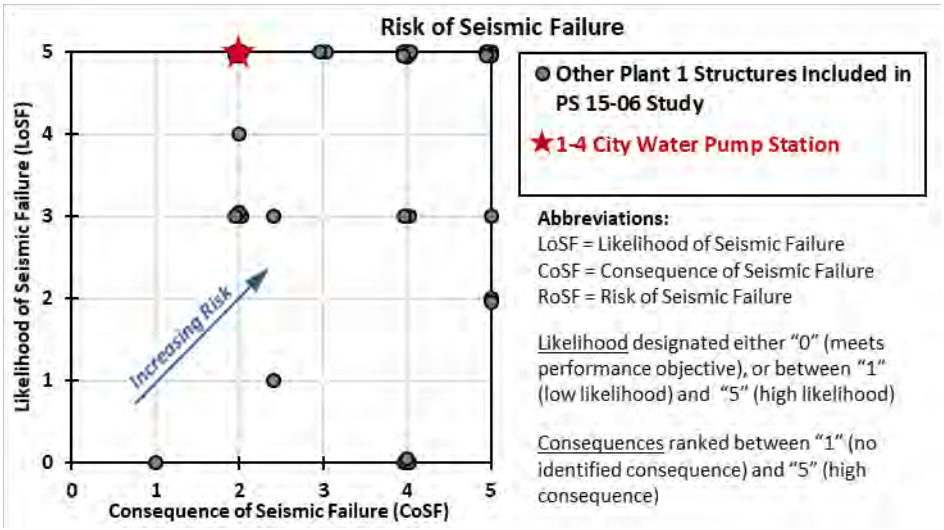
Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation or mitigate per **PFM 1**. Refer to TM4 (Geosyntec, 2019) for additional detail.*

risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:
LoSF Rating: 5
CoSF, Weighted Score : 2
Overall RoSF = LoSF x CoSF = 10



comments and clarifications

N/A

Next Planned Project and Date: X-038 (12/30/2028)

POWER BUILDING 2

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-5	1	I	IV	BUILDING

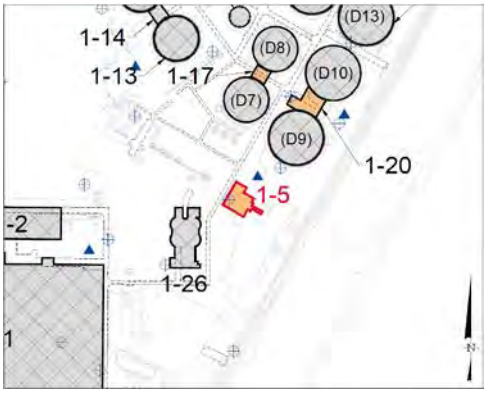
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Tunnel at 22.33' elev. (5.57' embed); dropped spread footings
Structure Dimensions: 50.3 ft x 42 ft
# of Stories: 1 story
Date of Original Construction: 1963
Retrofit (if any): Remodeled in 1973, 1985, and 1996; Chord splices and steel braced frames for the high roof.
Projects: P1-9 / P1-16 / P1-22 / P1-44-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

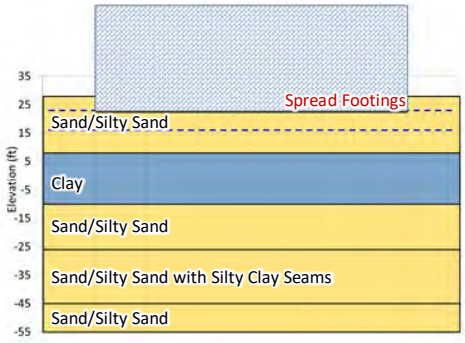
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 10	8 to 9
Lateral Spread (near river, inches)	42 to 45	25 to 40
Lateral Spread (far from river, inches)	29 to 31	17 to 28

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.9 ft-MSL
AWL	11.9 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Walls/footing are not tied together	T1	The walls can move independent of each other, which can result in structural instability (408 feet).
PFM 2: Wall anchorage at the north and south walls of the low roof	T1	The original W12x27 beams are supported by steel columns in the masonry wall, which are not tied into any reinforcing steel, so there is no load path for wall anchorage (4 locations).
PFM 7: Tension failure in the CMU walls due to ground deformation	T1/2	3" over 60 feet (214% of exemplar). Building is similar in size and has larger wall openings, which exacerbates tension failure in the walls.

PFM 8: Lateral spread toward the Santa Ana River due to liquefaction	T1/2	25" of lateral spread toward the Santa Ana River. Dropped wall footings are subject to high cantilevered bending. Stem wall has DCR > 2.0. This action is considered force-controlled, so mitigation is required at any performance level. Also, walls have no ties to the slab and separation can occur during spreading.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 7: Standard Geotechnical Mitigation B2	$2,790,000	Mitigation required to reduce differential settlement by at least 75% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 6 to 47 ft-bgs.
PFM 8: Standard Geotechnical Mitigation A2	See Note 3	Mitigation is required to reduce lateral spread by 70% (surface PGD = 8-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation C1	$145,000	Mitigation required over a length of 408 feet.
PFM 2: Standard Structural Mitigation A1 (SIM)	$245,000	New wall anchorage required at 4 locations where the original W12x27 beams are supported at the CMU walls. Similar, with no additional roof framing members required.
Total Geotechnical and Structural Mitigation Cost	**$3,180,000**	**(excluding lateral spread mitigation, see Note 3)**

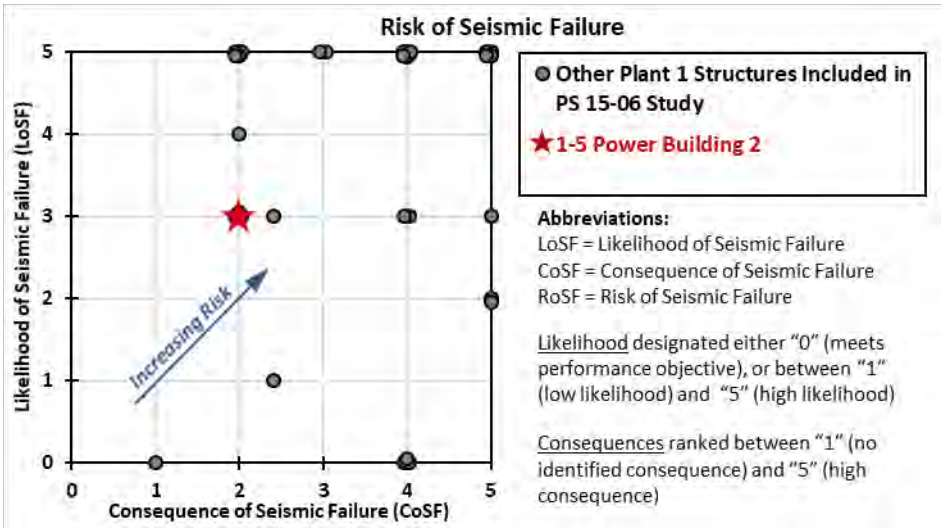
Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☒ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:
LoSF Rating: 3
CoSF, Weighted Score : 2
Overall RoSF = LoSF x CoSF = 6



comments and clarifications

N/A

Next Planned Project and Date: N/A

POWER BUILDING 4

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-6	1	I	IV	BUILDING

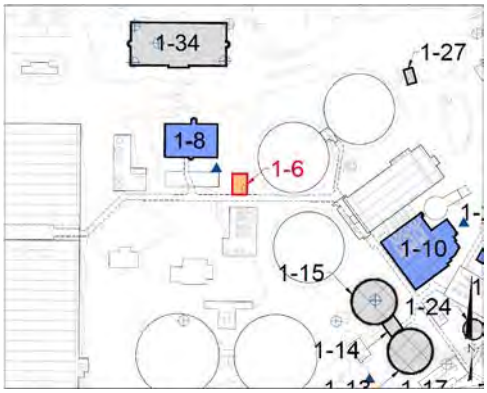
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Basement (partial) with tunnel at 15.50' elev. (13.00' embedment); dropped spread footings
Structure Dimensions: 44 ft x 31.3 ft
# of Stories: 1 story
Date of Original Construction: 1985
Retrofit (if any): N/A
Projects: P1-22

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

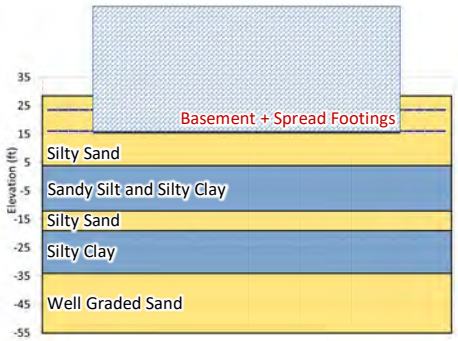
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	5 to 6	3 to 5
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+23.5 ft-MSL
AWL	12.5 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 3: Incomplete load path at the north side of the high roof diaphragm	T1	The north side of the high roof has no lateral load resisting elements to transfer shear forces down to the foundation. Steel bracing is required. Retrofit similar to Power Building C at Plant 2 is recommended.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 3: Provide concentric X-braced frames at the existing louver openings. Provide steel framed blocking at the roof level and weld the roof deck to it. Provide a new steel member sill and anchor to the top of the existing masonry wall with epoxy anchors.	$270,000	Mitigation required over a length of 31 feet. Frames occur at 4 locations having bay sizes of 8-ft long x 5-ft tall.
Total Geotechnical and Structural Mitigation Cost	**$270,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

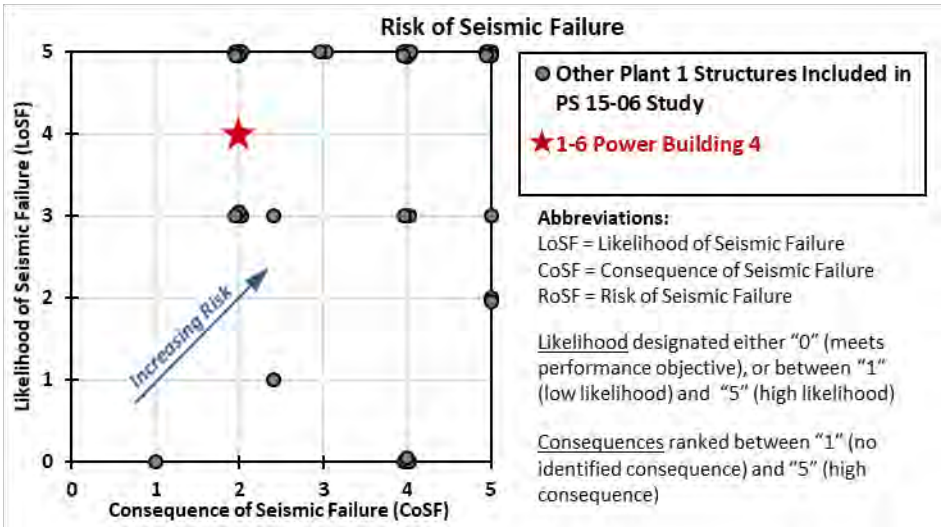
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	4
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	8



comments and clarifications

N/A

Next Planned Project and Date: N/A

POWER BUILDING 5

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-7	1	I	IV	BUILDING

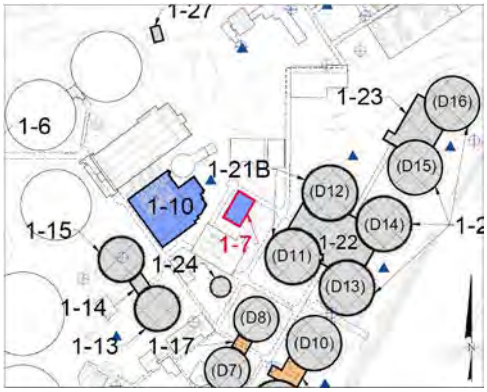
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

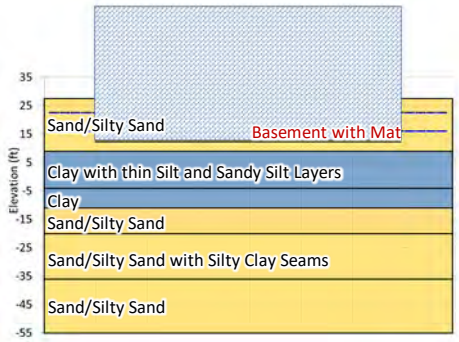
structural components

Foundation Type: Basement with mat foundation at 12.33' elev. (15.17' embedment)
Structure Dimensions: 63.3 ft x 40 ft
# of Stories: 1 story
Date of Original Construction: 1989
Retrofit (if any): N/A
Projects: P1-34-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.5 ft-MSL
AWL	11.5 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 11	8 to 10
Lateral Spread (near river, inches)	13 to 17	10 to 13
Lateral Spread (far from river, inches)	12 to 16	9 to 12

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 2: Wall anchorage at the east and west walls to the roof diaphragm	T1	Roof beam anchorage at the east and west walls is subject to pullout of the anchors at the tops of the pilasters, which can destabilize the W24x94 roof beams (8 locations).
PFM 5: Structure response to differential settlement due to liquefaction	T1/2	2.7" of differential settlement over 60 feet. Differential settlement is nearly the same as the exemplar. Walls have minimal amount of reinforcing steel and will likely experience high overstress due to tension stress. Also, columns supporting the first floor are subject to punching failure at the first floor.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 5: Standard Geotechnical Mitigation B1	$1,170,000	Mitigation required to reduce differential settlement by 60% (1" in 60 feet). Ground improvement for settlement mitigation is required from 12 to 46 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 2: Standard Structural Mitigation A2 (Low)	$220,000	Wall anchorage mitigation at W24x94 roof beams (8 locations).
Total Geotechnical and Structural Mitigation Cost	**$1,390,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

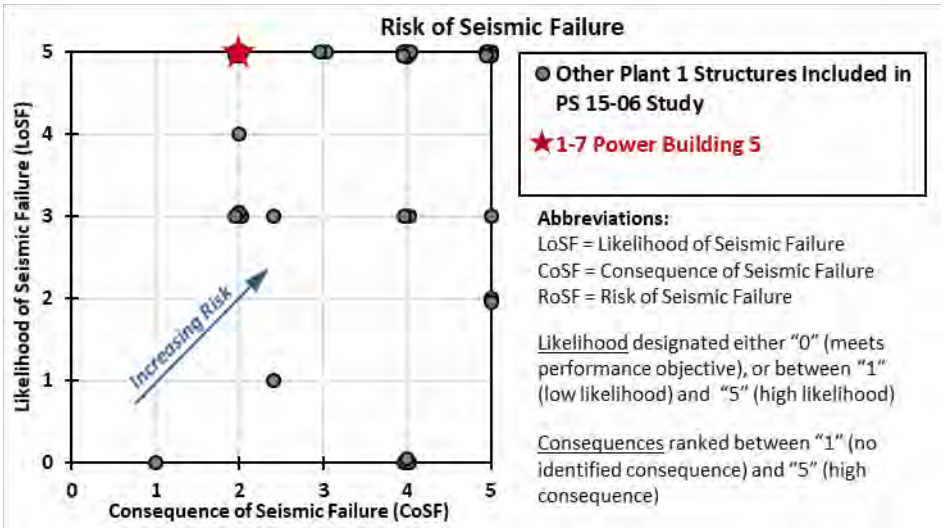
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	10



comments and clarifications

N/A

Next Planned Project and Date: N/A

CONTROL CENTER

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-8	1	I	IV	BUILDING

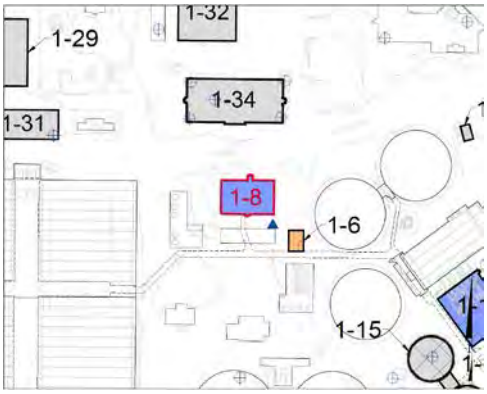
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Basement with mat foundation at 13.00' elev. (15.50' embedment)
Structure Dimensions: 110 ft x 70 ft
# of Stories: 2 above grade, 1 below grade
Date of Original Construction: 1997 (?)
Retrofit (if any): N/A
Projects: J-23-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

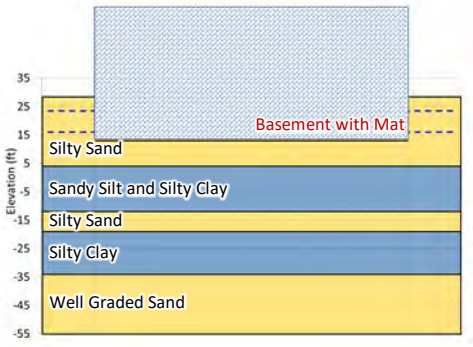
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	5 to 6	3 to 5
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+23.5 ft-MSL
AWL	12.5 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 2: Moment frame column anchorage is not adequate to resist seismic tension demands	T2	The moment frame base plate connections have insufficient capacity to resist tension seismic forces. The weld of the column to the base plate and the base plate thickness were also found to be insufficient.
PFM 4: 2nd Floor diaphragm shear transfer	T1	The 2nd floor diaphragm weld connections lack the capacity to develop the shear capacity of the diaphragm.
PFM 5: Moment frame connection strength	T2	Frame connections are pre-Northridge. 2nd floor frame connections at 48 locations do not meet the performance requirements (only BSE 1E was checked). BSE 2E will likely result in more frame locations that are deficient.
PFM 6: Moment frame panel zone shear strength	T2	Panel zone within moment frame joints lack the shear capacity at 22 locations at the 2nd floor.

PFM 10: Moment frame beam flexure	T2	Seven (7) beams (2 at the roof and 5 at the 2nd floor) have insufficient flexural capacity to meet the IO performance level because the beams are unbraced over their span.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 2, 4 - 6, and 10: Provide steel concentric braced frames from the roof level down to the first floor. Braced frames should be either chevron or X braces and may be comprised of tube steel or buckling restrained braced frame members. Columns will require strengthening at the basement level as required. Add supplemental connections along collector lines with epoxy anchors installed upward into the bottom of the 2nd floor. At roof level add puddle welds along collector lines as required.	$6,610,000	Braced frames required at 8 total bays over 2-stories (16 frames). Will require interior demo and restoration of interior finishes.
Total Geotechnical and Structural Mitigation Cost	**$6,610,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

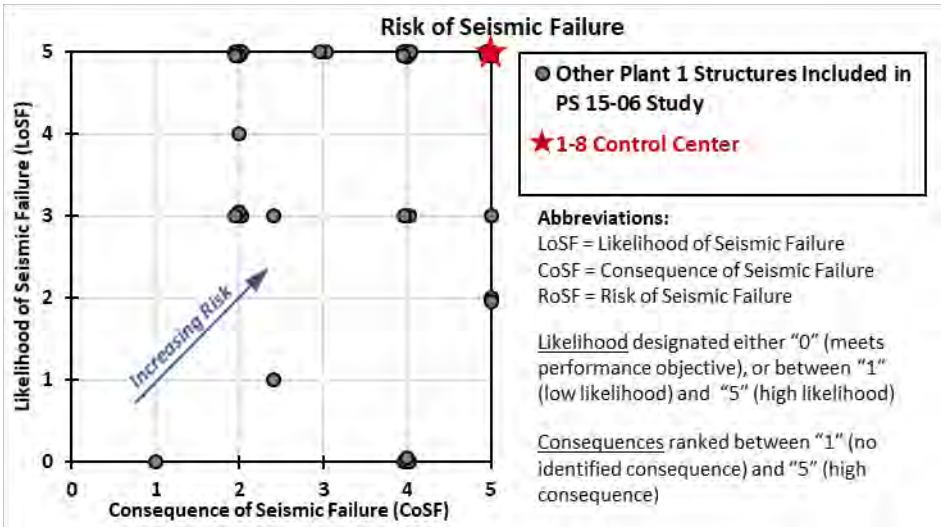
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	25



comments and clarifications

N/A

Next Planned Project and Date: N/A

12kV SERVICE CENTER

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-9	1	I	IV	BUILDING

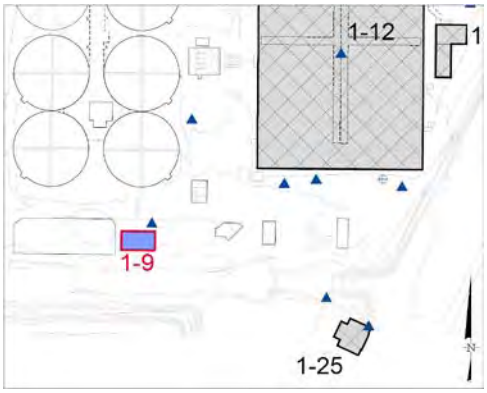
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Basement with mat foundation at 10.25' elev. (17.25' embedment)
Structure Dimensions: 70 ft x 40 ft
# of Stories: 1 above grade, 1 below grade
Date of Original Construction: 1989
Retrofit (if any): N/A
Projects: P1-34-2

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

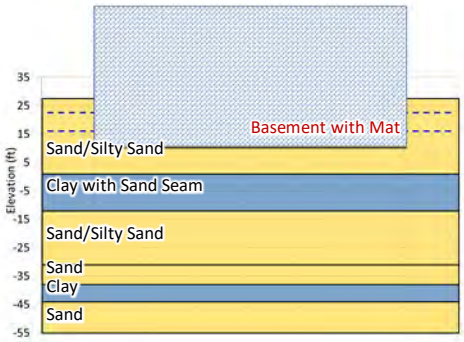
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 12	9 to 11
Lateral Spread (near river, inches)	15 to 19	12 to 16
Lateral Spread (far from river, inches)	13 to 17	11 to 14

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.5 ft-MSL
AWL	11.5 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 2: Wall anchorage to roof at east and west walls	T1	The steel roof deck is flexible and the span is parallel with the east and west walls, which does not provide a rigid connection to the walls. The W24x84 connections will be subject to the full wall anchorage force (8 locations).

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 2: Standard Structural Mitigation A2 (Low)	$220,000	Wall anchorage mitigation at W24x84 roof beams (8 locations).
Total Geotechnical and Structural Mitigation Cost	**$220,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

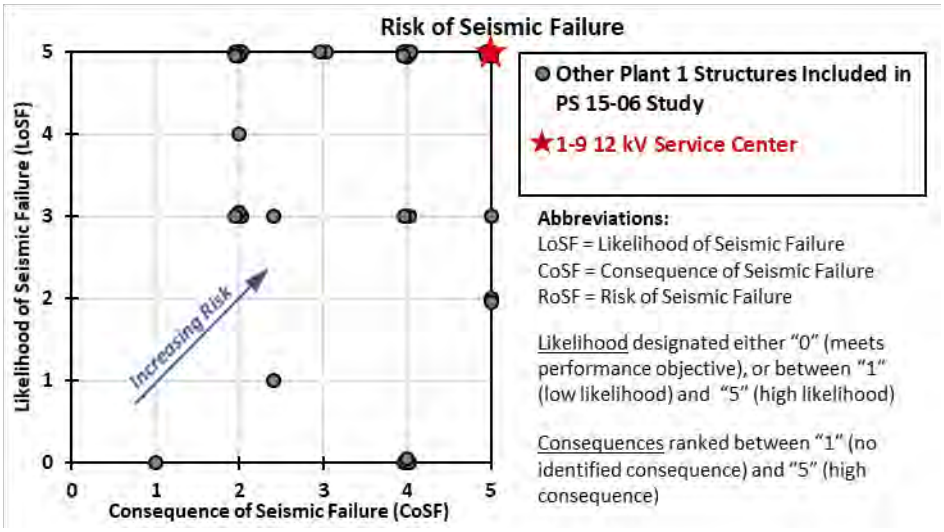
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☒ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	25



comments and clarifications

N/A

Next Planned Project and Date: N/A

CENTRAL POWER GENERATION BUILDING

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-10	1	I	IV	BUILDING

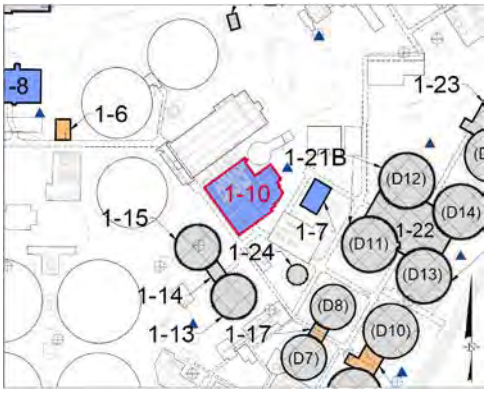
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

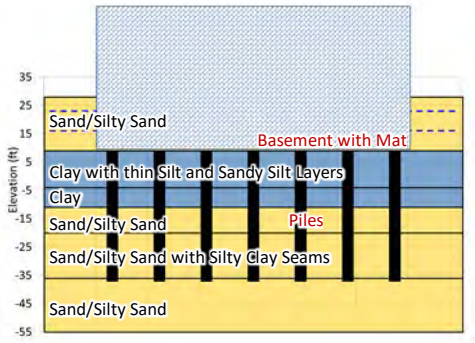
structural components

Foundation Type: Basement with mat foundation at 9.00' elev. (19.00' embedment); driven – PPC piles (46' long)
Structure Dimensions: 140 ft x 123 ft
# of Stories: 2 stories
Date of Original Construction: 1990
Retrofit (if any): N/A
Projects: J-19-1

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☒ Other Shop Drawings: Piles



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+23 ft-MSL
AWL	12 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 11	8 to 10
Lateral Spread (near river, inches)	12 to 15	8 to 9
Lateral Spread (far from river, inches)	10 to 12	7

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Lack of lateral bracing along the east side of the high roof diaphragm	T1	The east side of the high roof (flexible diaphragm) lacks seismic bracing (none provided).
PFM 2: Lack of lateral bracing along the west side of the low roof and 2nd floor at the basement level	T1	The shear walls along the west side of the low roof and the second floor is not continuous down to the foundation. The first-floor deck does not appear to have been designed for this condition.
PFM 3: Insufficient lateral bracing along the west side of the building	T2	The shear walls along the west side of the building are minimal and lack adequate capacity to resist the seismic loads of the building. The balance of the walls are compliant.
PFM 4: Wall anchorage at the high roof north and south walls	T1	The north and south walls use pilasters to brace the walls for out-of-plane loads, but these same pilasters are not anchored to the roof framing. The DCR reported is an estimate of what little capacity the deck provides to resisting these loads. This is a significant deficiency at all performance levels.
PFM 5A: High roof diaphragm shear in roof deck	T2	Excessive shear demands on the roof deck were estimated.

PFM 5B: High roof diaphragm shear in ledger anchor bolts	T2	Anchor bolt shear is excessive at ledger angle anchorage to walls.
PFM 6A: Low roof diaphragm shear in roof deck	T2	Excessive shear demands on the roof deck were estimated.
PFM 6B: Low roof diaphragm shear in ledger anchor bolts	T2	Anchor bolt shear is excessive at ledger angle anchorage to walls.
PFM 9: Out-of-plane bending on the buried walls due to liquefied soil conditions	T2	Performance is expected to experience some non-linear behavior and exceeds performance threshold for IO.
PFM 10: Out-of-plane shear on the buried walls due to liquefied soil conditions	T2	Walls may experience shear stresses that are higher than their capacity.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 9 & 10: Standard Geotechnical Mitigation C	$2,130,000	Mitigation required to reduce soil fluid density by 50% or preclude liquefaction development in backfill altogether. Ground improvement for lateral earth pressure reduction is required from 12 to 19 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation E	$200,000	Applies over 50 lineal feet x 5-ft tall window.
PFM 2: Provide 50 lineal feet of 12-inch thick cast-in-place concrete shear wall at the basement level and upgrade first floor beams with steel channel tie along the entire building length (140 feet) to serve as a collector.	$590,000	Conduit and piping is suspended from the first floor deck along grid line E. These would need to be removed and replaced or relocated.
PFM 3: Standard Structural Mitigation E	$85,000	Applies over 24 lineal feet x 9-ft tall windows.
PFM 4: Standard Structural Mitigation A2 (High) (SIM)	$610,000	Similar with new steel roof framing members. Provide at (6) locations.
PFM 5: Standard Structural Mitigation B1 and B2	$495,000	Replace the roof deck over 39% of the high roof (3,000 sf). Supplement existing anchors at 20" OC (total of 90 epoxy anchors).
PFM 6: Standard Structural Mitigation B1 and B2	$300,000	Replace the roof deck over 20% of the low roof between grid lines 2 to 6 (1,000 sf). Supplement existing anchors at 20" OC (total of 60 epoxy anchors).
Total Geotechnical and Structural Mitigation Cost	**$4,410,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

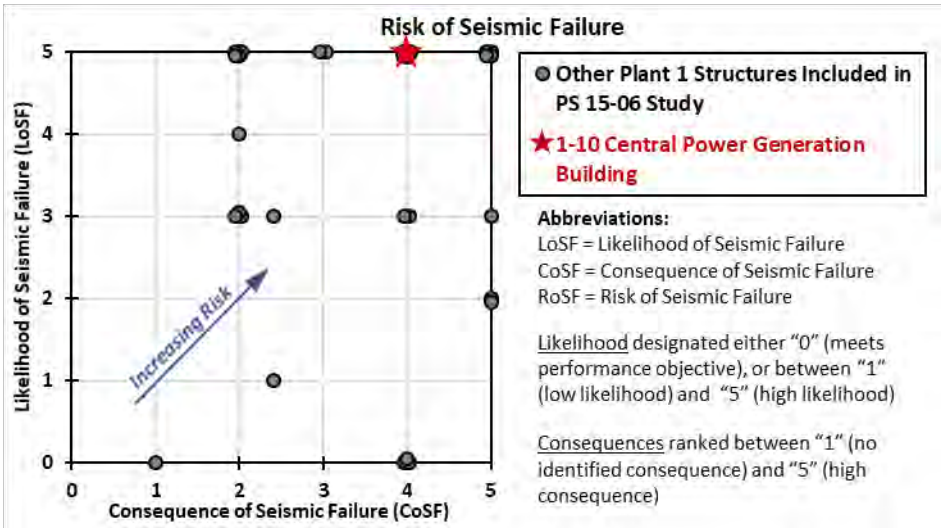
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: P1-127 (09/01/2027)

AERATION BASINS 1-10

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-11	1	I	IV	TANK

class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Driven – PPC piles at 10.00' elev. (17.50' embedment, 12" SQ, 50' long)
Structure Dimensions: 463.8 ft x 277.5 ft
# of Stories: 1 story
Date of Original Construction: 1973
Retrofit (if any): Remodeled in 1985
Projects: P1-16 / P1-36-2

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____

Plan View

geohazards and seismicity

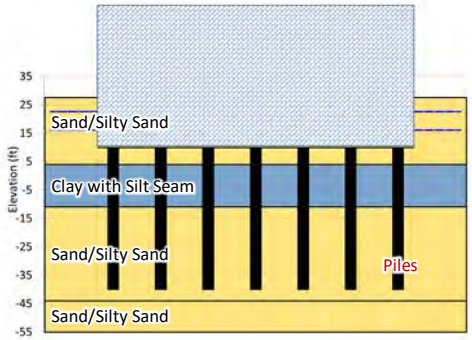
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 10	6 to 8
Lateral Spread (near river, inches)	22 to 44	16 to 26
Lateral Spread (far from river, inches)	8 to 17	6 to 10

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.5 ft-MSL
AWL	11.5 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
N/A		

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$0	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

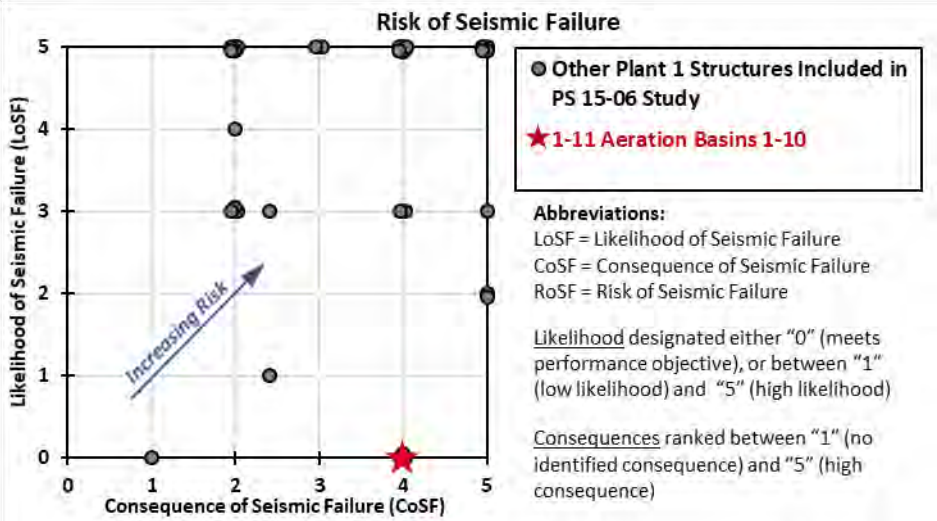
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	0
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	0



comments and clarifications

N/A

Next Planned Project and Date: N/A

SECONDARY CLARIFIERS 1-26

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-12	1	I	IV	TANK

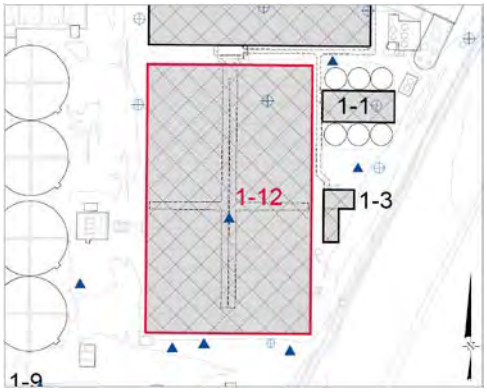
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Driven – PPC piles at 13.50' elev. (13.50' embedment, 12" SQ, 50' long)
Structure Dimensions: 555 ft x 345 ft
# of Stories: 1 story
Date of Original Construction: 1973 (1-14), 1996 (15-24) & 2005 (25-26)
Retrofit (if any): N/A
Projects: P1-16 / P1-36-2 / P1-82

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

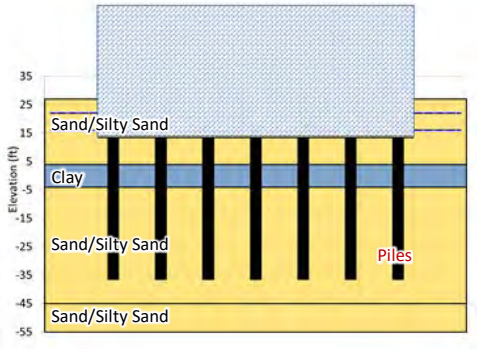
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 8	6 to 8
Lateral Spread (near river, inches)	40 to 57	38 to 56
Lateral Spread (far from river, inches)	7 to 10	6 to 9

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22 ft-MSL
AWL	11 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-20 Secondary Clarifiers A-L; 1-21A Digesters 13-16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 6: Separation across expansion joints due to lateral spread towards the Santa Ana River	T1/2	The structure is divided into 9 blocks via 2 longitudinal and 2 transverse expansion joints. Different lateral spread displacement at different locations (range from 6 to 40 inches) will likely cause large separation of as much as 6-inches at the expansion joints.
PFM 8: Failure of conveyor supporting structure due to lateral spread towards the Santa Ana River	T1/2	The conveyor supporting structures span over the longitudinal expansion gaps and will be subject to large deformations.
PFM 12: Bending/shear failure of piles due to lateral spread	T1/2	Bending moment in piles exceed ultimate capacity at around 24-inches of lateral spread < best estimate PGD of up to 40 inches.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 6 & 12: Standard Geotechnical Mitigation A2	See Note 3	Mitigation is required to reduce lateral spread by at least 60% (surface PGD = 15-inches).
PFM 8: Standard Geotechnical Mitigation A2	See Note 3	Mitigation is required to reduce lateral spread by at least 60% (surface PGD = 15-inches). However, damage to Clarifiers 25 is still likely. To reduced likelihood of damage to Clarifier 25 lateral spread displacement should be limited to half of this value (no more than 6 to 7 inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	**$0**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

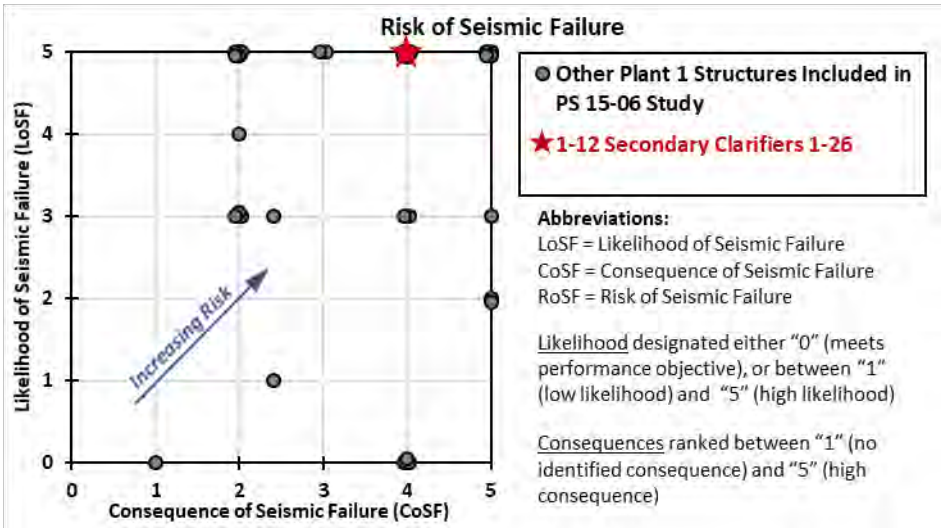
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTER 5

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-13	1	I	IV	TANK

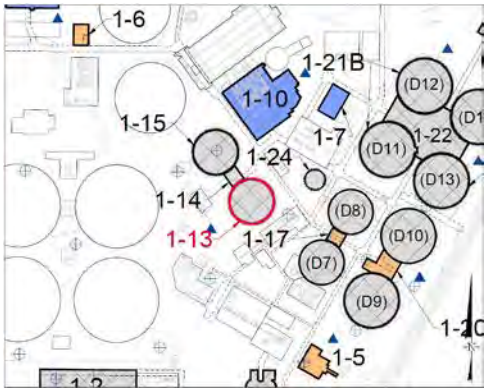
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Driven – PPC piles at 24.92' elev. (3.08' embedment, 14" SQ, 60' long)
Structure Dimensions: 90 ft diameter, 31 ft height, 19 inch wall thickness
# of Stories: 1 story
Date of Original Construction: 1958
Retrofit (if any): N/A
Projects: P1-2

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

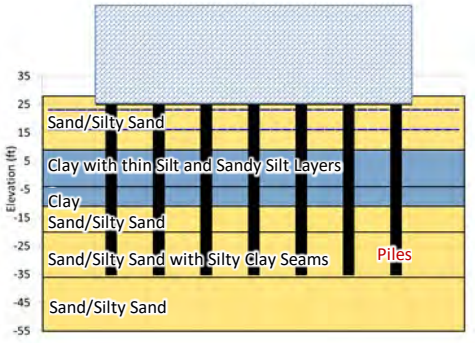
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 11	8 to 10
Lateral Spread (near river, inches)	16 to 19	10 to 11
Lateral Spread (far from river, inches)	14 to 16	9

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+23 ft-MSL
AWL	12 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): Digester 11

PFM and Description[1]	Tier[2]	Assessment Results
N/A		

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$0

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

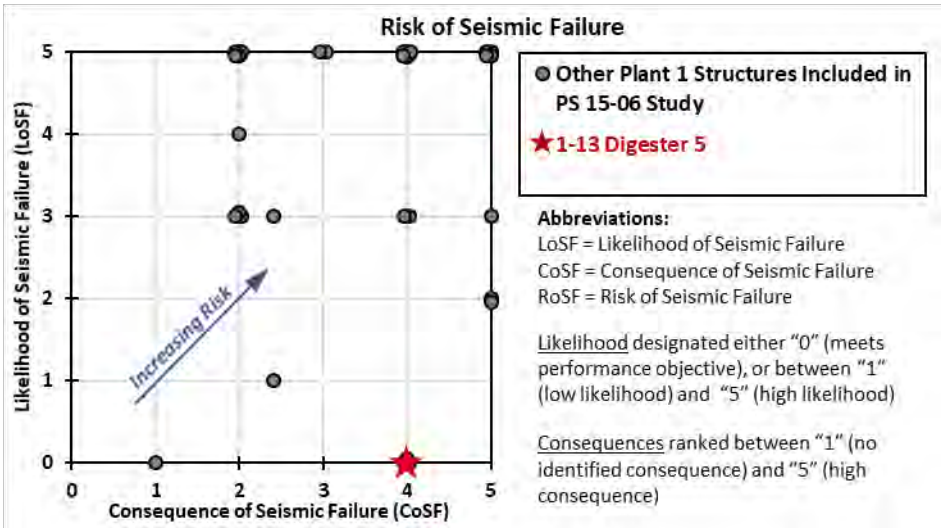
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	0
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	0



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTER 5 PUMP ROOM

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-14	1	I	IV	TANK

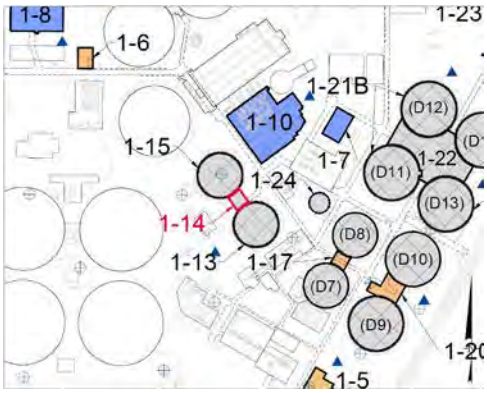
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

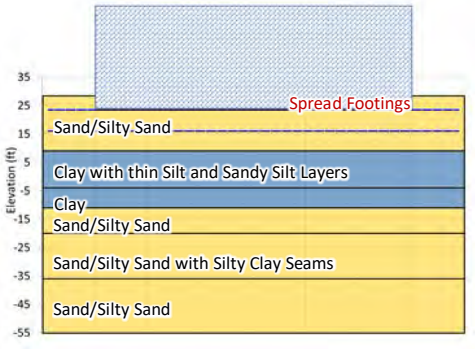
structural components

Foundation Type: Dropped spread footings at 23.50' elev. (5.00' embedment)
Structure Dimensions: 30 ft x 29.5 ft
# of Stories: 1 story
Date of Original Construction: 1958
Retrofit (if any): Remodeled in 1961 and 2009
Projects: P1-2 / P1-5

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+23.5 ft-MSL
AWL	12.5 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 11	8 to 10
Lateral Spread (near river, inches)	14 to 17	9 to 10
Lateral Spread (far from river, inches)	13 to 16	8 to 9

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Footings move independent of the wall	T1	Walls have no structural tie between the wall and the floor slab. Building wall can move differentially from other walls (120 ft).
PFM 2: Insufficient separation from adjacent digesters	T1	The roof deck of the digester pump room is separated from the walls of Digester 5 by 1-inch. Pounding of the roof deck into Digester 5 can occur.
PFM 3: Torsional response of roof diaphragm	T1	The roof diaphragm has shear walls on (3) sides, which will create a torsional response and exacerbate pounding into Digester 5 wall.

PFM 5: Tension failure in the concrete walls due to ground deformation	T1/2	3.2" over 60 feet of differential settlement. Building is smaller than exemplar but has shorter walls and a larger differential settlement. Response is estimated to be similar to the exemplar.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 5: Standard Geotechnical Mitigation B2	$1,420,000	Mitigation required to reduce differential settlement by at least 50% (1-1/2" in 60 feet). Ground improvement for settlement mitigation is required from 5 to 42 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation C1	$55,000	Provide over a length of 120 lineal feet.
PFM 2 & 3: Add cast-in-place concrete shear walls to brace the building on the south side adjacent to Digester 5. Alternatively, consider using the existing masonry wall inside the building and tie it to the existing roof deck to transfer in-plane shear.	$145,000	Add about 12 feet of shear wall x 13.5 feet tall.
Total Geotechnical and Structural Mitigation Cost	**$1,620,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

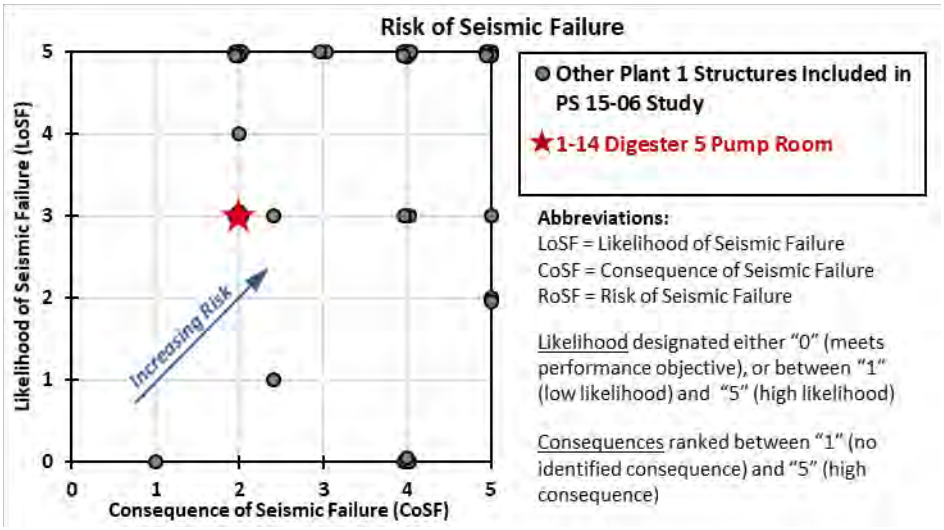
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	6



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTER 6

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-15	1	I	IV	TANK

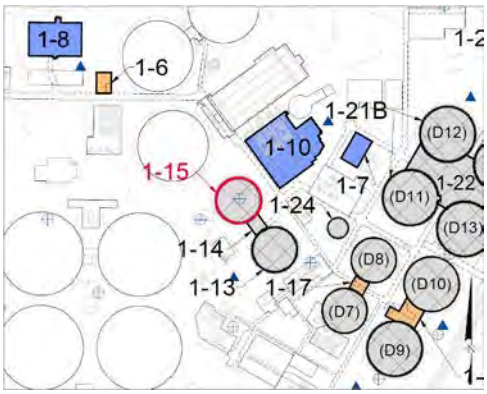
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

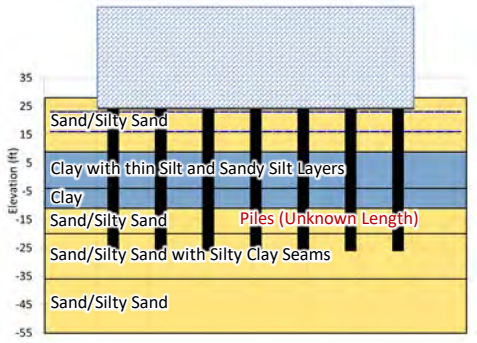
structural components

Foundation Type: Driven – PC piles at 24.07' elev. (3.08' embedment, 14" SQ, unknown length)
Structure Dimensions: 90 ft diameter, 31 ft height, 22 inch wall thickness
# of Stories: 1 story
Date of Original Construction: 1961
Retrofit (if any): P1-100 project 2009
Projects: P1-5

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☒ Other Shop Drawings: Steel dome



Plan View



Schematic Cross Section

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 11	8 to 10
Lateral Spread (near river, inches)	13 to 16	9
Lateral Spread (far from river, inches)	11 to 14	8

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+23 ft-MSL
AWL	12 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): Digester 11

PFM and Description[1]	Tier[2]	Assessment Results
N/A		

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$0

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

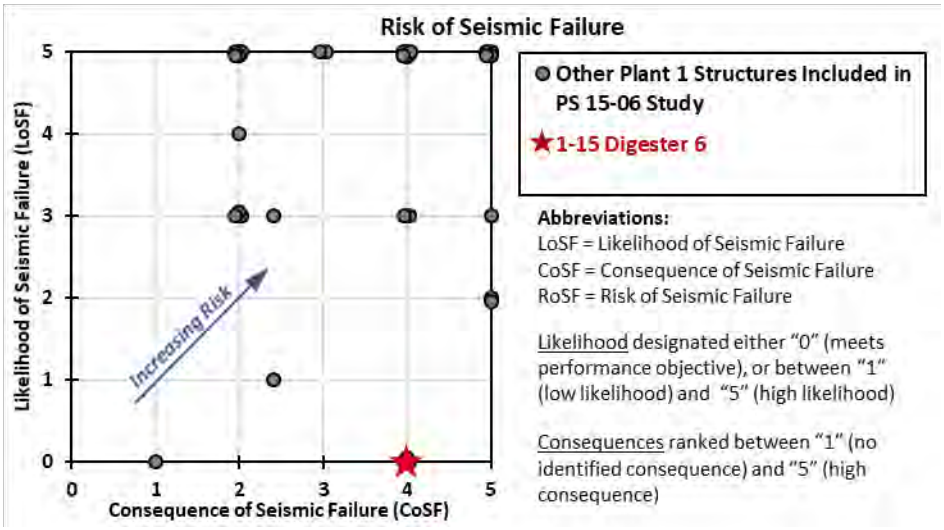
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	0
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	0



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTER 7

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-16	1	I	IV	TANK

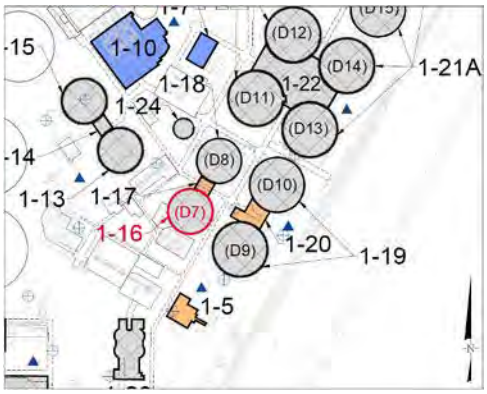
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Driven – STP piles at 23.32' elev. (4.68' embedment, 15.5" to 9.5" dia., 45' long)
Structure Dimensions: 90 ft diameter, 31 ft height, 22 inch wall thickness
# of Stories: 1 story
Date of Original Construction: 1963
Retrofit (if any): N/A
Projects: P1-9 / P1-35-1

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

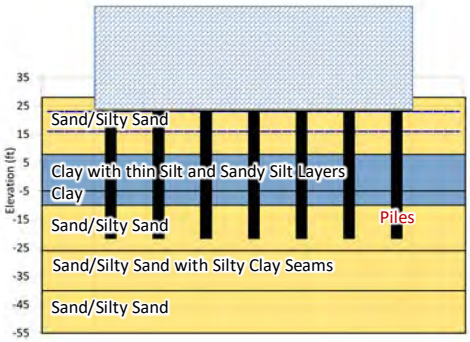
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 12	9 to 10
Lateral Spread (near river, inches)	25 to 33	19 to 29
Lateral Spread (far from river, inches)	19 to 25	15 to 22

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+23 ft-MSL
AWL	12 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-21B Digester 11

PFM and Description[1]	Tier[2]	Assessment Results
PFM 10: Bending/shear failure of piles due to lateral spread (surface PGD = 19 inches)	T1/2	Bending moment in piles exceed **IO (BSE 1E)** limit at 10-inches and **LS (BSE 2E)** limit at 15-inches.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 10: Standard Geotechnical Mitigation A1 or A2	See Note 3	Mitigation is required to reduce lateral spread by at least 20% (surface PGD = 15-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$0	(excluding lateral spread mitigation, see Note 3)

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

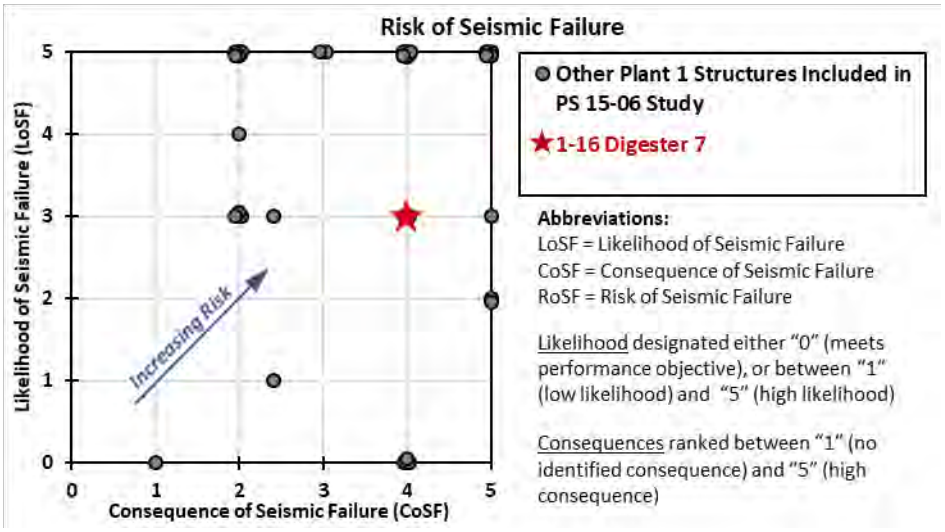
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	12



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTER 7 PUMP ROOM

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-17	1	I	IV	TANK

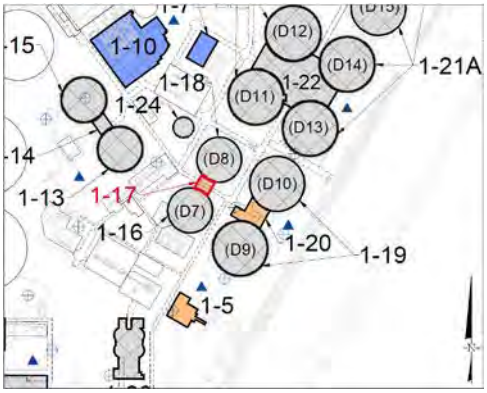
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

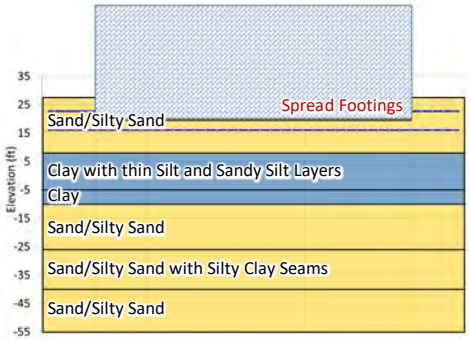
structural components

Foundation Type: Tunnel with dropped spread footings at 19.50' elev. (8.07' embedment)
Structure Dimensions: 32 ft x 28.2 ft
# of Stories: 1 story
Date of Original Construction: 1963
Retrofit (if any): Remodeled in 1969 and 2009
Projects: P1-9 / P1-14

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.6 ft-MSL
AWL	11.6 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 12	9 to 10
Lateral Spread (near river, inches)	22 to 29	17 to 26
Lateral Spread (far from river, inches)	20 to 27	16 to 24

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Footings move independent of the wall	T1	Walls have no structural tie between the wall and the floor slab. Building wall can move differentially from other walls (120 ft).
PFM 2: Insufficient separation from adjacent digesters	T1	The roof deck of the digester pump room is separated from the walls of Digesters 7 and 8 by 1-inch. Pounding of the roof deck into the digesters can occur. Consider adding independent braced frames or shear walls.
PFM 6: Differential lateral spread between Digesters 7 and 8 due to liquefaction	T1/2	Digesters 7 and 8 lateral spread is estimated to be 19"/14.5" and 18"/13.7", respectively. This can result in the Digesters moving into the joint and damaging the building.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 6: Standard Geotechnical Mitigation A1 or A2	See Note 3	Mitigation is required to reduce lateral spread by at least 50% (surface PGD = 9-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation C1	$50,000	Provide over a length of 120 lineal feet.
PFM 2: Add cast-in-place concrete shear walls to brace the building on the north and south sides.	$200,000	Add about 24 feet of shear wall x 13.5 feet tall.
Total Geotechnical and Structural Mitigation Cost	**$250,000**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

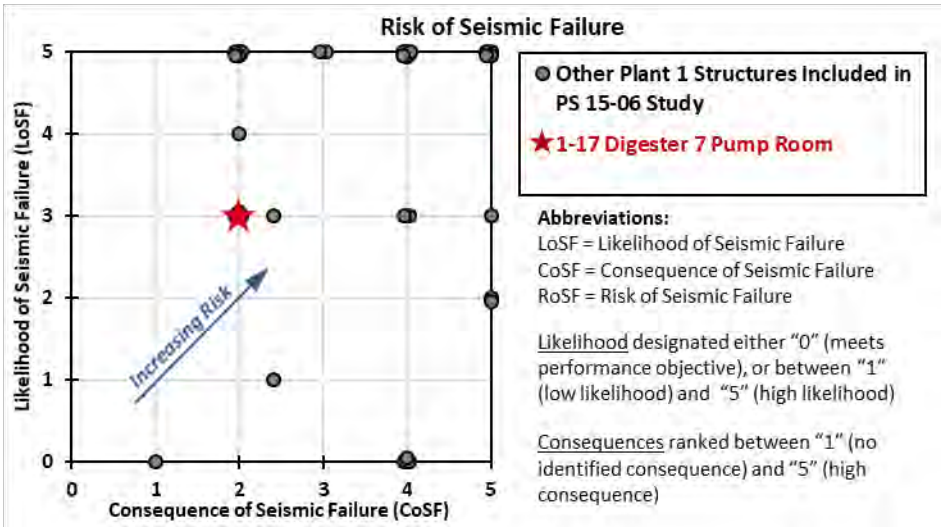
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	6



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTER 8

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-18	1	I	IV	TANK

class based performance objectives

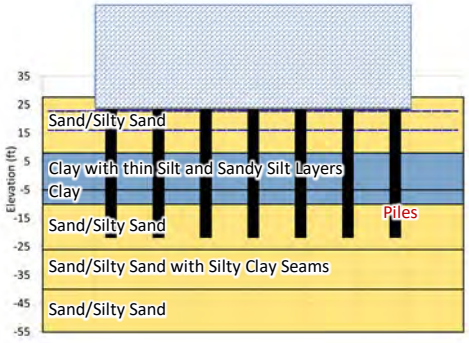
Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Driven – SPP piles at 23.32' elev. (4.25' embedment, 12.75" dia., 45' long)
Structure Dimensions: 90 ft diameter, 31 ft height, 22 inch wall thickness
# of Stories: 1 story
Date of Original Construction: 1969
Retrofit (if any): N/A
Projects: P1-14 / P1-35-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____

Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.6 ft-MSL
AWL	11.6 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 12	9 to 10
Lateral Spread (near river, inches)	24 to 31	18 to 28
Lateral Spread (far from river, inches)	18 to 24	14 to 21

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-21B Digester 11

PFM and Description[1]	Tier[2]	Assessment Results
PFM 10: Bending/shear failure of piles due to lateral spread (surface PGD = 18 inches)	T1/2	Bending moment in piles exceed **IO (BSE 1E)** limit at 10-inches and **LS (BSE 2E)** limit at 15-inches.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 10: Standard Geotechnical Mitigation A1 or A2	See Note 3	Mitigation is required to reduce lateral spread by at least 15% (surface PGD = 15-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	**$0**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

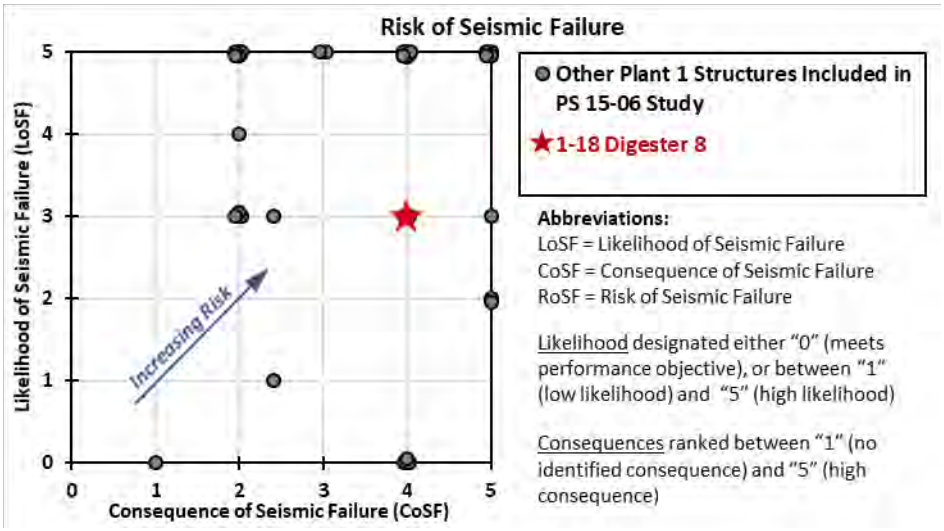
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	12



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTER 9-10

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-19	1	I	IV	BUILDING

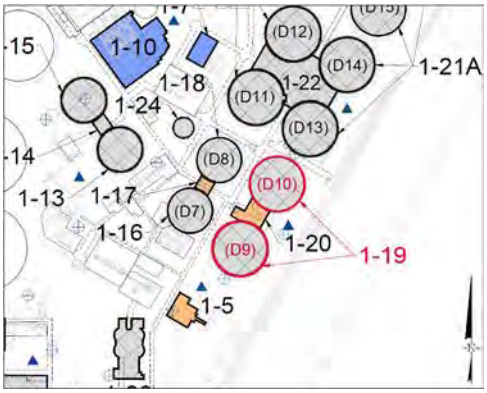
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

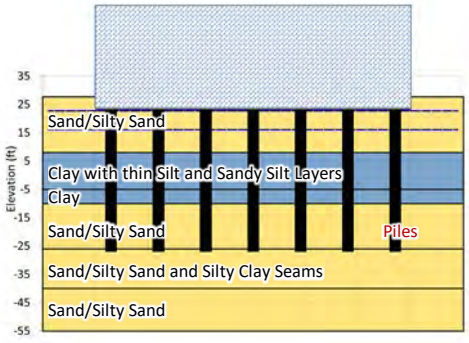
structural components

Foundation Type: Driven – PPC piles at 23.15' elev. (4.51' embedment, 12" SQ, 50' long)
Structure Dimensions: 110 ft diameter, 32 ft height, 27 inch wall thickness
# of Stories: 1 story
Date of Original Construction: 1973
Retrofit (if any): N/A
Projects: P1-16 / P1-35-2

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☒ Other Shop Drawings: Piles



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.7 ft-MSL
AWL	11.7 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 12	9 to 10
Lateral Spread (near river, inches)	55 to 72	40 to 64
Lateral Spread (far from river, inches)	28 to 37	20 to 33

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-21B Digester 11

PFM and Description[1]	Tier[2]	Assessment Results
PFM 10: Bending/shear failure of piles due to lateral spread (surface PGD = 40 inches)	T1/2	Bending moment in piles exceed **IO (BSE 1E)** limit at 10-inches and **LS (BSE 2E)** limit at 15-inches.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 10: Standard Geotechnical Mitigation A1 or A2	See Note 3	Mitigation is required to reduce lateral spread by at least 60% (surface PGD = 15-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$0	(excluding lateral spread mitigation, see Note 3)

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

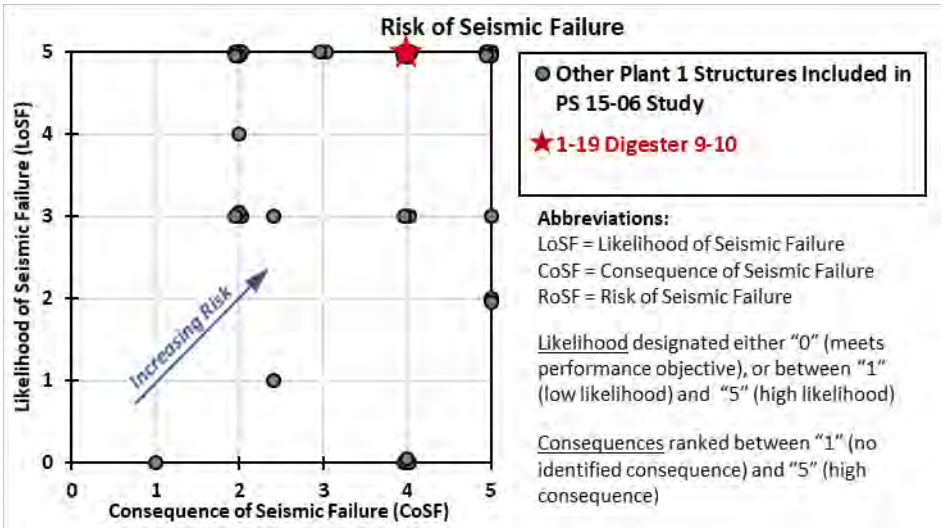
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTER 9-10 PUMP ROOM

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-20	1	I	IV	TANK

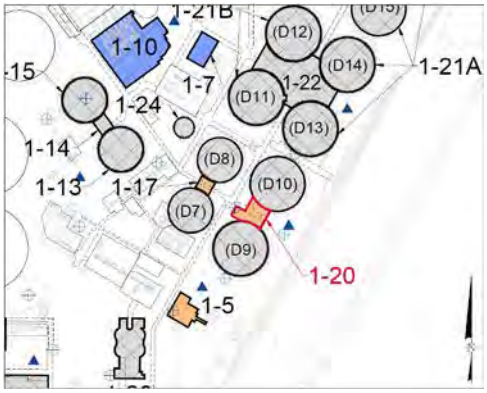
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type: Tunnel with dropped spread footings at 16.61' elev. (10.96' embedment)
Structure Dimensions: 55 ft x 40 ft
# of Stories: 1 story
Date of Original Construction: 1963
Retrofit (if any): Remodeled in 2009
Projects: P1-16

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

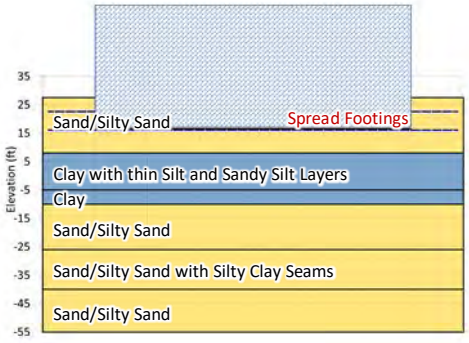
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 12	9 to 10
Lateral Spread (near river, inches)	38 to 50	29 to 45
Lateral Spread (far from river, inches)	27 to 36	21 to 32

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.6 ft-MSL
AWL	11.6 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Footings move independent of the wall	T1	Walls have no structural tie between the wall and the floor slab. Building walls can move differentially from other walls (140 ft).
PFM 2: Insufficient separation from adjacent digesters	T1	The roof deck of the digester pump room is separated from the walls of Digesters 9 and 10 by 1-inch. Pounding of the roof deck into the digesters can occur. Consider adding independent braced frames or shear walls.
PFM 3: Torsional response of roof diaphragm	T1	The roof diaphragm has an irregular configuration of shear walls, which will create a torsional response and exacerbate pounding into the digester walls.
PFM 4: Diaphragm connections at re-entrant corner	T1	The building has (1) re-entrant corner and the roof diaphragm has no detailing to provide chord continuity or drag connections.

PFM 7: Lateral spread toward the Santa Ana River due to liquefaction	T1/2	29"/20.8" (near/far) lateral spread varies by 8.2 inches across the structure. Lateral spread can pull apart the building walls because the floor slab is not tied to the wall/footing (140 ft).
PFM 8: Differential lateral spread between Digesters 9 and 10 due to liquefaction	T1/2	Digesters 9 and 10 lateral spread is estimated to be 40"/20.4". This can result in the Digesters moving into the joint and damaging the building.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 7 & 8: Standard Geotechnical Mitigation A1 or A2	See Note 3	Mitigation is required to reduce lateral spread by 70% (surface PGD = 9-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation C1	$60,000	Provide over a length of 140 lineal feet.
PFM 2 & 3: Add cast-in-place concrete shear walls to brace the building on the north side adjacent to Digester 10.	$180,000	Add about 16 feet of shear wall x 16 feet tall.
PFM 4: Provide stainless steel channel that is anchored to the bottom side of the roof deck with epoxy anchors. The channel should be provided over the full length of the building in the east-west direction.	$100,000	Provide 54 lineal feet.
Total Geotechnical and Structural Mitigation Cost	**$340,000**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

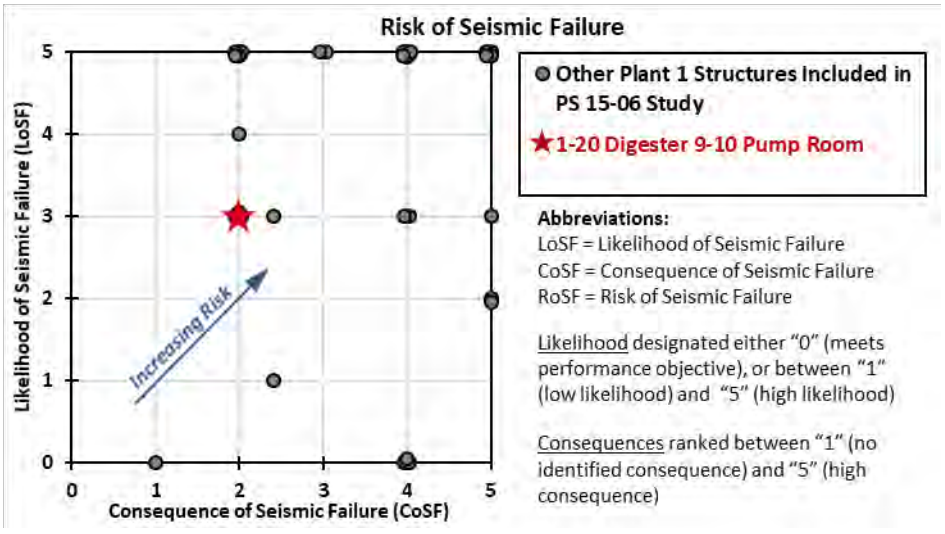
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	6



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTERS 13-16 (FRONT ROW)

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-21A	1	I	IV	TANK

class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Driven – PPC piles at 22.67' elev. (4.33' embedment, 12" SQ, 52' long)
Structure Dimensions: 110 ft diameter, 32 ft height, 27 inch wall thickness
# of Stories: 1 story
Date of Original Construction: 1989
Retrofit (if any): P1-100 project 2009
Projects: P1-34-3

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☒ Other Shop Drawings: Piles

Plan View

geohazards and seismicity

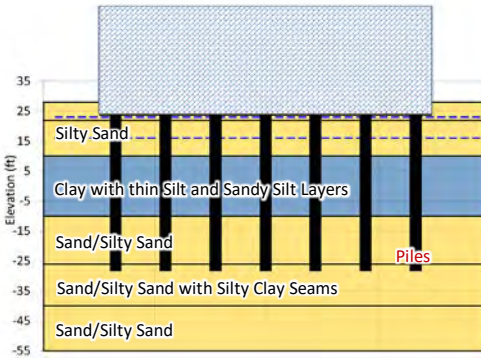
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 11	8 to 10
Lateral Spread (near river, inches)	42 to 58	35 to 52
Lateral Spread (far from river, inches)	21 to 29	17 to 26

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22 ft-MSL
AWL	11 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 10: Bending/shear failure of piles due to lateral spread (surface PGD > 35-inches)	T3	Bending moment in piles exceed **IO (BSE 1E)** limit at 10-inches and LS **(BSE 2E)** limit at 15-inches.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 10: Standard Geotechnical Mitigation A1 or A2	See Note 3	Mitigation is required to reduce lateral spread by at least 60% (surface PGD = 15-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$0	(excluding lateral spread mitigation, see Note 3)

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

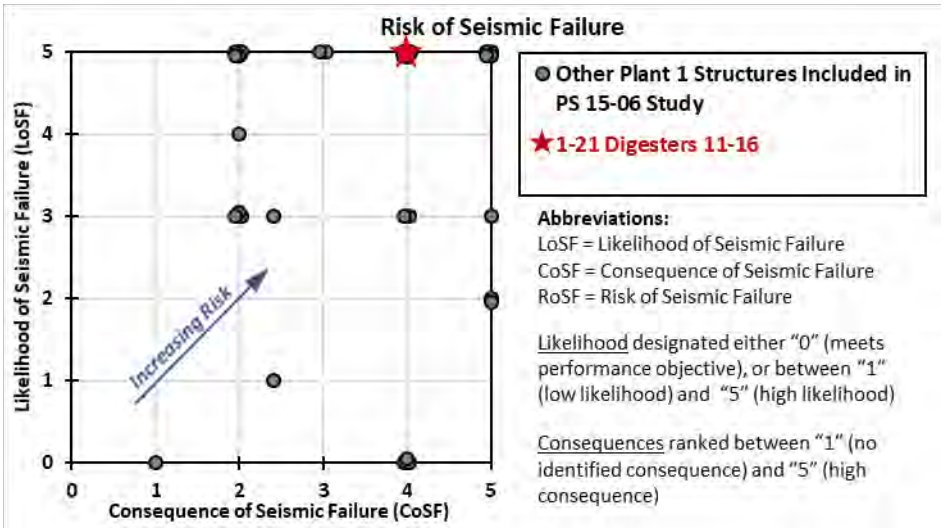
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTERS 11-12 (BACK ROW)

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-21B	1	I	IV	TANK

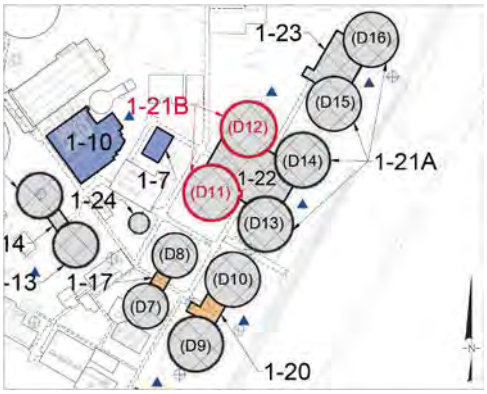
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

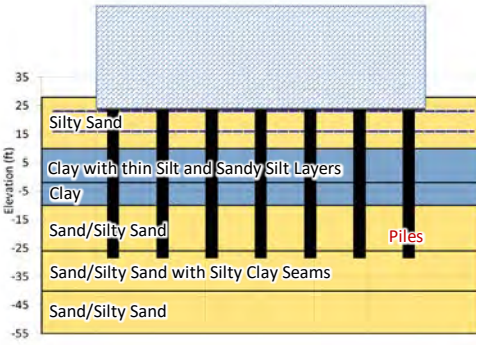
structural components

Foundation Type/Dimensions: Driven – PPC piles at 22.67' elev. (4.33' embedment, 12" SQ, 52' long)
Structure Dimensions: 110 ft diameter, 32 ft height, 27 inch wall thickness
# of Stories: 1 story
Date of Original Construction: 1989
Retrofit (if any): P1-100 project 2009
Projects: P1-34-3

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☒ Other Shop Drawings: Piles



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22 ft-MSL
AWL	11 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 11	8 to 10
Lateral Spread (near river, inches)	20 to 27	16 to 24
Lateral Spread (far from river, inches)	14 to 19	11 to 17

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 10: Bending/shear failure of piles due to lateral spread (surface PGD = 16 inches)	T3	Bending moment in piles exceed **IO (BSE 1E)** limit at 10-inches and **LS (BSE 2E)** limit at 15-inches.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 10: Standard Geotechnical Mitigation A1 or A2	See Note 3	Mitigation is required to reduce lateral spread to at least 5% (surface PGD = 15-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	**$0**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

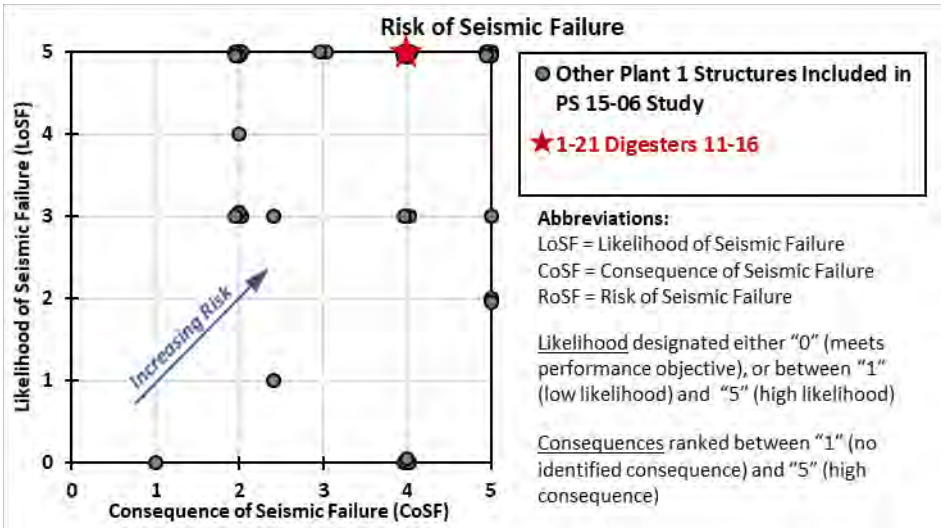
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTERS 11-16 PUMP ROOM 1

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-22	1	I	IV	TANK

class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Driven – PPC piles at 10.50' elev. (16.50' embedment, 12" SQ, 52' long)
Structure Dimensions: 178 ft x 116 ft
# of Stories: 1 story
Date of Original Construction: 1990
Retrofit (if any): Remodeled in 2009 (non-structural components only)
Projects: P1-34-3

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____

Plan View

geohazards and seismicity

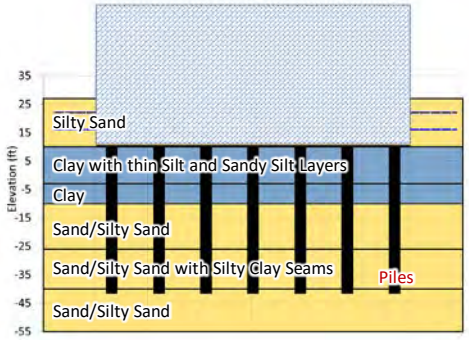
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 11	8 to 10
Lateral Spread (near river, inches)	32 to 43	26 to 38
Lateral Spread (far from river, inches)	16 to 21	13 to 19

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22 ft-MSL
AWL	11 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-21A Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Insufficient separation from adjacent digesters causes structure pounding	T1	The roof deck of the digester pump room is separated from the walls of Digesters 11-14 by a 2-inch expansion joint. Pounding of the roof deck into the digester walls can occur. Drift at the roof is estimated to be 3". Given the findings for the concrete moment frames, addition of braced frames or shear walls is recommended.
PFM 2: In-plane wall shear at shear walls	T1	Walls in both orthogonal directions were found to be deficient for the **IO (BSE 1E)** performance level, but only in the E-W direction for both **IO (BSE 1E)** and **LS (BSE 2E)** performance levels.
PFM 3: Column shear at moment frames	T1	Columns that are part of the concrete moment frames have excessive shear force. The evaluation was made assuming that the shear walls were not providing lateral load resistance. Mitigation with addition of shear walls will address this potential failure mode.

PFM 5: Bending/shear failure of piles due to lateral spread (surface PGD = 26 inches)	T1/2	10.3" (estimate at pile head) lateral spread toward the Santa Ana River. DCR is the near pile top displacement over pile top displacement at yield (3.5").
PFM 6: Differential lateral spread between Digesters 11-14 due to liquefaction	T1/2	Digesters 11 and 12 lateral spread is estimated to vary from 11.3'' to 16''. This can result in the Digesters moving into the joint and damaging the building.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 5 & 6: Standard Geotechnical Mitigation A1 or A2	See Note 3	Mitigation is required to reduce lateral spread by 50% (surface PGD = 13-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1 – 3: Provide cast-in-place concrete shear walls in both orthogonal directions from the roof down to the basement to reduce building drift.	$1,080,000	Provide approximately 420 lineal feet x 15 feet tall.
Total Geotechnical and Structural Mitigation Cost	**$1,080,000**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

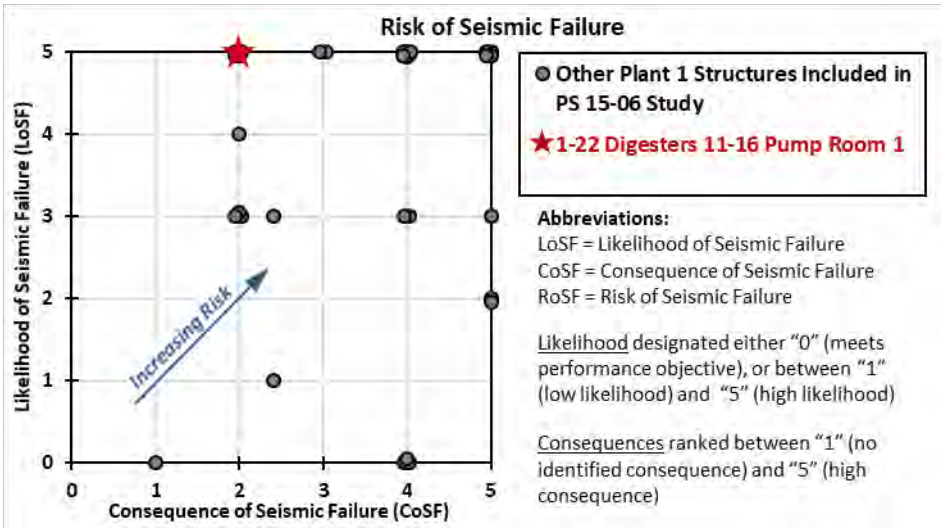
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	10



comments and clarifications

N/A

Next Planned Project and Date: N/A

DIGESTERS 11-16 PUMP ROOM 2

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-23	1	I	IV	TANK

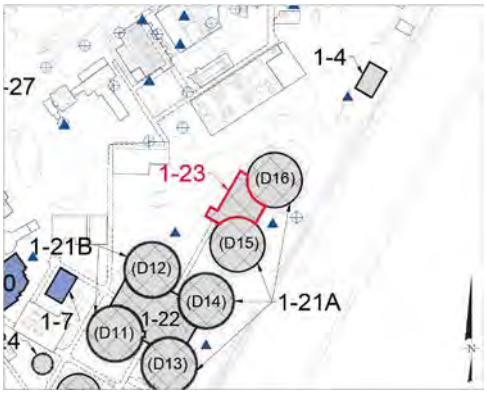
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Driven – PPC piles at 10.50' elev. (16.50' embedment, 12" SQ, 52' long)
Structure Dimensions: 116 ft x 80 ft
# of Stories: 1 story
Date of Original Construction: 1990
Retrofit (if any): Remodeled in 2009 (non-structural components only)
Projects: P1-34-3

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

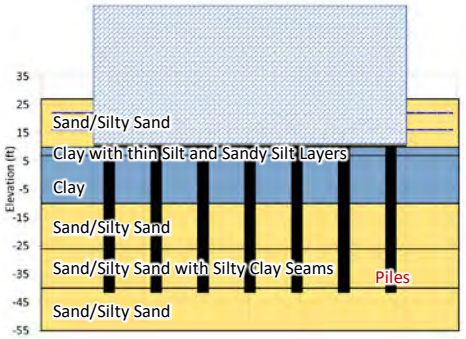
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	8 to 9	6 to 8
Lateral Spread (near river, inches)	28 to 38	20 to 29
Lateral Spread (far from river, inches)	18 to 24	13 to 18

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22 ft-MSL
AWL	11 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-21A Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Insufficient separation from adjacent digesters	T1	The roof deck of the digester pump room is separated from the walls of Digesters 15-16 by a 2-inch expansion joint. Pounding of the roof deck into the digester walls can occur. Drift at the roof is estimated to be 5.7". Given the findings for the concrete moment frames, addition of braced frames or shear walls is recommended.
PFM 2: Discontinuous shear wall at the east and south elevations	T1	Shear wall at the south side of the building is discontinuous below the first floor.
PFM 3: In-plane wall shear at shear walls	T1	Only the walls in the east-west direction were found to be deficient.

PFM 4: Column shear at moment frames	T1	Columns that are part of the concrete moment frames have excessive shear force. The evaluation was made assuming that the shear walls were not providing lateral load resistance. Mitigation with addition of shear walls will address this potential failure mode.
PFM 6: Bending/shear failure of piles due to lateral spread (surface PGD = 20 inches)	T1/2	9.7" (estimate at pile head level) lateral spread toward the Santa Ana River. DCR is the near pile top displacement over pile top displacement at yield (3.5").

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	**Cost[2]**	**Comments**
PFM 6: Standard Geotechnical Mitigation A1 or A2	See Note 3	Mitigation is required to reduce lateral spread by 50% (surface PGD = 10-inches).

Recommended Structural Mitigation[1]	**Cost[2]**	**Comments**
PFM 1-4: Provide cast-in-place concrete shear walls in both orthogonal directions from the roof down to the basement to reduce building drift.	$420,000	Provide approximately 120 lineal feet x 15 feet tall.
Total Geotechnical and Structural Mitigation Cost	**$420,000**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

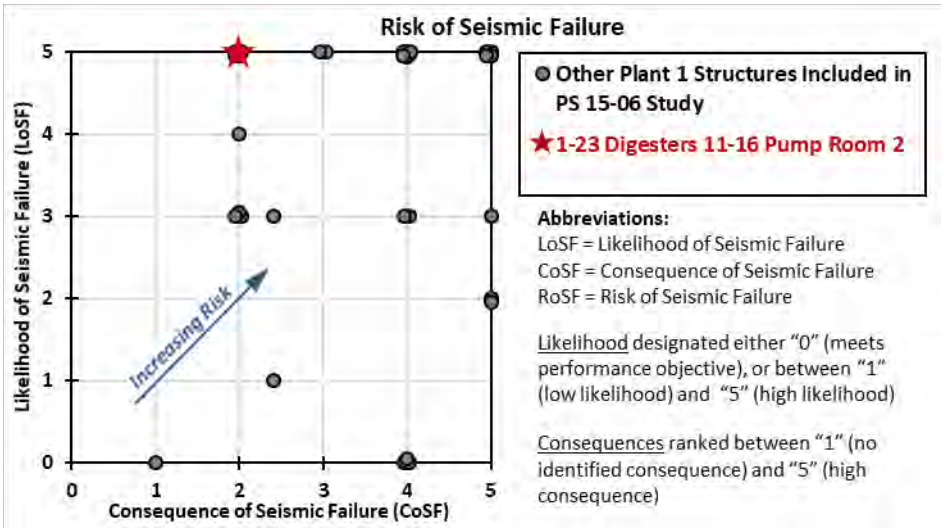
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	10



comments and clarifications

N/A

Next Planned Project and Date: N/A

GAS HOLDER

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-24	1	I	IV	TANK

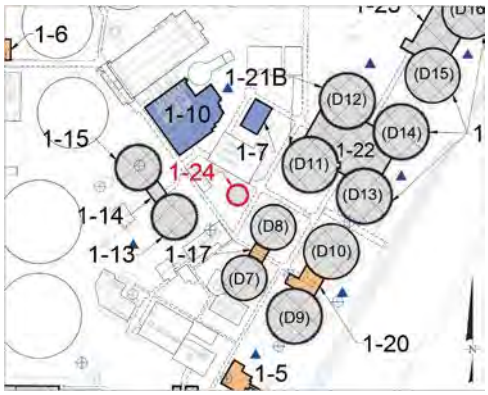
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

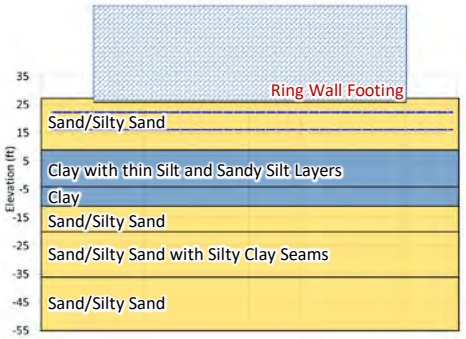
structural components

Foundation Type/Dimensions: Ring wall footing at 25.75' elev. (1.50' embedment, 2' wide)
Structure Dimensions: 42 ft diameter, 32 ft height
# of Stories: 1 story
Date of Original Construction: 1990
Retrofit (if any): N/A
Projects: P1-34-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☒ Other Shop Drawings: Gas holder



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22.3 ft-MSL
AWL	11.3 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 11	8 to 10
Lateral Spread (near river, inches)	16 to 20	11 to 12
Lateral Spread (far from river, inches)	15 to 18	10 to 11

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-19 Gas Holder

PFM and Description[1]	Tier[2]	Assessment Results
PFM 6: Tank shell overstress due to liquefaction-induced settlements	T1/2	Does not meet **IO (BSE 1E)** performance objectives. Stress in thank shell at the anchor chair location may exceed yield, may result in gas leakage. Does meet **LS (BSE 2)** performance objectives. DCR > 1.0, overstress at anchor locations may cause permanent deformation and/or gas leakage, low likelihood of collapse.
PFM 7: Anchor failure overstress due to liquefaction-induced settlements	T1/2	Does not meet **IO (BSE 1E)** performance objectives. Stress in the anchor bolt may exceed yield, local tear in tank shell at anchor chair location possible. Does meet **LS (BSE 2)** performance objectives. DCR > 1.0, overstress in anchor locations may cause permanent deformation or fracture, low likelihood of collapse.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 6 & 7: Standard Geotechnical Mitigation B2	$1,800,000	Mitigation required to reduce differential settlement by 80% (1.5" in 60 feet). Ground improvement for settlement mitigation is required from 2 to 51 ft-bgs

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$1,800,000	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

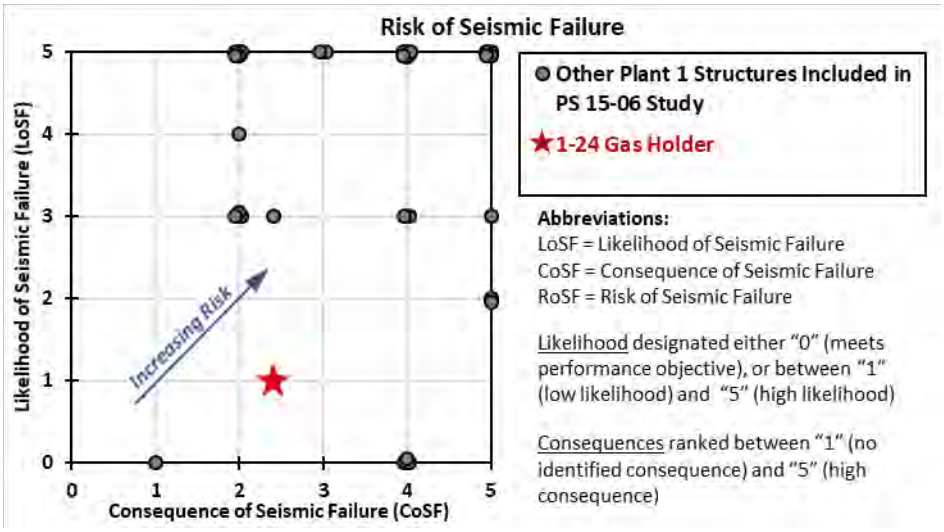
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	1
CoSF, Weighted Score:	2.4
Overall RoSF = LoSF x CoSF =	2.4



comments and clarifications

N/A

Next Planned Project and Date: J-124 (In Progress)

EFFLUENT JUNCTION BOX

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-25	1	I	IV	BUILDING

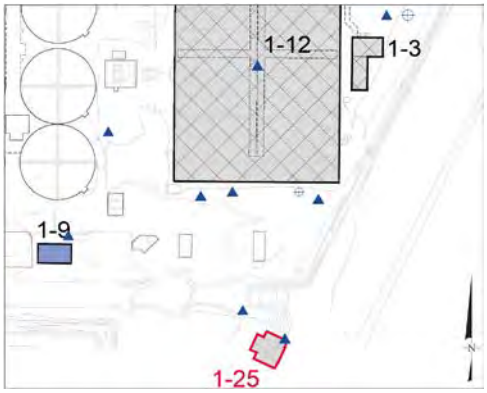
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Driven – PPC piles at 0.00' elev. (25.40' embedment, 14" SQ, unknown length)
Structure Dimensions: 48 ft x 63 ft
# of Stories: 1 below grade
Date of Original Construction: 1989
Retrofit (if any): N/A
Projects: P1-33

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

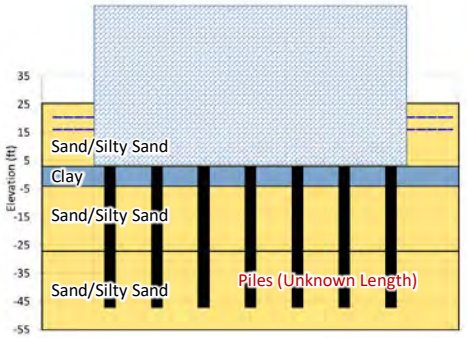
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 10	7 to 9
Lateral Spread (near river, inches)	160 to 225	150 to 165
Lateral Spread (far from river, inches)	49 to 69	46 to 50

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+20.4 ft-MSL
AWL	9.4 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-21A Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 4: Shear failure of piles due to lateral spread towards the Santa Ana River	T2	No lateral spread is estimated at the base of the structure. The structure is founded on piles. Structure is subject to overturning and shearing due to application of passive and active earth pressures from spreading soils above the base of the structure. Shear failure of piles is possible.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 4: Standard Geotechnical Mitigation A2	See Note 3	Mitigation requires reduction of lateral spread so that passive force application on the structure is reduced by at least 50%.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	**$0**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

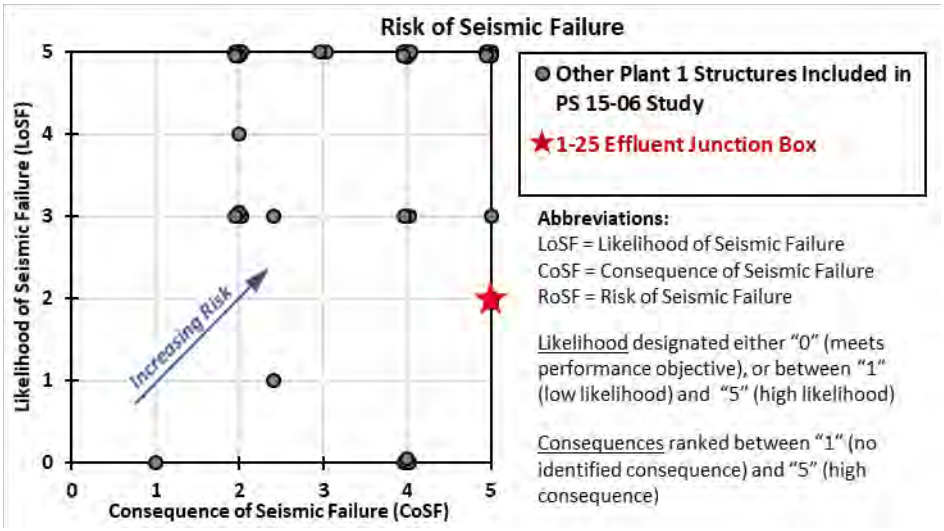
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☒ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	2
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	10



comments and clarifications

N/A

Next Planned Project and Date: N/A

SOLIDS STORAGE FACILITY

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-26	1	II	II	BUILDING

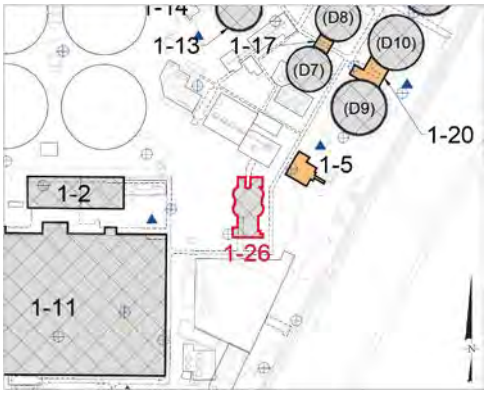
class based performance objectives

Class II: Not directly necessary to preserve wastewater flow through system; loss of life potential is low. Continued occupancy and operation might not be likely before repair.

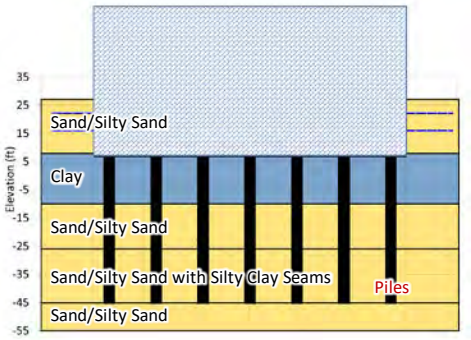
structural components

Foundation Type/Dimensions: Driven – PPC piles at 6.75' elev. (20.25' embedment, 12" SQ, 52' long)
Structure Dimensions: 71 ft x 41 ft
# of Stories: 2 stories
Date of Original Construction: 1989
Retrofit (if any): N/A
Projects: P1-34-2

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	8 to 10	7 to 9
Lateral Spread (near river, inches)	24 to 35	18 to 31
Lateral Spread (far from river, inches)	17 to 25	13 to 22

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22 ft-MSL
AWL	11 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-21A Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Building pounding due to response to ground shaking	T1	The north and south structures are separated by a 2-inch expansion joint, which is much less than 4% of the building height. Tying the structures together may result in significant damage as the north and south structures may have a large differential lateral spread.
PFM 5: Bending/shear failure of piles at the south structure due to lateral spread (surface PGD = 18 inches)	T1/2	15.3" (estimate at pile head) lateral spread toward the Santa Ana River. DCR is the near pile top displacement over pile top displacement at yield (3.5").

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 5: Standard Geotechnical Mitigation A2	See Note 3	Mitigation is required to reduce lateral spread by 60% (surface PGD = 7-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Tie the structures together using steel shapes with slotted connections and epoxy anchors. Steel shapes will need to be sized and located to promote uniform response of the building to ground shaking. Lateral spread can impose differential demands across the expansion joint.	$60,000	The recommended mitigation will also require that the lateral spread potential be mitigated.
Total Geotechnical and Structural Mitigation Cost	**$60,000**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

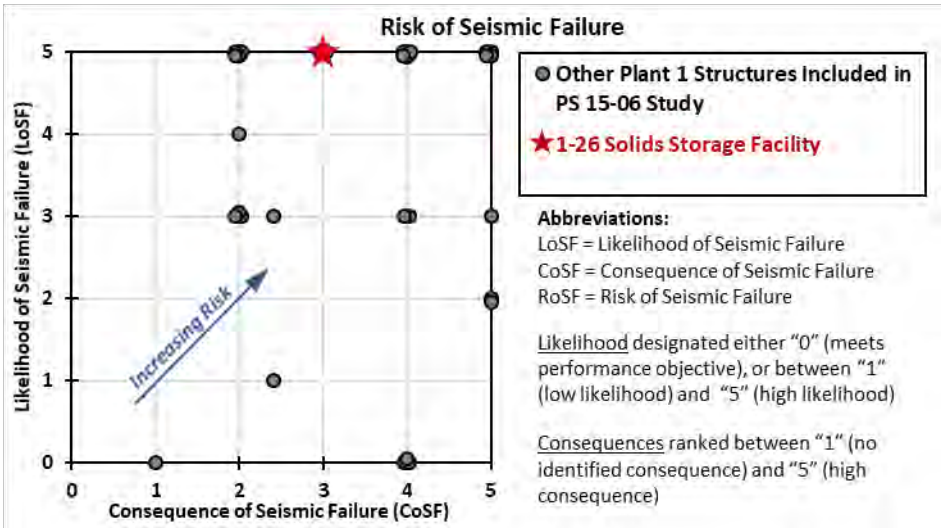
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	3
Overall RoSF = LoSF x CoSF =	15



comments and clarifications

N/A

Next Planned Project and Date: N/A

CHILLER BUILDING

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-27	1	II	II	BUILDING

class based performance objectives

Class II: Not directly necessary to preserve wastewater flow through system; loss of life potential is low. Continued occupancy and operation might not be likely before repair.

structural components

Foundation Type/Dimensions: Shallow spread footings at-grade
Structure Dimensions: 30 ft x 19.3 ft
# of Stories: 1 story
Date of Original Construction: 1989
Retrofit (if any): 1996: Strengthening of roof-to-wall anchorage connections
Projects: J7-4 / P1-44-3

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____

Plan View

geohazards and seismicity

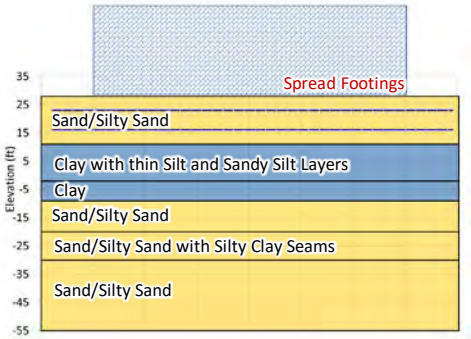
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 8	5 to 6
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+23 ft-MSL
AWL	12 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
N/A		

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$0	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

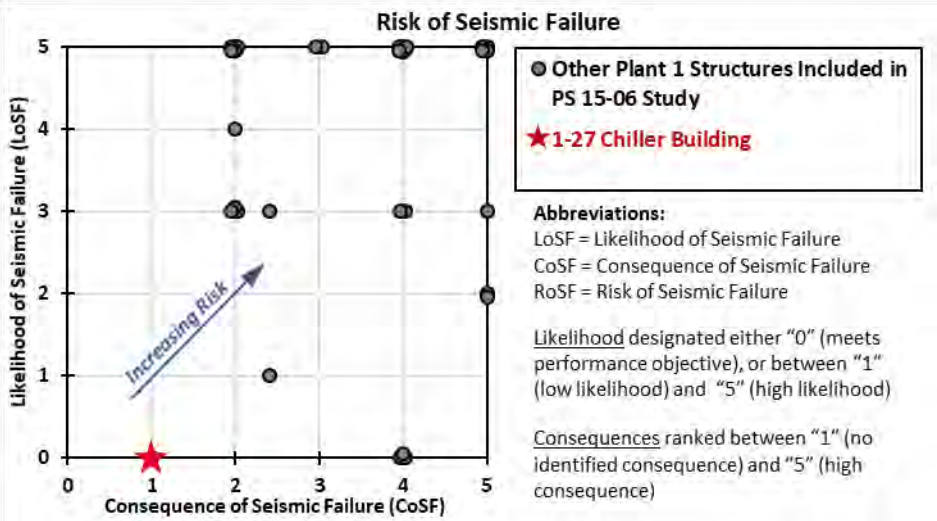
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☒ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	0
CoSF, Weighted Score:	1
Overall RoSF = LoSF x CoSF =	0



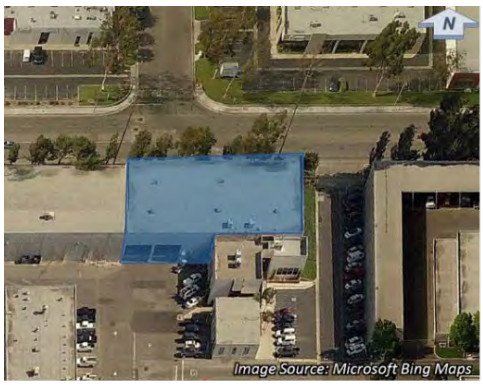
comments and clarifications

N/A

Next Planned Project and Date: N/A

WAREHOUSE BUILDING

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-28	1	II	II	BUILDING



class based performance objectives

Class II: Not directly necessary to preserve wastewater flow through system; loss of life potential is low. Continued occupancy and operation might not be likely before repair.

structural components

Foundation Type/Dimensions: Shallow spread footings at-grade
Structure Dimensions: 100 ft x 150 ft
# of Stories: 1 story
Date of Original Construction: 1972
Retrofit (if any): Remodeled in 1978 and 1996; 1996: Provision of wall anchorage connections at the roof and mezzanine diaphragms, addition of roof and mezzanine diaphragm cross ties, and addition of shear wall bracing for the mezzanine.
Projects: J-13 / J-13-2R / P1-44-3

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____

Plan View

geohazards and seismicity

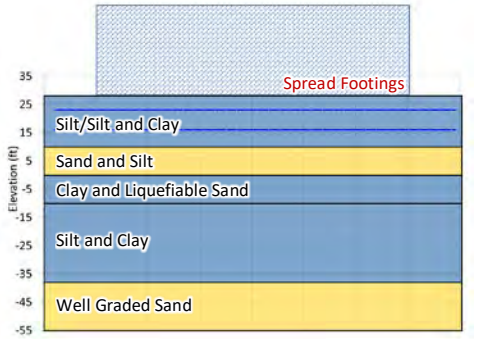
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	6 to 7	5
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+23 ft-MSL
AWL	12 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-29 Shop Building A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Wall panels are not tied to the footings	T1	Walls have no structural tie between the wall and the footing. The behavior of the building is unpredictable and relative movement of the footing below the walls is possible (20 pad footings x 8 ft).
PFM 6: Wall panels are not tied together to resist overturning	T1	Except the south wall, panels are not tied together to resist overturning and can experience spalling at the roof ledger. The south wall joints are stitched together continuously with a pour strip (15 x 20 ft).

PFM 8: Tension failure in the walls due to differential settlement	T1/2	2.2" over 60 feet differential settlement. Tilt-up panels provided with (2) #5 bars at the top of the panel and a continuous ledger angle, which will both work to resist tension in the wall due to ground deformation. The limiting strength occurs at the ledger angle splice (L2x2x1/4).

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation C2	$315,000	Applies over 160 lineal feet (20 pad footings x 8-ft each).
PFM 6: Tie tilt-up wall panels together along their vertical joints using steel plates and epoxy anchors spaced at 4.0-ft on center.	$125,000	Applies to 15 joints that are 20-ft tall each.
PFM 8: Provide continuous supplemental steel chord member along the east and west walls anchored to the existing tilt-up wall panels with epoxy anchors.	$250,000	Applies over the middle 50% of each wall for a total of 250 lineal feet.
Total Geotechnical and Structural Mitigation Cost	**$690,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

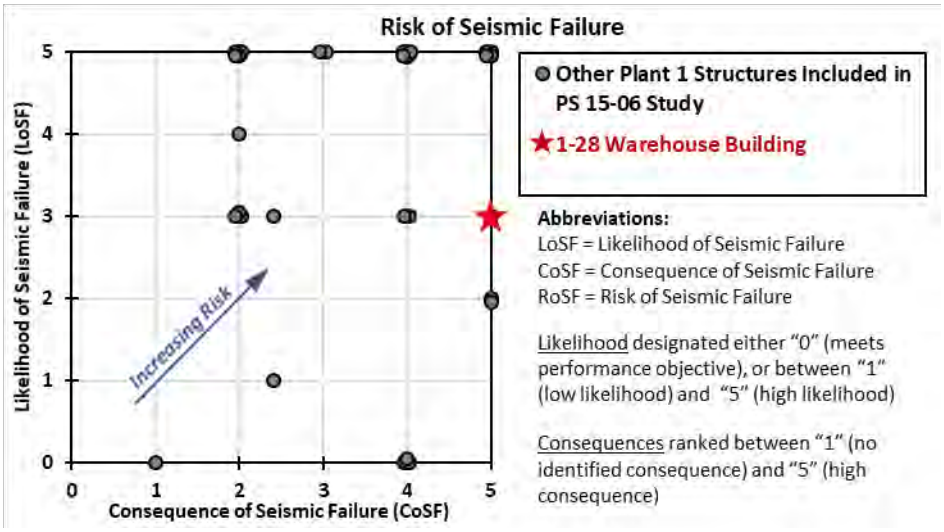
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	15



comments and clarifications

N/A

Next Planned Project and Date: N/A

SHOP BUILDING A

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-29	1	II	II	BUILDING

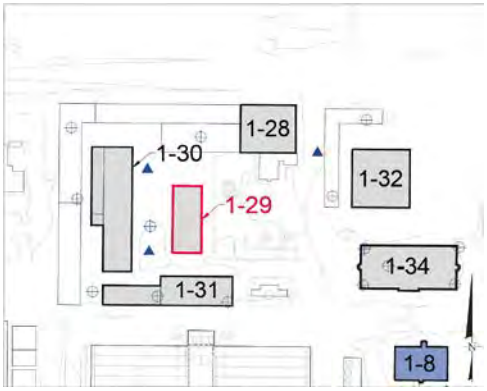
class based performance objectives

Class II: Not directly necessary to preserve wastewater flow through system; loss of life potential is low. Continued occupancy and operation might not be likely before repair.

structural components

Foundation Type/Dimensions: Shallow spread footings at-grade
Structure Dimensions: 140 ft x 60 ft
# of Stories: 1 story
Date of Original Construction: 1972
Retrofit (if any): 1996: Provision of wall anchorage connections at the roof and mezzanine diaphragms, addition of roof and mezzanine diaphragm cross ties, addition of shear wall bracing for the mezzanine, and strengthening of the roof diaphragm for shear resistance.
Projects: J-13 / P1-44-3

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

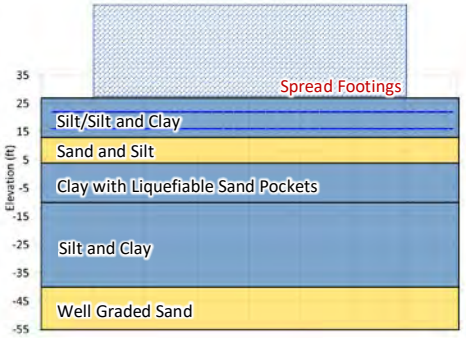
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	6 to 7	5
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22 ft-MSL
AWL	11 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Wall panels are not tied to the footings	T1	Walls have no structural tie between the wall and the footing. The behavior of the building is unpredictable and relative movement of the footing below the walls is possible (20 footings x 8 ft).

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation C2	$280,000	Applies over 160 lineal feet (20 pad footings x 8-ft each).
Total Geotechnical and Structural Mitigation Cost	**$280,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

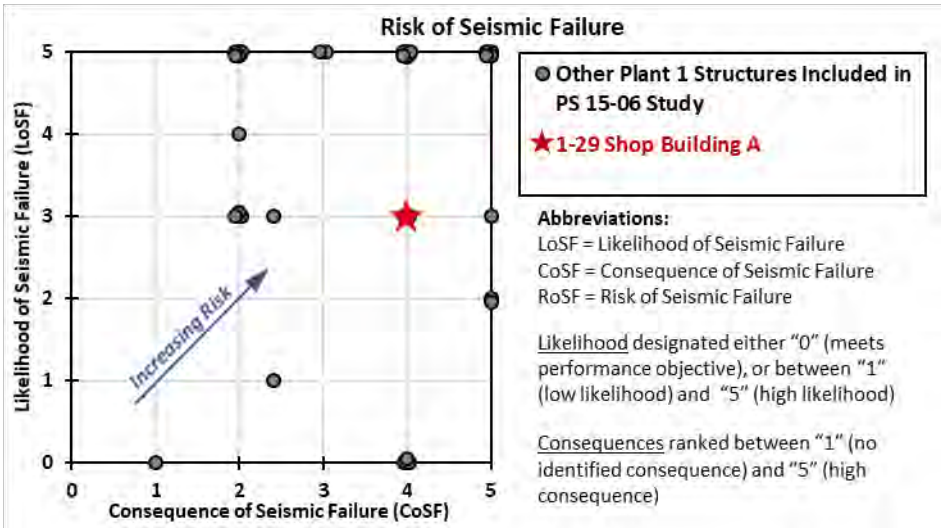
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	12



comments and clarifications

N/A

Next Planned Project and Date: N/A

SHOP BUILDING B AND BUILDING 3

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-30	1	II	II	BUILDING

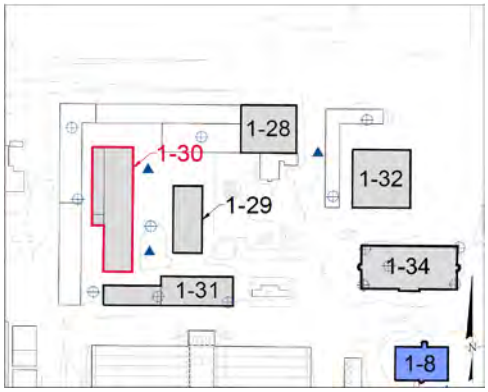
class based performance objectives

Class II: Not directly necessary to preserve wastewater flow through system; loss of life potential is low. Continued occupancy and operation might not be likely before repair.

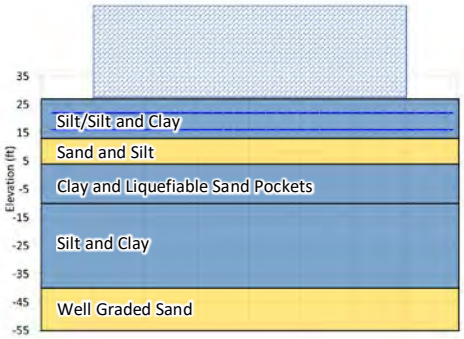
structural components

Foundation Type/Dimensions: Shallow spread footings at-grade
Structure Dimensions: 260 x 85 ft
# of Stories: 1 story
Date of Original Construction: 1972
Retrofit (if any): Remodeled in 1988, 1996, and 2003; 1996: Provision of wall anchorage connections at the roof diaphragm, addition of roof diaphragm cross ties, strengthening of the roof diaphragm for shear resistance, and shear strengthening of the concrete shear walls.
Projects: J-13, J-20 / J-89 / P1-44-3

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+22 ft-MSL
AWL	11 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)		
Lateral Spread (near river, inches)		
Lateral Spread (far from river, inches)		

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-29 Shop Building A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Wall panels are not tied to the footings	T1	Walls have no structural tie between the wall and the footing. The behavior of the building is unpredictable and relative movement of the pad footings below the walls is possible (32 x 8-ft).
PFM 5: Wall anchorage of the roof at the south wall of Building 3	T1	Occurs at (3) locations. The nail transfer to the diaphragm is insufficient.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation C2	$430,000	Applies over 256 lineal feet (32 pad footings x 8-ft each).
PFM 5: Provide additional nailing to develop the wall anchorage force into the diaphragm. Installation of clips angles that are screwed into the strut member and the bottom side of the plywood diaphragm on both sides of the strut member is recommended.	$10,000	Occurs at (3) locations.
Total Geotechnical and Structural Mitigation Cost	**$440,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

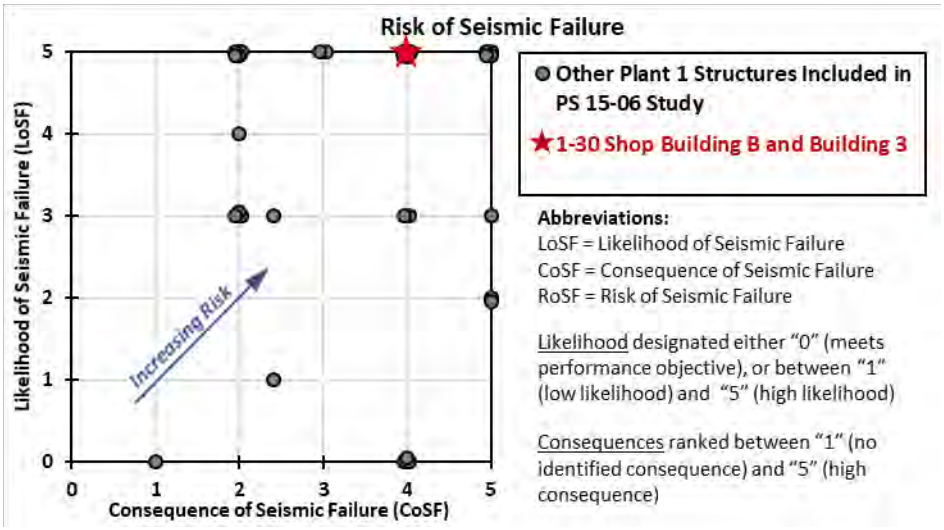
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: N/A

BUILDINGS 5 AND 6

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-31	1	II	II	BUILDING

class based performance objectives

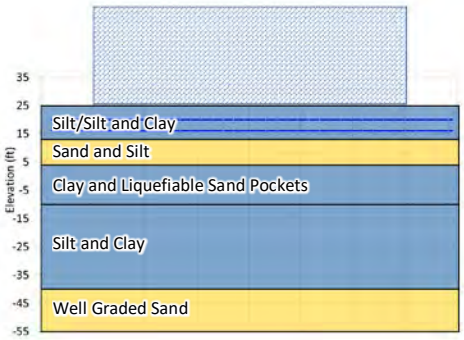
Class II: Not directly necessary to preserve wastewater flow through system; loss of life potential is low. Continued occupancy and operation might not be likely before repair.

structural components

Foundation Type/Dimensions: Shallow spread footings at-grade
Structure Dimensions: 270 ft x 61 ft
# of Stories: 2 stories
Date of Original Construction: 1988
Retrofit (if any): 1996: Provision of wall anchorage connections at the roof and 2nd floor levels, addition of cross ties, and provision of connections between concrete tilt-up wall panels.
Projects: J-20 / P1-44-3

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____

Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+20 ft-MSL
AWL	9 ft-bgs	+16 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	6 to 7	5
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-29 Shop Building A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Wall panels are not tied to the footings	T1	Walls have no structural tie between the wall and the footing. The behavior of the building is unpredictable and relative movement of the footing below the walls is possible (662 ft).
PFM 4: Wall anchorage of the 2nd floor	T1	Building was seismically retrofit in 1996 as part of P1-44-3. The single concrete anchor is subject to failure by concrete break-out (13 locations).
PFM 6B: Bending failure of beams over chevron braced frames	T1	The W16x and W21x beams at the 2nd floor over the chevron braced frames do not have sufficient bending capacity to handle unbalanced brace loads due to buckling in the compression brace (5 locations).

PFM 6D: 2nd Floor diaphragm collectors	T2	Floor diaphragm collector connections, including the welded stud connection of the beams to the floor diaphragm, the beam end connections, and the beam itself are not adequate along grid line B from 3 to 4.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation C2	$705,000	Applies over 662 lineal feet.
PFM 4: Supplement the existing wall anchorage with additional hardware and epoxy anchor into the existing wall panel.	$185,000	Applies at 13 locations. Access will require removal and replacement of building finishes (ceiling panels, etc.).
PFM 6B: Add steel cover plates to the top and bottom flanges of the steel beam member located directly above the braced frame.	$190,000	Applies at 5 locations x 20-ft each (100 lineal feet).
PFM 6D: Enhance the capacity of the W21x50 drag along grid line B, the beam end connections, and the nailer connection for transfer of collector forces.	$180,000	Applies to the existing W21x50 beam at the 2nd floor along grid line B between grid line 3 and 4 (20-ft long).
Total Geotechnical and Structural Mitigation Cost	**$1,260,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

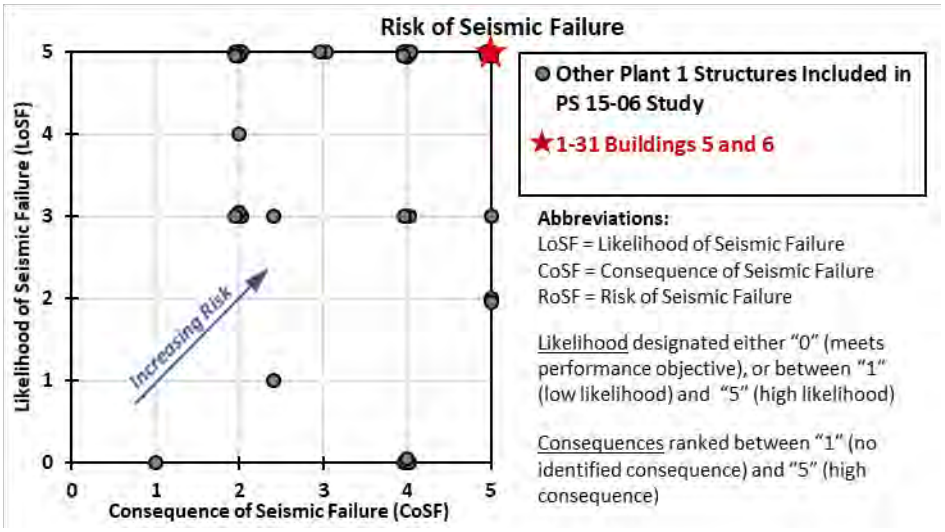
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	25



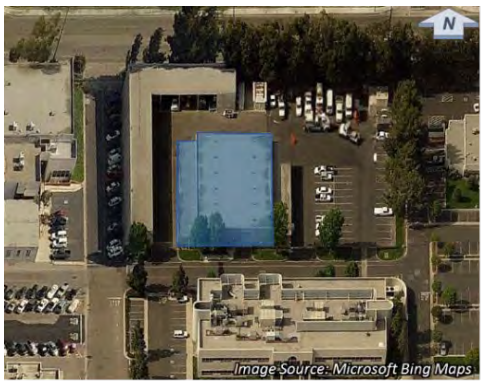
comments and clarifications

N/A

Next Planned Project and Date: N/A

AUTO SHOP

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-32	1	II	II	BUILDING



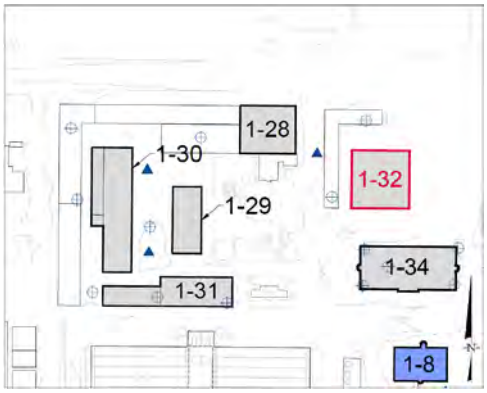
class based performance objectives

Class II: Not directly necessary to preserve wastewater flow through system; loss of life potential is low. Continued occupancy and operation might not be likely before repair.

structural components

Foundation Type/Dimensions: Shallow spread footings at-grade
Structure Dimensions: 121.3 ft x 121.3 ft
# of Stories: 1 story
Date of Original Construction: 1971
Retrofit (if any): 1996: Provision of wall anchorage at the roof diaphragm and addition of cross ties at the roof diaphragm.
Projects: J-12 / P1-44-3

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

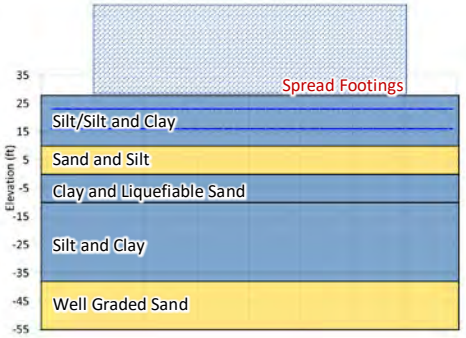
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	6 to 7	5
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+23 ft-MSL
AWL	12 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-29 Shop Building A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Wall panels are not tied to the footings	T1	Walls have no structural tie between the wall and the footing. The behavior of the building is unpredictable and relative movement of the footing below the walls is possible (25 footings x 7 ft).
PFM 4: Wall anchorage of the low roof at the north and south side	T1	Building was seismically retrofit in 1996 as part of P1-44-3. Capacity of hardware is limiting (16 locations).

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation C2	$305,000	Applies to 25 footings x 7-ft each (175 lineal feet).
PFM 4: Standard Structural Mitigation A1 (SIM)	$110,000	Similar without the need for additional roof framing members. Occurs at 16 locations.
Total Geotechnical and Structural Mitigation Cost	**$415,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

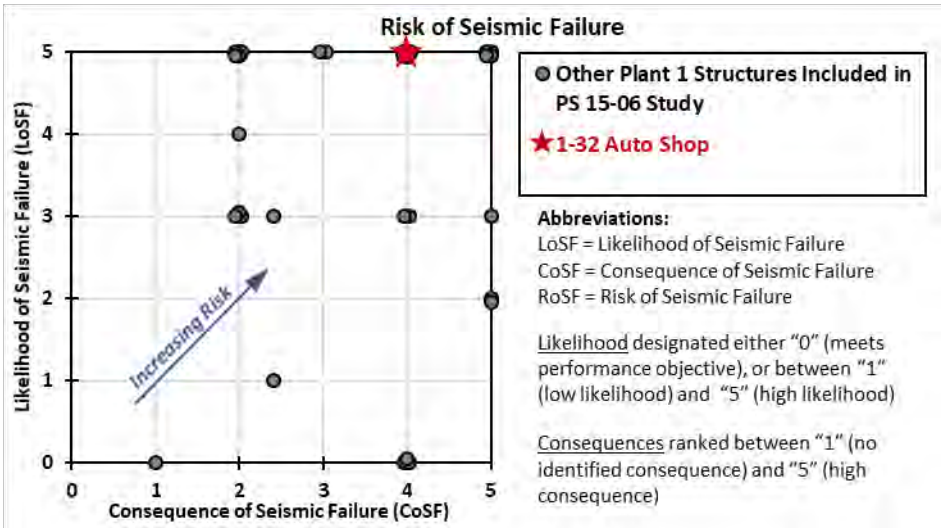
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: N/A

PEDB2

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-33	1	I	IV	BURIED BOX

class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Basement with 3' mat foundation at -4.00' elev. (29.00' embedment)
Structure Dimensions: 39.3 ft x 29 ft
# of Stories: N/A
Date of Original Construction: 1989
Retrofit (if any): N/A
Projects: P1-33

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☐ Specifications ☐ Other _____

Plan View

geohazards and seismicity

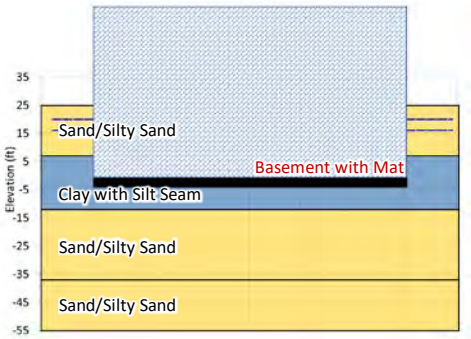
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	6 to 9	5 to 7
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+20 ft-MSL
AWL	9 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-21A Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 2: Out-of-plane shear on the buried walls due to liquefied soil conditions	T2	Walls may experience excessive shear forces.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 2: Standard Geotechnical Mitigation C	$840,000	Mitigation required to reduce soil fluid density by 50% or preclude liquefaction development in backfill altogether. Ground improvement for lateral earth pressure reduction is required from 9 to 29 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$840,000

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

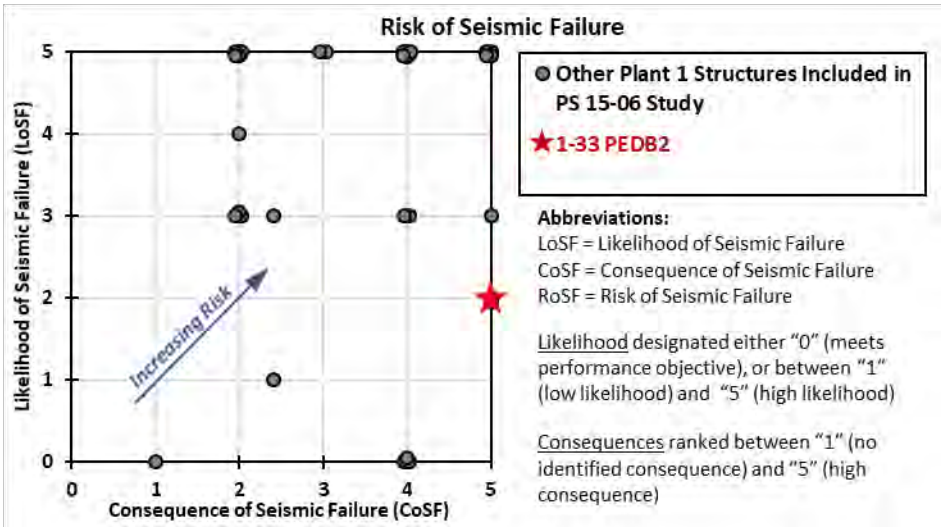
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☒ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	2
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	10



comments and clarifications

N/A

Next Planned Project and Date: N/A

LABORATORY COMPLEX

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
1-34	1	I	IV	BUILDING

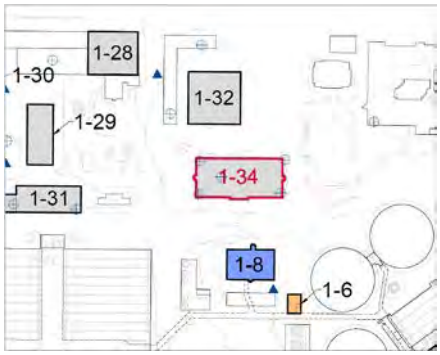
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Shallow spread foundation at-grade
Structure Dimensions: 200 ft x 90 ft
# of Stories: 2 stories
Date of Original Construction: 1989
Retrofit (if any): N/A
Projects: J-17

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

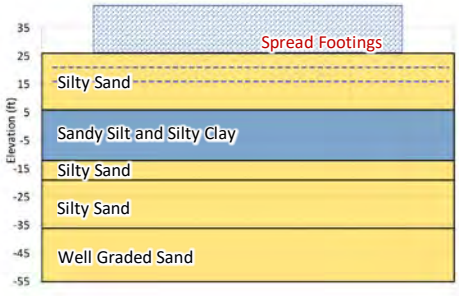
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	5 to 6	4
Lateral Spread (near river, inches)	*----No Lateral Spread----*	
Lateral Spread (far from river, inches)	*----No Lateral Spread----*	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	San Joaquin Hills	7.5	0.5	2
Far Field	San Andreas	8.5	0.17	78

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.30	0.30	0.54	0.21
BSE-2E[7]	5% in 50 yr	7.71	0.46	0.46	1.09	0.39

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	5 ft-bgs	+21 ft-MSL
AWL	10 ft-bgs	+16 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-29 Shop Building A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Braced frame column axial stress due to overturning forces	T1	Applicable to all frames in both orthogonal directions.
PFM 2: 2nd floor diaphragm seismic load transfer to braced frames	T1	Applicable to bolted connections and shear transfer connections (diaphragm welding). The check is not applicable for the LS performance level.
PFM 3: Out-of-plane bracing of braced frame beams	T1	The east-west braced frame beams have no lateral bracing at the 2nd floor. The check is not applicable for the LS performance level.
PFM 4: Braces for braced frames are non-compact members	T1	8 out of 10 of the braces at the 2nd floor are non-compact. The first floor braces are all compact. None of the braces meet the compactness requirements for highly ductile members per AISC 341.
PFM 5: Bending failure of beams over chevron braced frames	T2	The W24x beams at the roof and 2nd floor over the chevron braced frames do not have sufficient bending capacity to handle unbalanced brace loads due to buckling in the compression brace (16 locations).
PFM 6: Connection strength at braces	T1	The braced frame connections are mostly non-compliant for bolt, weld, and gusset plate strength.
PFM 7: Roof diaphragm shear	T2	Excessive shear demands on the 20 GA corrugated steel deck diaphragm in both the transverse and longitudinal directions.

PFM 8: Column anchorage to the foundation	T1	The braced frame columns along grid 3 and A (4 columns) have insufficient anchor bolt capacity to develop the uplift capacity of the footing.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	**Cost[2]**	**Comments**
N/A	$0	N/A
Recommended Structural Mitigation[1]	**Cost[2]**	**Comments**
PFM 1: Provide additional steel concentric braced frames from the roof level down to the first floor. Braced frames should be chevron frames and should be comprised of bracing members that are similar to the existing frame braces (double angle). Addition of columns and enlarging footings is to be included in this mitigation.	$2,425,000	Add (5) bays of braced frames in the E-W direction and (3) bays of braced frames in the N-S direction.
PFM 2: See **PFM 1** Mitigation	--	Additional frames will reduce demands on collectors and diaphragm shear transfer to collectors and frames.
PFM 3: Add out-of-plane bracing of the braced frame beams that lack this bracing.	$340,000	Applies to (4) locations at the roof and (8) locations at the 2nd floor.
PFM 4: Add stiffener plates to the bracing members to make the sections compact. Plates should be welded along the length of each leg of each individual angle brace.	$710,000	Applies to (8) braces at the 2nd floor. Each brace is comprised of a double angle, which has two legs. Each brace is about 16 feet long, so the application is required for a total of 512 feet.
PFM 5: Add a tube steel column member below the middle of each chevron braced frame or provide steel cover plates to stiffen the existing beam members.	--	Applies to (32) locations, which includes locations at the (16) existing braced frames and (16) new braced frames as recommended per **PFM 1** Mitigation.
PFM 6: See **PFM 1** Mitigation	--	Provided that **PFM 1** Mitigation is implemented, the demands on the connections are anticipated to reduce.
PFM 7: Standard Structural Mitigation B1	$1,655,000	Applies to the entire roof diaphragm over an approximate area of 17,000 square feet. Depending on how new braced frames are added to the building, the area of diaphragm mitigation could be reduced.
PFM 8: See **PFM 1** Mitigation	--	Provided that **PFM 1** Mitigation is implemented, the demands on the anchorage to the foundation will be diminished and will likely meet the performance objectives.
Total Geotechnical and Structural Mitigation Cost	**$5,130,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

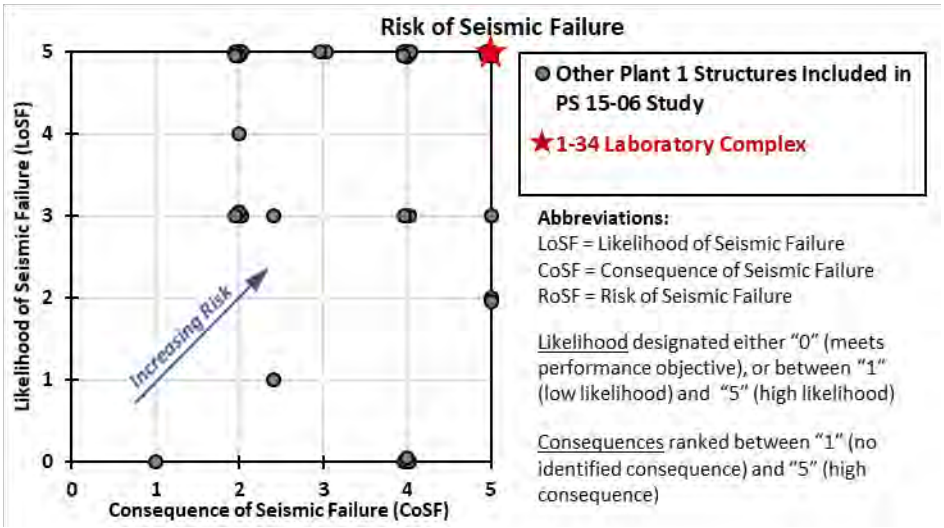
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	25



comments and clarifications

N/A

Next Planned Project and Date: N/A

DAFT A, B, & C GALLERY

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-1	2	I	IV	BUILDING

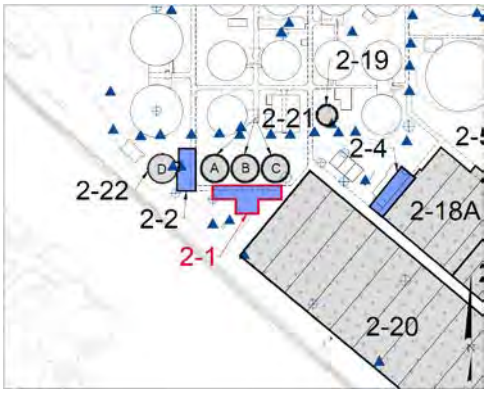
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Basement with 1'-10" thick mat at -6.97' elev. (17.47' embedment); tie-down anchors (PTA, 1" DIA, 35' bond length, 46' total length)
Structure Dimensions: 144.3 ft x 60 ft
# of Stories: 1 story
Date of Original Construction: 1977
Retrofit (if any): Remodeled in 1993 (minor structural modifications)
Projects: P2-23-6 / P2-42-2

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

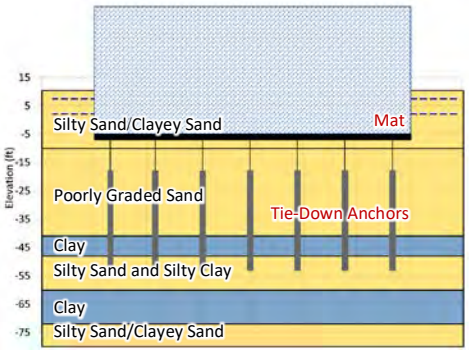
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 10	6 to 9
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	20 to 40	14 to 28
Lateral Spread (far from marsh, inches)	11 to 21	7 to 15

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+7.5 ft-MSL
AWL	8.5 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 6: Structure response to differential settlement due to liquefaction	T1/2	2.1" over 60 feet of differential settlement. Differential settlement is 75% of that for the exemplar. The walls have less reinforcing steel and will be subject to similar tensile stresses at the top.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 6: Standard Geotechnical Mitigation B2	$5,160,000	Mitigation required to reduce differential settlement by 50% (1" in 60 feet). Ground improvement for settlement mitigation is required from 8 to 59 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$5,160,000

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

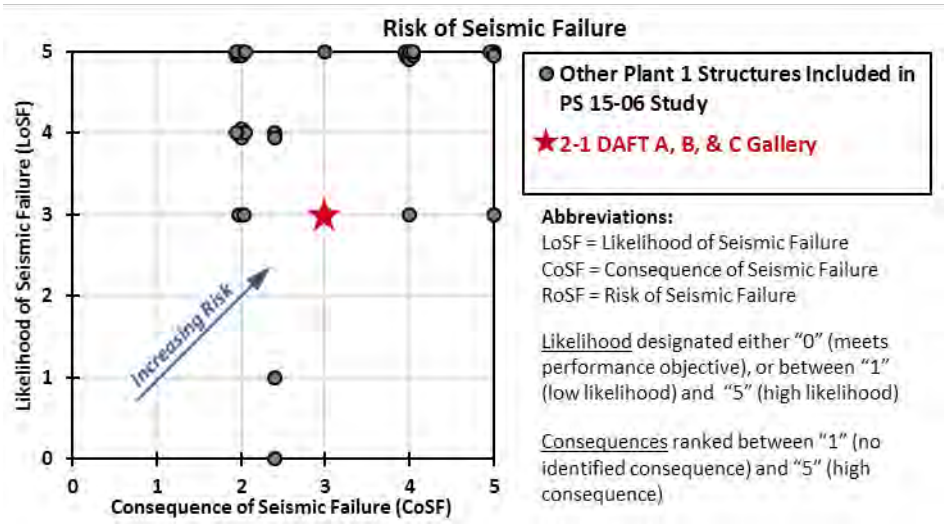
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	3
Overall RoSF = LoSF x CoSF =	9



comments and clarifications

N/A

Next Planned Project and Date: N/A

DAFT D GALLERY & WSSPS

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-2	2	I	IV	BUILDING

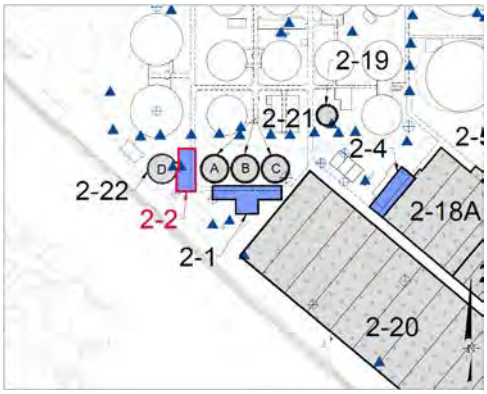
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Basement with 1'-10" thick mat at -7.67' elev. (17.67' embedment)
Structure Dimensions: 89 ft x 37 ft
# of Stories: 1 below grade
Date of Original Construction: 1993
Retrofit (if any): N/A
Projects: P2-42-2

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

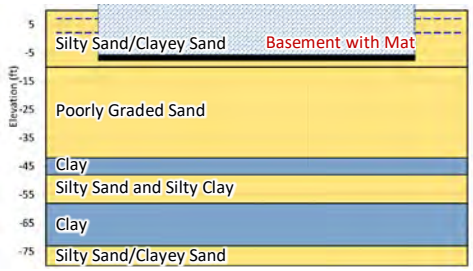
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	8 to 10	7 to 9
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	30 to 62	22 to 42
Lateral Spread (far from marsh, inches)	14 to 29	10 to 20

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+7 ft-MSL
AWL	8 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 4: Lateral spread towards the Talbert Marsh due to liquefaction (surface PGD = 22-inches).	T1/2	9.1"/6.7" (near/far) lateral spread toward the Talbert Marsh. The structure may experience differential spread with DAFT D, which can cause separation at the sump rooms, causing a loss in service and/or structural damage to the sump room.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 4: Standard Geotechnical Mitigation A2	See Note 3	Mitigation is required to reduce lateral spread by at least 50% (surface PGD = 11-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$0	(excluding lateral spread mitigation, see Note 3)

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

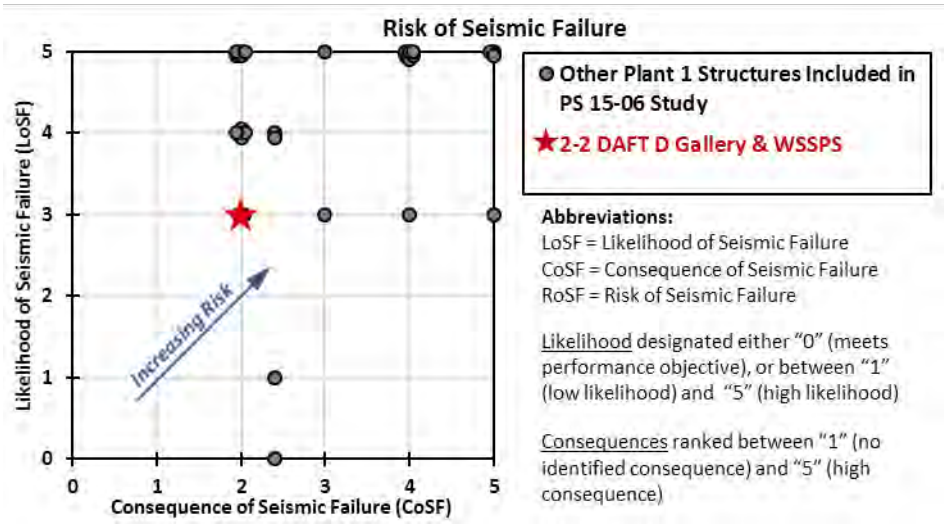
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	6



comments and clarifications

N/A

Next Planned Project and Date: N/A

RAS PS EAST

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-3	2	I	IV	BUILDING

class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Basement with 2' thick mat at -7.00' elev. (17.50' embedment); tie-down anchors (PTA, 1" DIA, 35' bonded length, 46' total length)
Structure Dimensions: 114.4 ft x 56.4 ft
# of Stories: 1 above grade, 1 below grade
Date of Original Construction: 1977
Retrofit (if any): N/A
Projects: P2-23-6

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____

Plan View

geohazards and seismicity

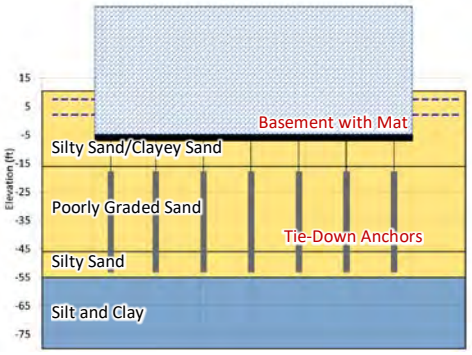
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 8	6 to 8
Lateral Spread (near river, inches)	19 to 33	16 to 31
Lateral Spread (far from river, inches)	15 to 26	13 to 24
Lateral Spread (near marsh, inches)	15 to 26	13 to 25
Lateral Spread (far from marsh, inches)	12 to 22	11 to 21

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+7.5 ft-MSL
AWL	8.5 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-18B Aeration Basins A-H

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Vertical irregularities in building shear walls	T1	Discontinuous shear walls at EL 10.50 occur at the east and north walls of the building. Provide for drag connections and strengthening of columns below discontinuous walls.
PFM 4: Structural response to differential settlement due to liquefaction	T1/2	1.6" over 60 feet of differential settlement. Refer to exemplar for typical deficiencies, which are anticipated to occur at the same rate below the RAS PS East.
PFM 8: Out-of-plane shear on the buried walls due to liquefied soil conditions	T2	Walls may experience shear stresses that are higher than their capacity.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 4: Standard Geotechnical Mitigation B1	$1,340,000	Mitigation required to reduce differential settlement by 50% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 8 to 40 ft-bgs.
PFM 8: Standard Geotechnical Mitigation C	$460,000	Mitigation required to reduce soil fluid density by 50% or preclude liquefaction development in backfill altogether. Ground improvement for lateral earth pressure reduction is required from 8 to 17 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Add new columns and strengthen existing members for axial overturning forces below each end of the high shear wall at the north side of the building. Provide additional collector member (steel channel) at the bottom side of the low roof.	$180,000	Additional column and strengthening required at 3 locations x 30 feet. Collector length estimated to be 64 lineal feet (1 along grid line B x 32 feet and 1 along grid line 0.5 x 32 feet).

Total Geotechnical and Structural Mitigation Cost	**$1,980,000**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

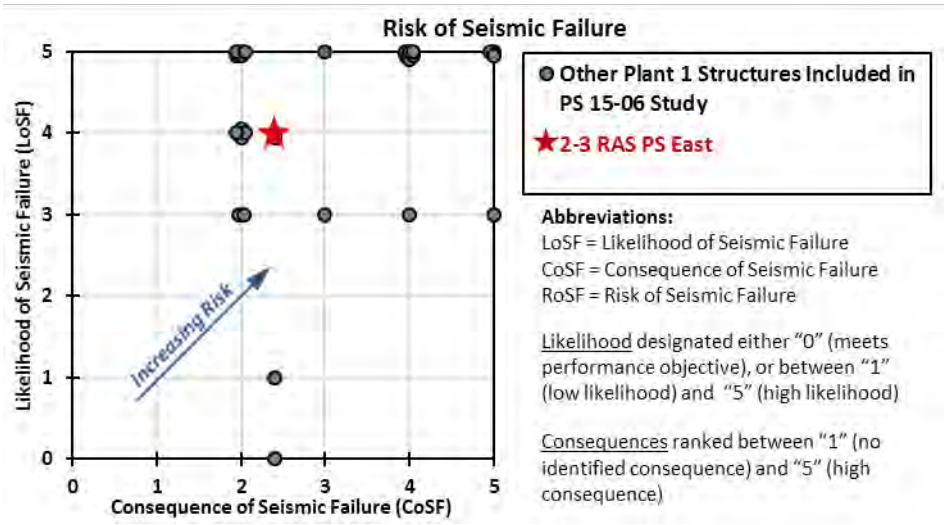
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	4
CoSF, Weighted Score:	2.4
Overall RoSF = LoSF x CoSF =	9.6



comments and clarifications

N/A

Next Planned Project and Date: X-052 (09/01/2032)

RAS PS WEST

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-4	2	I	IV	BUILDING

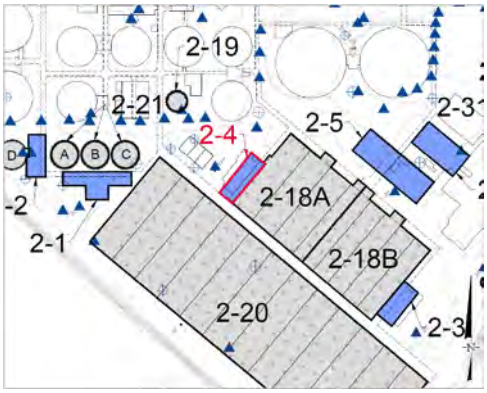
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Basement with 2' thick mat at -7.00' elev. (17.50' embedment); tie-down anchors (PTA, 1" DIA, 35' bonded length, 46' total length)
Structure Dimensions: 114.4 ft x 56.4 ft
# of Stories: 2 stories
Date of Original Construction: 1977
Retrofit (if any): N/A
Projects: P2-23-6

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

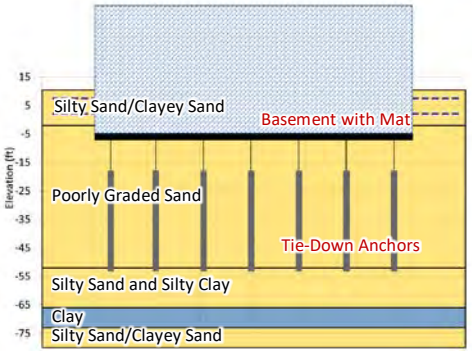
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	5 to 6	3 to 4
Lateral Spread (near river, inches)	3 to 4	1
Lateral Spread (far from river, inches)	3	1
Lateral Spread (near marsh, inches)	5 to 6	1 to 2
Lateral Spread (far from marsh, inches)	4 to 5	1 to 2

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: 1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+7.5 ft-MSL
AWL	8.5 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-18A Aeration Basins A-H

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Vertical irregularities in building shear walls	T1	Discontinuous shear walls at EL 10.50 occur at the west and north walls of the building. Provide for drag connections and strengthening of columns below discontinuous walls.
PFM 4: Structural response to differential settlement due to liquefaction	T1/2	1.2" over 60 feet differential settlement. Refer to exemplar for typical deficiencies, which are anticipated to occur at the same rate below the RAS PS West.
PFM 8: Out-of-plane shear on the buried walls due to liquefied soil conditions	T2	Walls may experience shear stresses that are higher than their capacity.

Notes: 1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 4: Standard Geotechnical Mitigation B1	$2,810,000	Mitigation required to reduce differential settlement by 40% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 8 to 66 ft-bgs.
PFM 8: Standard Geotechnical Mitigation C	$520,000	Mitigation required to reduce soil fluid density by 50% or preclude liquefaction development in backfill altogether. Ground improvement for lateral earth pressure reduction is required from 8 to 17 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Add new columns and strengthen existing members for axial overturning forces below each end of the high shear wall at the north side of the building. Provide additional collector member (steel channel) at the bottom side of the low roof.	$180,000	Additional column and strengthening required at 3 locations x 30 feet. Collector length estimated to be 64 lineal feet (1 along grid line B x 32 feet and 1 along grid line 0.5 x 32 feet).

Total Geotechnical and Structural Mitigation Cost	**$3,510,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

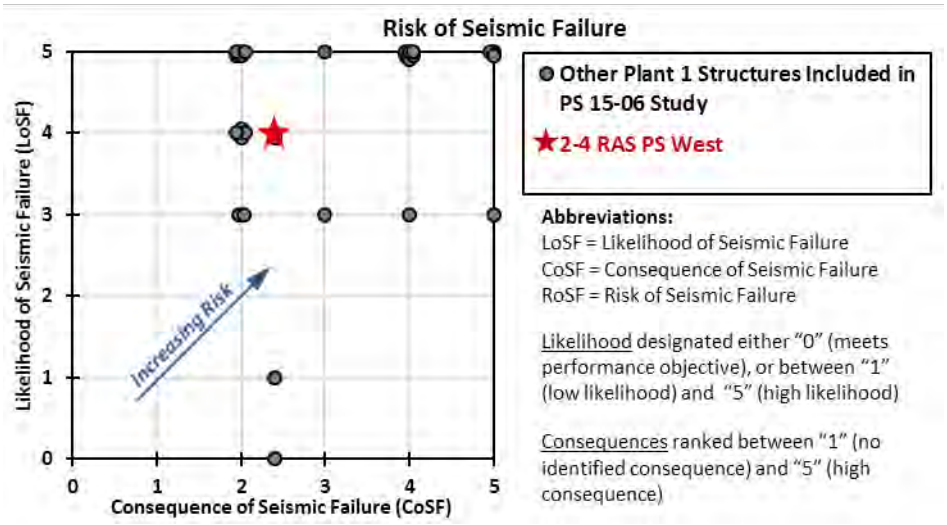
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	4
CoSF, Weighted Score:	2.4
Overall RoSF = LoSF x CoSF =	9.6



comments and clarifications

N/A

Next Planned Project and Date: X-052 (09/01/2032)

PEPS & MAC

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-5	2	I	IV	BUILDING

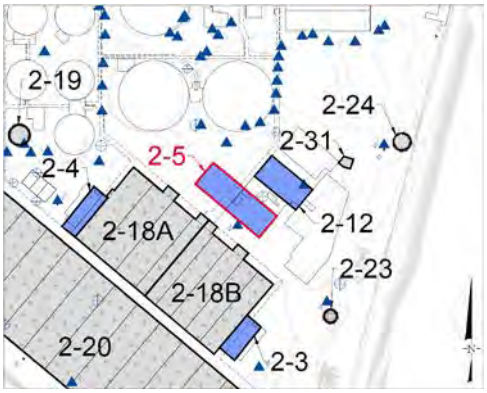
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Basement with 2' thick mat at -7.50' elev. (19.00' embedment); tie-down anchors (PTA, 1" DIA, 35' bonded length, 46' total length)
Structure Dimensions: 167 ft x 54 ft
# of Stories: 1 story
Date of Original Construction: 1977
Retrofit (if any): 1994: Provision of shear transfer at the north wall with window infill and out-of-plane bracing of a non-bearing masonry wall.
Projects: P2-23-6 / P2-23-2

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

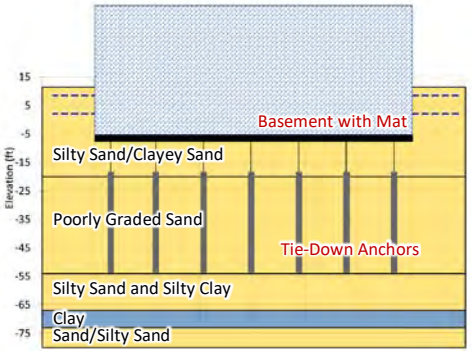
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 16	9 to 14
Lateral Spread (near river, inches)	30 to 45	28 to 42
Lateral Spread (far from river, inches)	20 to 31	19 to 29
Lateral Spread (near marsh, inches)	18 to 30	17 to 26
Lateral Spread (far from marsh, inches)	17 to 28	15 to 24

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+8.5 ft-MSL
AWL	9.5 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 4: Flexure in bottom mat due to differential settlement due to liquefaction	T3	2.8" differential settlement over 60 feet. Occurs over length of basement wall along grid line 6 and at high foundation slab at the west side of the building. Could be compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).
PFM 5: Flexure in walls due to differential settlement	T1/2	2.8" differential settlement over 60 feet. Occurs at bottom of east wall over half the length of the wall. Could be compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft)
PFM 6: Tension stress in structure slabs due to differential settlement	T3	2.8" differential settlement over 60 feet. Occurs at the roof, first floor, and basement slab.
PFM 7: Tension stress in structure walls due to differential settlement	T3	2.8" differential settlement over 60 feet. Occurs at the top of the north, south, west, and at the bottom of the wall along grid line 4 (interior wall).

PFM 8: Lateral spread towards the Santa Ana River due to liquefaction (surface PGD = 27.5-inches).	T1/2	17.7"/12" (near/far) lateral spread toward the Santa Ana River. Foundation is within lateral spreading soils. Deep foundation wall at the west end is subject to failure and the effluent conduit at the south side of the structure will likely separate causing loss of service.
PFM 11: Out-of-plane shear on the buried walls due to liquefied soil conditions	T2	Walls may experience shear stresses that are higher than their capacity.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 4 – 7: Standard Geotechnical Mitigation B1	$5,740,000	Mitigation required to reduce differential settlement by 60% (1" in 60 feet). Ground improvement for settlement mitigation is required from 10 to 60 ft-bgs.
PFM 8: Standard Geotechnical Mitigation A2	See Note 3	Mitigation required to reduce lateral spread by 75% (surface PGD = 7-inches).
PFM 11: Standard Geotechnical Mitigation C	$1,860,000	Mitigation required to reduce soil fluid density by 50% or preclude liquefaction development in backfill altogether. Ground improvement for lateral earth pressure reduction is required from 10 to 20 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	**$7,600,000**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

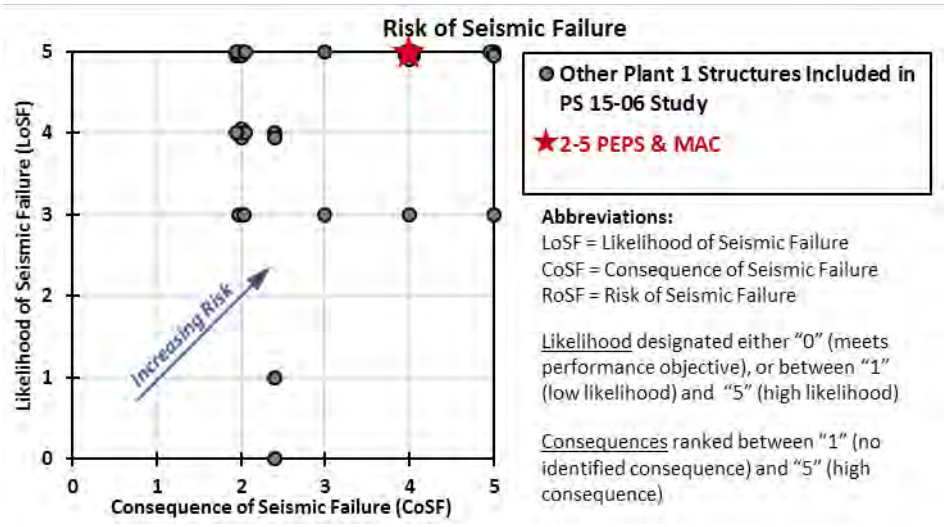
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: X-052 (09/01/2032)

OPERATIONS/CONTROL CENTER BUILDING

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-6	2	I	IV	BUILDING

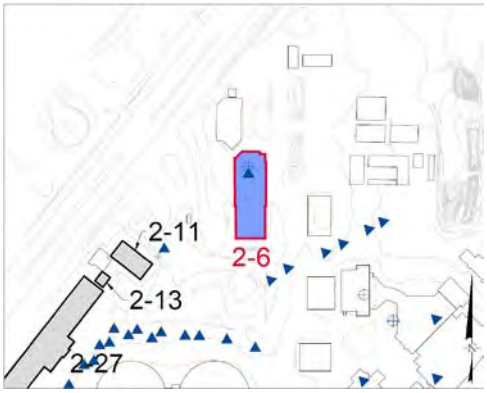
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Basement with 2' thick mat at -2.50' elev (10.50' embedment)
Structure Dimensions: 95 ft and 66 ft x 65 ft
# of Stories: 2 above grade, 1 below grade
Date of Original Construction: 1977
Retrofit (if any): Remodeled in 1992; 1994: Provision of collectors and ties at the roof diaphragm, provision of tilt-up wall holdowns to the foundation, and strengthening of wall anchorage connections at the roof diaphragm.
Projects: P2-23-5

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

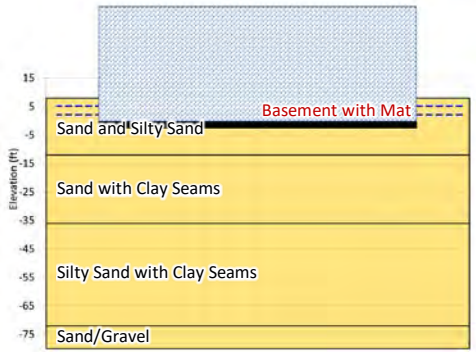
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	12 to 14	11 to 13
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+5 ft-MSL
AWL	6 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Wall anchorage at east and west walls (original building)	T1	Wall anchorage at the joist bearing seats relies on bending through the bearing seat, which has minimal flexural capacity (16 locations).
PFM 3: Wall anchorage at east and west walls (addition)	T1	Similar design as original building. The connection also has slotted holes that do not allow for transfer of wall anchorage forces into the diaphragm (14 locations).
PFM 5: Incomplete load path at the south entrance canopy addition for resisting seismic loads	T1	The canopy has no discernible load path back to the moment frame. The building is also experiencing static settlement at the south end as the canopy extension is bearing within backfill.
PFM 6: In-plane shear at shear walls	T1	N-S seismic at the north building governs. East and west walls have continuous openings over most of the building length.
PFM 7: Drag connection at roof to east and west shear walls	T1	Connection occurs at the original 1977 building. Retrofit in 1996 is not sufficient to develop the capacity of the roof diaphragm.

PFM 8: Precast wall panel connection to foundation walls	T1	Precast wall panels have minimal connections to the tops of the foundation walls.
PFM 9: Structure response to differential settlement due to liquefaction	T1/2	4.0" over 60 feet of differential settlement. Differential settlement is about 43% higher than the exemplar. The walls are framed in a similar manner to the south wall of the exemplar. Tensile forces are anticipated to well exceed the wall beam capacity. Also, the mat slab has interior walls and columns that are likely to generate large bending moments and shear demands on the slab, similar to the exemplar.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	**Cost[2]**	**Comments**
PFM 9: Standard Geotechnical Mitigation B1	$6,780,000	Mitigation required to reduce differential settlement by 75% (1" in 60 feet). Ground improvement for settlement mitigation is required from 6 to 61 ft-bgs.
Recommended Structural Mitigation[1]	**Cost[2]**	**Comments**
PFM 1: Add stiffeners to the existing joist bearing seats by field welding in place to eliminate flexure in the joist seat.	$550,000	Required at 16 locations x 2 stiffeners each (32 total).
PFM 3: Add stiffeners to the existing joist bearing seats by field welding in place to eliminate flexure in the joist seat. Also, field weld bolts to the bearing seat to eliminate gap in the load path.	$450,000	Required at 14 locations x 2 stiffeners each (28 total).
PFM 5: Add (2) steel braced frames with grade beams at the south canopy.	$160,000	Repair to correct settlement within the backfill (slab on grade, canopy, stairs, etc.) may also be considered at the time of mitigation.
PFM 6: Standard Structural Mitigation E	$20,000	Applies over 15-ft x 1-ft windows at (2) locations (east and west walls).
PFM 7: Upgrade the existing connections with larger through bolts, plates, and anchors.	$10,000	Occurs at 10 locations total.
PFM 8: Standard Structural Mitigation A1	$910,000	Applies to 530 lineal feet.
Total Geotechnical and Structural Mitigation Cost	**$8,880,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

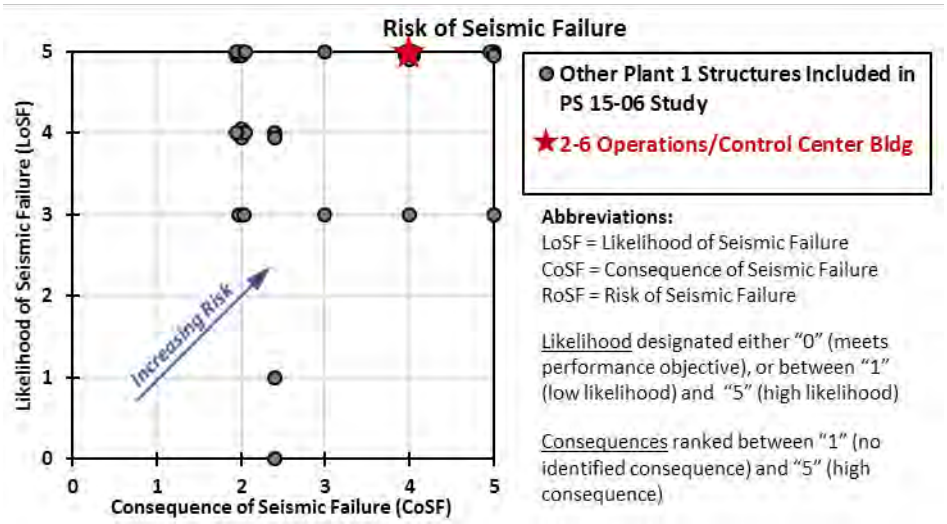
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: X-008 (03/01/2028)

12 kV SERVICE CENTER

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-7	2	I	IV	BUILDING

class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Basement with 1' thick mat and grade beams at 1' elev. (9' embedment)
Structure Dimensions: 68 ft x 41 ft
# of Stories: 1 story
Date of Original Construction: 1977
Retrofit (if any): N/A
Projects: P2-23-3

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____

Plan View

geohazards and seismicity

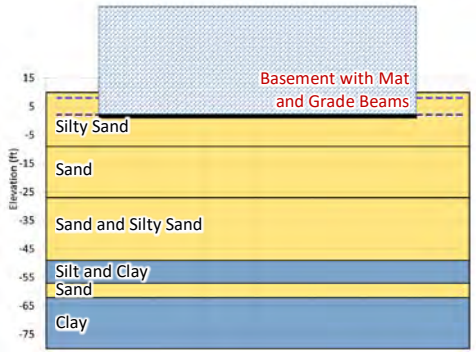
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	13	11
Lateral Spread (near river, inches)	19 to 20	16 to 19
Lateral Spread (far from river, inches)	17 to 18	15 to 17
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+7 ft-MSL
AWL	8 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Wall anchorage to roof at north and south walls	T1	North and south walls have no rigid diaphragm connection as the wall anchorage force will be applied perpendicular to the 7.5-inch deep deck corrugation.
PFM 3: Wall anchorage forces at the north and south walls have no sub-diaphragm or ties	T1	In conjunction with wall anchorage at the north and south walls, sub-diaphragms and struts are required to develop wall anchorage forces into the diaphragm.
PFM 4: Roof diaphragm shear	T2	Excessive shear demands for the 7.5-inch deep steel deck (low shear capacity).
PFM 5: Shear at frame columns	T1	Frame columns along the north and south walls have high shear demands and cannot develop moment frame behavior due to restraint by the infill wall panels. Conversion of building to shear walls is recommended.

PFM 7: Structure response to differential settlement due to liquefaction	T1/2	4.3" over 60 feet of differential settlement. Differential settlement is about 54% higher than the exemplar. The walls are framed in a similar manner to the south wall of the exemplar. Tensile forces are anticipated to well exceed the wall beam capacity.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 7: Standard Geotechnical Mitigation B2	$2,300,000	Mitigation required to reduce differential settlement by 75% (1" in 60 feet). Ground improvement for settlement mitigation is required from 8 to 50 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1 & 3: Standard Structural Mitigation A1	$200,000	Applied at 8-ft on center along the north and south walls (approximately 8 locations).
PFM 4: Replace entire roof deck with a new roof support system that provides for new steel beams that span across the building width in the east-west direction (40 feet) and a new standard corrugated steel deck that spans in the north-south direction.	$420,000	Existing roof deck is 7.5-inch deep steel deck without any concrete topping. Protect electrical gear in place.
PFM 5: Standard Structural Mitigation E	$160,000	Applies at the east and west walls for 22-ft x 2-ft window (88 square feet total).
Total Geotechnical and Structural Mitigation Cost	**$3,080,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

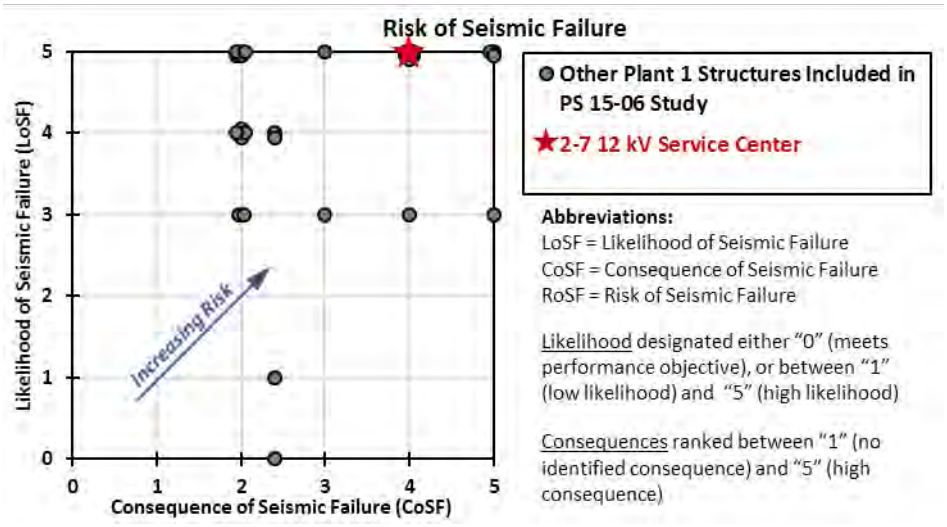
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☒ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: X-047 (09/01/2023)

POWER BUILDING B

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-8	2	I	IV	BUILDING

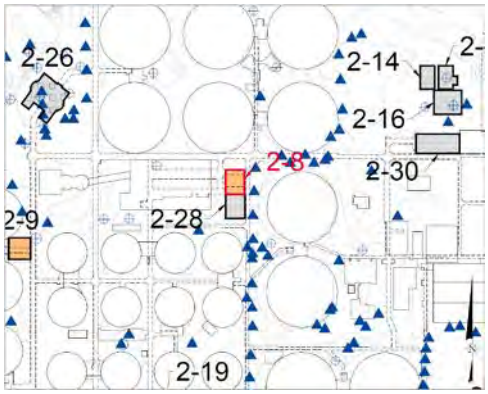
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

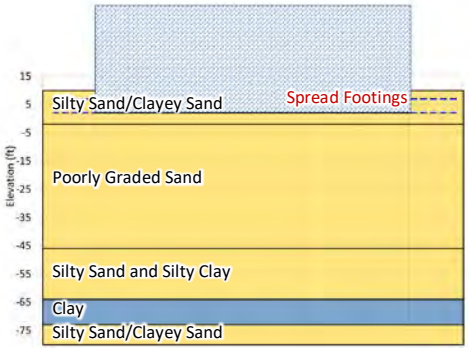
structural components

Foundation Type/Dimensions: Tunnel with dropped spread footings at 2.00' elev. (8.00' embedment)
Structure Dimensions: 52.2 ft x 40 ft
# of Stories: 1 story
Date of Original Construction: 1971
Retrofit (if any): Remodeled in 1980 and 1996; 1994: Provision of roof chords and connections, addition of connections between the roof and shear walls, and addition of connections between the shear walls and the floor slab.
Projects: P1-15 / P2-24-2

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+7 ft-MSL
AWL	8 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	6 to 8	5 to 6
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 4: Roof diaphragm shear	T2	Diaphragm shear capacity is limiting. Mitigation is recommended to enhance the diaphragm capacity.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 4: Standard Structural Mitigation B1	$210,000	Applies over the entire roof plan between grid lines 2 and 5 (1,600 sf) and requires the addition of (2) W12x31 beams x 25-ft long.

Total Geotechnical and Structural Mitigation Cost	**$210,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

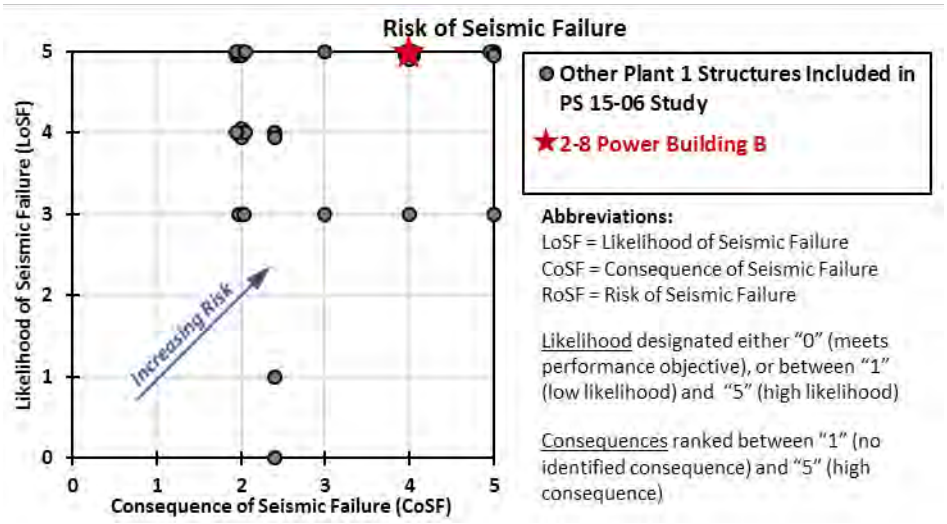
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☒ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: N/A

POWER BUILDING C

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-9	2	I	IV	BUILDING

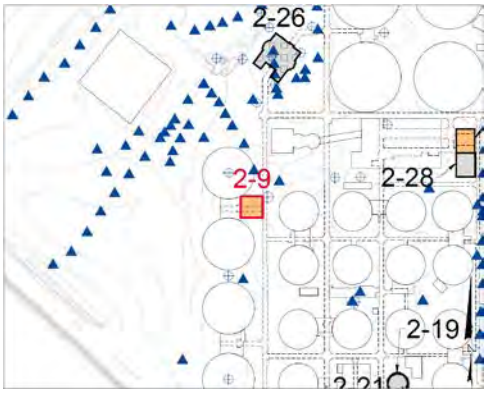
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

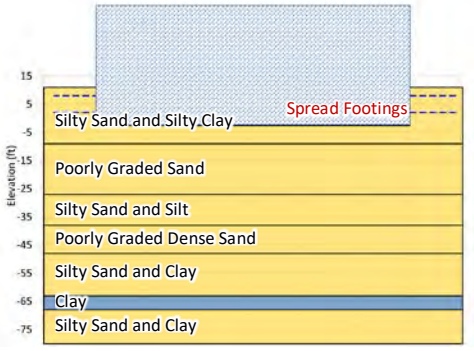
structural components

Foundation Type/Dimensions: Tunnel with dropped spread footings at -2.61' elev. (13.61' embedment)
Structure Dimensions: 76 ft x 46 ft
# of Stories: 1 story
Date of Original Construction: 1979
Retrofit (if any): Remodeled in 1985 and 1996; 1994: Provision of braced frames to laterally support the high roof and wall ties.
Projects: P2-24-1 / J-6-2

Available Information: ☒ Construction Drawings ☒ Geotechnical Report
☐ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+8 ft-MSL
AWL	9 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 9	6 to 8
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	9 to 16	8 to 11
Lateral Spread (far from marsh, inches)	8 to 14	7 to 10

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Incomplete lateral load resisting system in the east-west direction	T1	The west end of the building has no lateral load resisting system. The west concrete roof deck will impart large out-of-plane forces onto the east wall of the digester pump room creating a collapse hazard.
PFM 6: In-plane wall shear at shear walls	T1	Lack of shear walls in the east-west direction at the west end increase the demands on the remaining walls, which have no load path to resist the seismic loads at the digester pump room.
PFM 7: Insufficient separation from adjacent digesters	T1	The roof deck of the digester pump room is separated from the walls of Digester R and Digester S by 1-inch. Pounding of the roof deck into the digester walls can occur and cause significant structural damage to the building.
PFM 8: Footings move independent of the wall	T1	Walls have no structural tie between the wall and the floor slab. Building wall can move differentially from other walls (232 ft).

PFM 9: Tension failure in the CMU walls due to differential settlement	T1/2	2.2" of differential settlement over 60 feet. Walls are lightly reinforced and shorter than the exemplar. Ground deformation upward will fail the upper portion of the walls in tension.
PFM 10: Lateral spread towards Talbert Marsh due to liquefaction (surface PGD = 7.5-inches)	T1/2	6" lateral spread toward Talbert Marsh, which can pull apart the building foundation relative to the roof and the because the floor slab is not tied to the wall/footing (232 ft). The building is founded on tunnels and shallow footings, which have varying depths. Differential lateral spread is anticipated, which is also a potential cause for building instability.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	**Cost[2]**	**Comments**
PFM 9: Standard Geotechnical Mitigation B2	$2,500,000	Mitigation required to reduce differential settlement by at least 50% (1" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 65 ft-bgs.
PFM 10: Standard Geotechnical Mitigation A2	See Note 3	Mitigation required to reduce lateral spread by 50%. (surface PGD = 4-inches).

Recommended Structural Mitigation[1]	**Cost[2]**	**Comments**
PFM 1, 6, and 7: Provide new cast-in-place concrete shear walls inside the digester control room. Provide with continuous footing.	$210,000	Applied at (2) places x 16 feet x 16-ft tall (32 lineal feet).
PFM 8: Standard Structural Mitigation C1	$70,000	Applies over 232 lineal feet.
Total Geotechnical and Structural Mitigation Cost	**$2,780,000**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

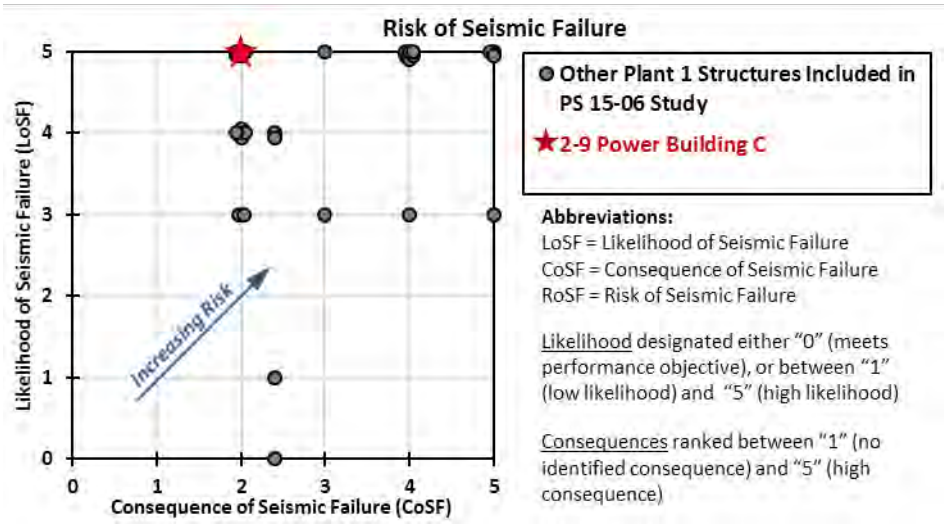
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	10



comments and clarifications

N/A

Next Planned Project and Date: N/A

POWER BUILDING D

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-10	2	I	IV	BUILDING

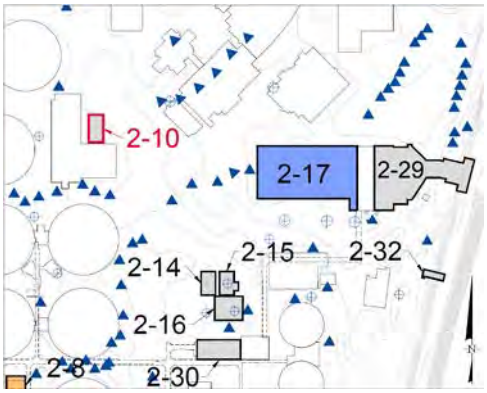
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

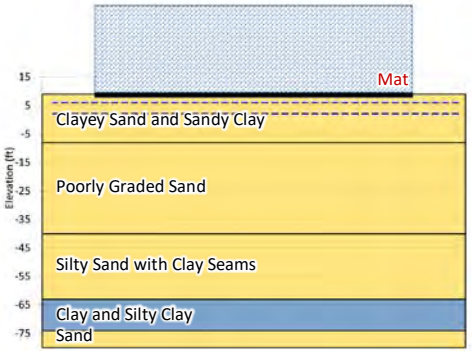
structural components

Foundation Type/Dimensions: 1'-4" thick mat at-grade at 8' elev. (1' embedment)
Structure Dimensions: 57.7 ft x 31.3 ft
# of Stories: 1 story
Date of Original Construction: 1985
Retrofit (if any): N/A
Projects: J-6-2

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+6 ft-MSL
AWL	7 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	6 to 8	5 to 6
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Incomplete load path at the south side of the high roof diaphragm	T1	The south side of the high roof has no lateral load resisting elements to transfer shear forces down to the foundation.
PFM 5: Out-of-plane horizontal bending	T1	Horizontal wall reinforcing is less than the minimum. Based on exemplar behavior, horizontal bending is a vulnerability. In-plane shear is relatively low and not considered to be a vulnerability.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Provide concentric X-braced frames at the existing louver openings. Provide steel framed blocking at the roof level and weld the roof deck to it. Provide a new steel member sill and anchor to the top of the existing masonry wall with epoxy anchors.	$260,000	Mitigation required over a length of 31 feet. Frames occur at 4 locations having bay sizes of 8-ft long x 5-ft tall.
PFM 5: Standard Structural Mitigation D	$410,000	To be applied at a spacing that reduces horizontal wall spans by 50%.
Total Geotechnical and Structural Mitigation Cost	**$670,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

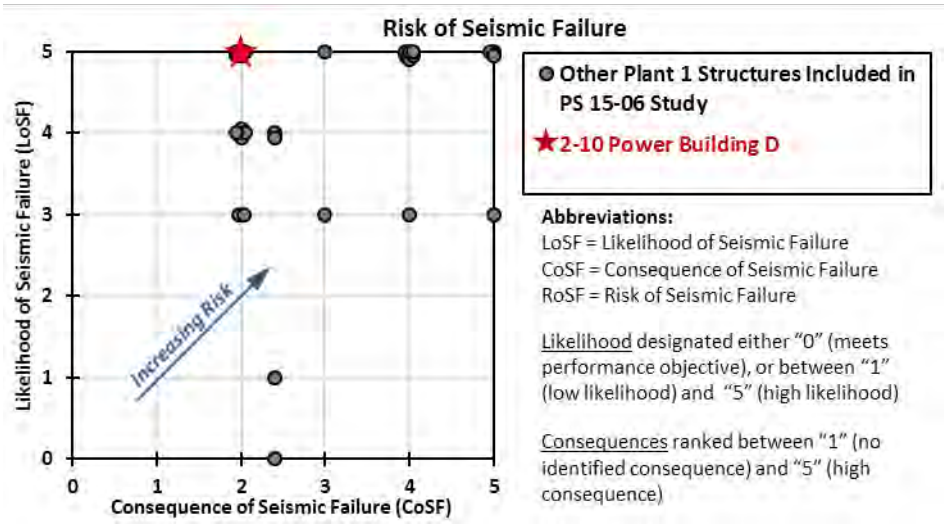
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	10



comments and clarifications

N/A

Next Planned Project and Date: N/A

CITY WATER PUMP STATION

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-11	2	I	IV	BUILDING

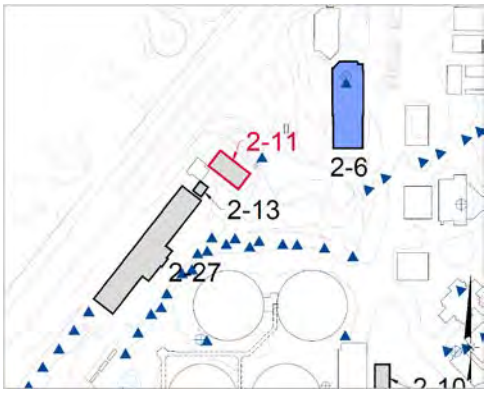
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Dropped spread footings at 5.40' elev. (3.10' embedment)
Structure Dimensions: 79.3 ft x 40.7 ft
# of Stories: 1 story
Date of Original Construction: 1995
Retrofit (if any): N/A
Projects: P2-46

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

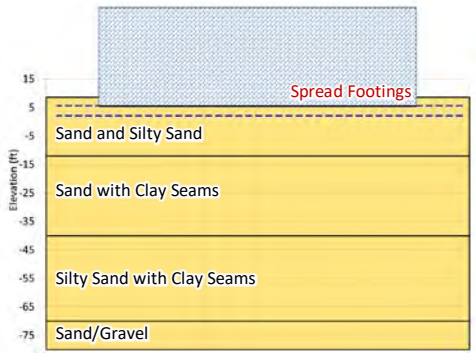
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	12 to 14	12 to 13
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+5.6 ft-MSL
AWL	6.6 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Wall anchorage at north and south walls	T1	Open-web joist seat anchor is subject to pull-out (24 locations).
PFM 5: Out-of-plane horizontal bending	T1	Horizontal wall reinforcing is less than the minimum. Based on exemplar behavior, horizontal bending is a vulnerability at wall corners (8 locations). In-plane shear is relatively low and not considered to be a vulnerability.
PFM 6: Differential settlement due to liquefaction	T1/2	4.6" of differential settlement over 60 feet. Building is of similar size, height, and reinforcement to exemplar, but has 2.6 times the amount of differential settlement.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 6: Standard Geotechnical Mitigation B2	$4,040,000	Mitigation required to reduce differential settlement by at least 80% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 3 to 65 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation A1 (SIM)	$180,000	Similar without additional steel framing members. Applies at 24 locations.
PFM 5: Standard Structural Mitigation D	$560,000	Applies below every other roof joist and at 16-ft spacing elsewhere.
Total Geotechnical and Structural Mitigation Cost	**$4,780,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

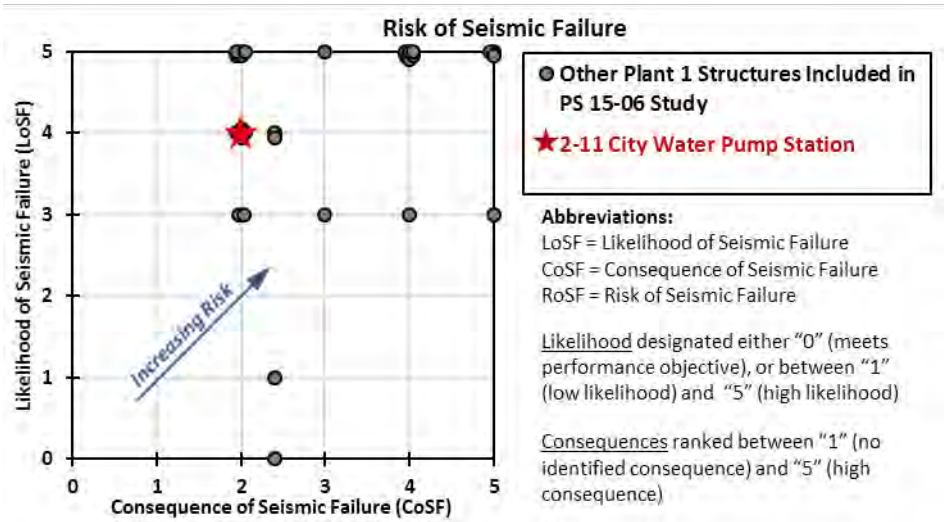
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	4
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	8



comments and clarifications

N/A

Next Planned Project and Date: X-036 (12/30/2028)

12 kV DISTRIBUTION CENTER B

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-12	2	I	IV	BUILDING

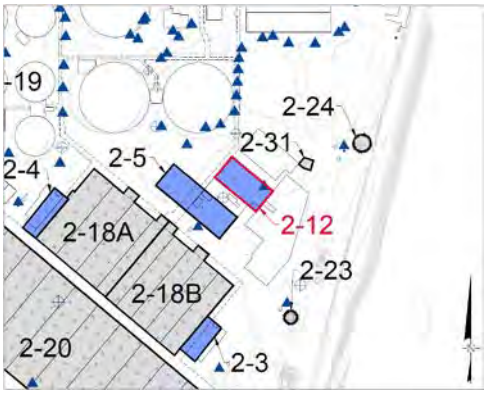
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

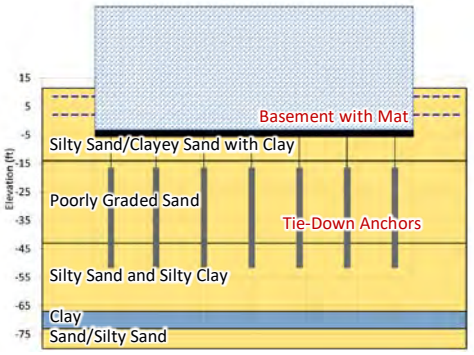
structural components

Foundation Type/Dimensions: Basement with 2' mat at -5.50' elev. (17.00' embedment); tie-down anchors (PTA, 1" DIA, 35' bonded length, 46' total length)
Structure Dimensions: 112.8 ft x 59.8 ft
# of Stories: 1 above grade, 1 below grade
Date of Original Construction: 1978
Retrofit (if any): N/A
Projects: P2-23-6 / P2-23-2

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	10 to 15	9 to 14
Lateral Spread (near river, inches)	26 to 57	23 to 51
Lateral Spread (far from river, inches)	18 to 40	16 to 36
Lateral Spread (near marsh, inches)	12 to 25	10 to 23
Lateral Spread (far from marsh, inches)	11 to 23	9 to 21

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+8 ft-MSL
AWL	9 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 2: Structure response to differential settlement due to liquefaction	T1/2	2.7" differential settlement over 60 feet. Building has nearly identical foundation and reinforcing as exemplar. Walls have same framing and reinforcing steel and are expected to experience high tensile stresses, similar to the exemplar.
PFM 6: Out-of-plane shear on the buried walls due to liquefied soil conditions	T2	Walls may experience shear stresses that are higher than their capacity.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 2: Standard Geotechnical Mitigation B1	$3,920,000	Mitigation required to reduce differential settlement by 60% (1" in 60 feet). Ground improvement for settlement mitigation is required from 10 to 59 ft-bgs.
PFM 6: Standard Geotechnical Mitigation C	$1,250,000	Mitigation required to reduce soil fluid density by 50% or preclude liquefaction development in backfill altogether. Ground improvement for lateral earth pressure reduction is required from 10 to 18 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	**$5,170,000**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

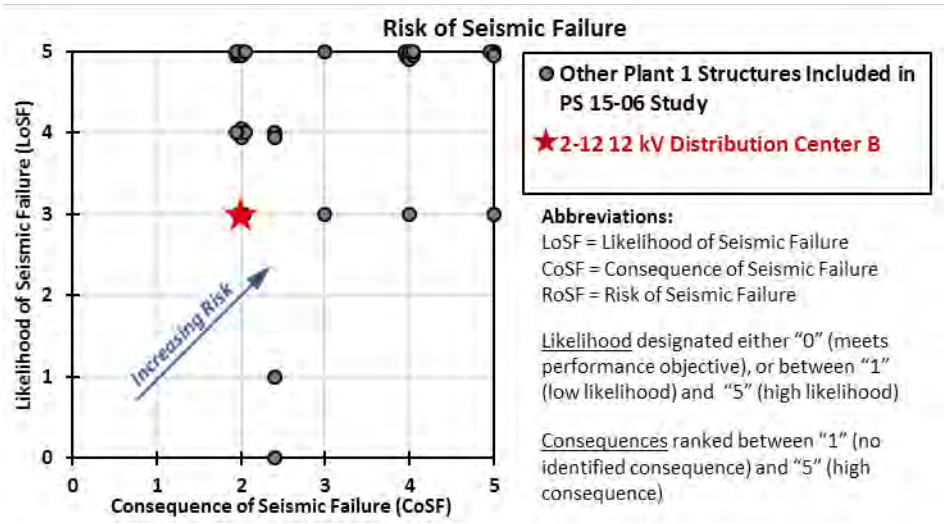
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	6



comments and clarifications

N/A

Next Planned Project and Date: N/A

12 kV DISTRIBUTION CENTER D

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-13	2	I	IV	BUILDING

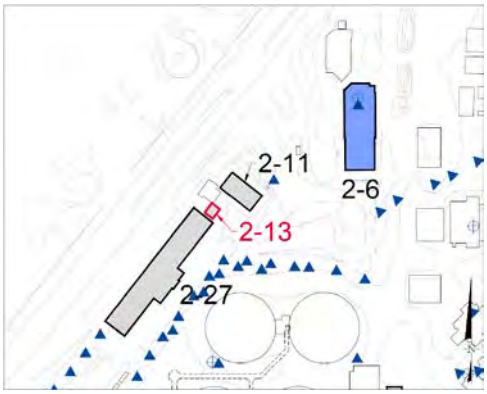
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Shallow spread footings at unknown elevation
Structure Dimensions: 28 ft x 22 ft
# of Stories: 1 story
Date of Original Construction: 1995
Retrofit (if any): N/A
Projects: P2-35-3

Available Information: ☐ Construction Drawings ☐ Geotechnical Report ☐ Specifications ☒ Other no drawings or specs for the current configuration



Plan View

geohazards and seismicity

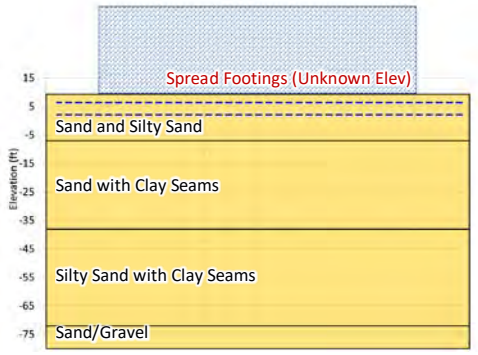
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	12 to 14	12 to 13
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+6.3 ft-MSL
AWL	7.3 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 4: Differential settlement due to liquefaction	T1/2	4.6" of differential settlement over 60 feet. The building has a large opening along the north side. The CMU lintel can experience large differential settlement that can stress the lintel beam into non-linear behavior.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 4: Standard Geotechnical Mitigation B2	$1,500,000	Mitigation required to reduce differential settlement by at least 80% (1" in 60 feet). Ground improvement for settlement mitigation is required from 3 to 63 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$1,500,000

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

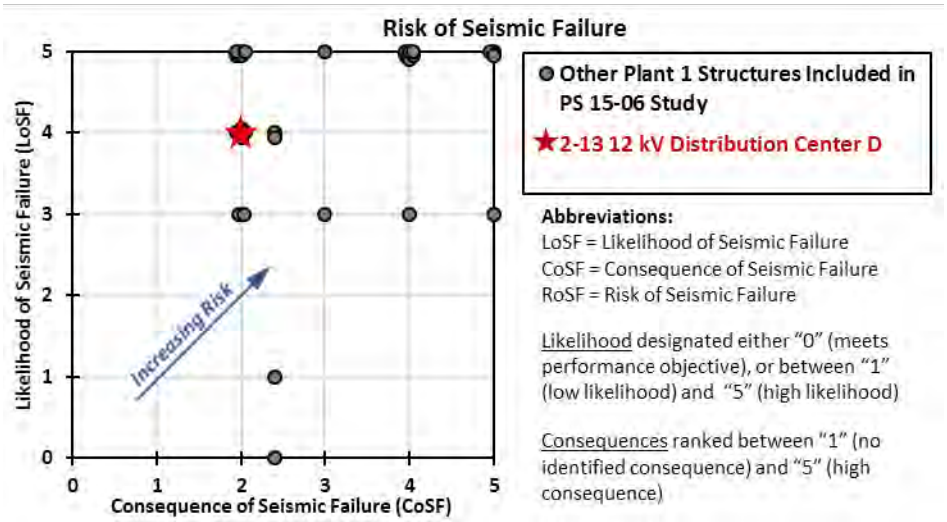
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	4
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	8



comments and clarifications

N/A

Next Planned Project and Date: N/A

HEADWORKS POWER BUILDING A

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-14	2	I	IV	BUILDING

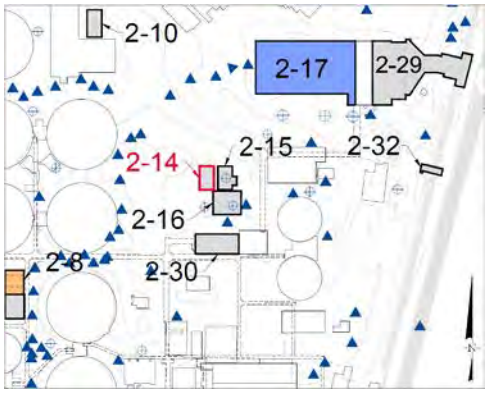
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

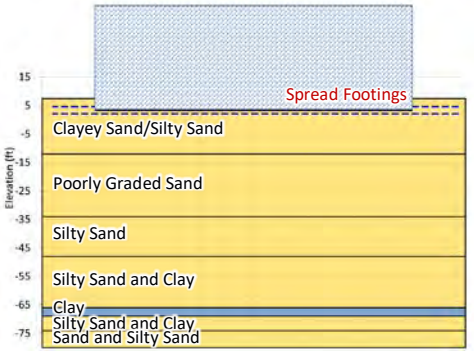
structural components

Foundation Type/Dimensions: Dropped spread footings at 3.35' elev. (4.15' embedment)
Structure Dimensions: 50 ft x 30 ft
# of Stories: 1 story
Date of Original Construction: 1988
Retrofit (if any): N/A
Projects: P2-37 / J-33-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+4.5 ft-MSL
AWL	5.5 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	13 to 18	13 to 17
Lateral Spread (near river, inches)	19 to 28	17 to 25
Lateral Spread (far from river, inches)	18 to 26	16 to 23
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 3: Building separation allows pounding	T1	Building separation is only 3/16-inch, but only occurs in alignment with the west wall of the Headworks Standby Power Building. Buildings should be tied together to help ensure uniform response.
PFM 5: Building response to differential settlement due to liquefaction	T1/2	5.2" of differential settlement over 60 feet. The differential settlement is 3.7 times that at the exemplar. By inspection, the building walls will likely experience tension failures.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 5: Standard Geotechnical Mitigation B2	$2,150,000	Mitigation required to reduce differential settlement by at least 80% (1" in 60 feet). Ground improvement for settlement mitigation is required from 5 to 54 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 3: Tie the structures together using steel plates and through bolts with epoxy anchors. Steel shapes will need to be sized to promote uniform response of the building to ground shaking.	$60,000	Applies at one location where the east wall adjoins to the west wall of 2-16 Headworks Standby Power Building.

Total Geotechnical and Structural Mitigation Cost	**$2,210,000**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

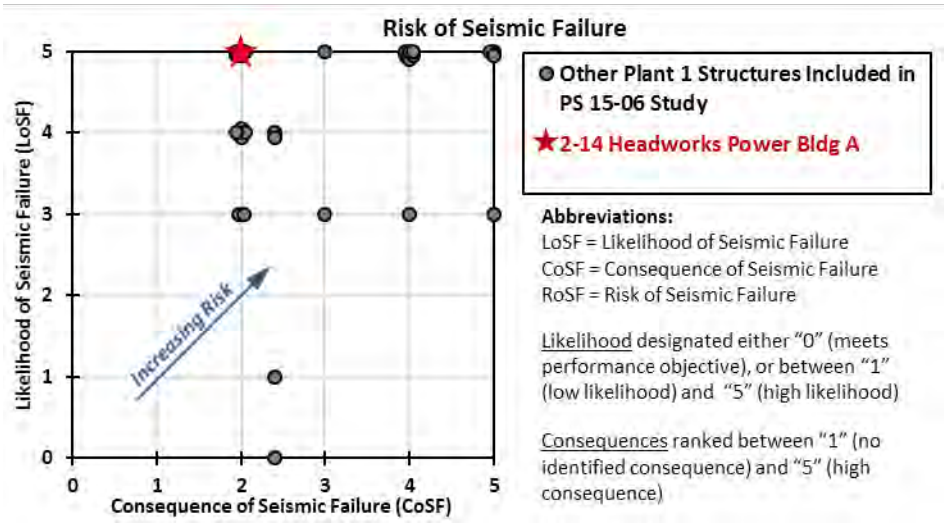
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	10



comments and clarifications

N/A

Next Planned Project and Date: N/A

HEADWORKS POWER BUILDING B

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-15	2	I	IV	BUILDING

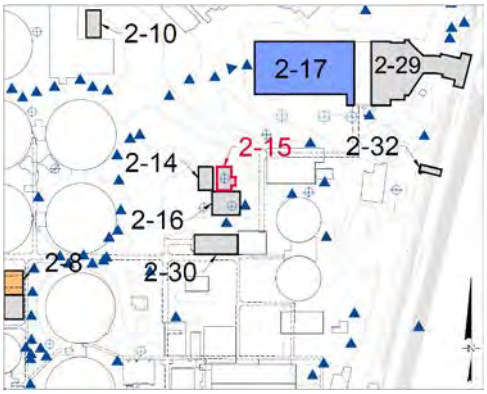
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Shallow spread at 5.00' elevation (2.00' embedment)
Structure Dimensions: 50 ft x 30 ft
# of Stories: 1 story
Date of Original Construction: 1990
Retrofit (if any): N/A
Projects: P2-42-1 / J-33-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

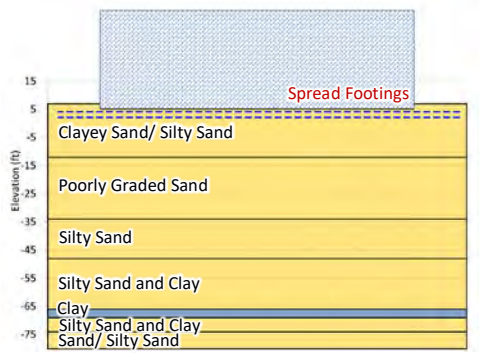
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	13 to 18	13 to 17
Lateral Spread (near river, inches)	20 to 30	19 to 27
Lateral Spread (far from river, inches)	18 to 28	18 to 25
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+4 ft-MSL
AWL	5 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 3: Building separation allows pounding	T1	Building separation is only 3/16-inch at walls and ¾-inch at the roof, where the adjacent roof diaphragm is lower than the roof deck. This can result in pounding of the south bearing wall. Sufficient separation at the roof and walls should be provided.
PFM 5: Building response to differential settlement due to liquefaction	T1/2	5.2" of differential settlement over 60 feet. The differential settlement is 3.7 times that at the exemplar. By inspection, the building walls will likely experience tension failures.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 5: Standard Geotechnical Mitigation B2	$2,400,000	Mitigation required to reduce differential settlement by at least 80% (1" in 60 feet). Ground improvement for settlement mitigation is required from 2 to 53 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 3: Tie the structures together using steel plates and through bolts with epoxy anchors. Steel shapes will need to be sized to promote uniform response of the building to ground shaking. Additional ties at the roof diaphragm of the adjacent building will be required, since that building's diaphragm will be restrained by tying the structures together.	$130,000	Applies at two wall locations and along the low roof of the adjacent 2-16 Headworks Standby Power Building (30 lineal feet).

Total Geotechnical and Structural Mitigation Cost	**$2,530,000**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

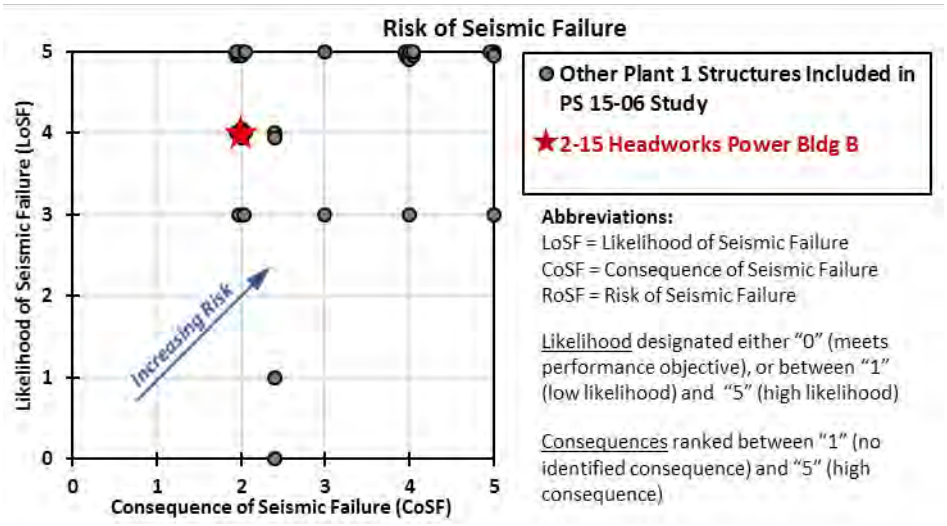
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	4
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	8



comments and clarifications

N/A

Next Planned Project and Date: N/A

HEADWORKS STANDBY POWER BUILDING

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-16	2	I	IV	BUILDING

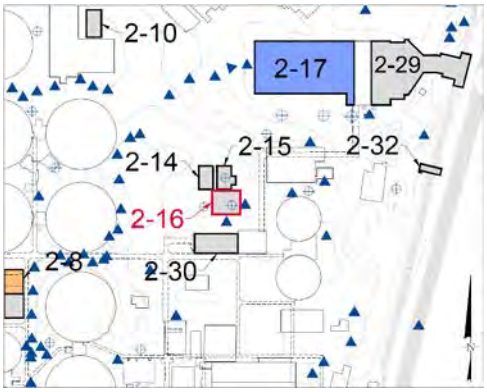
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

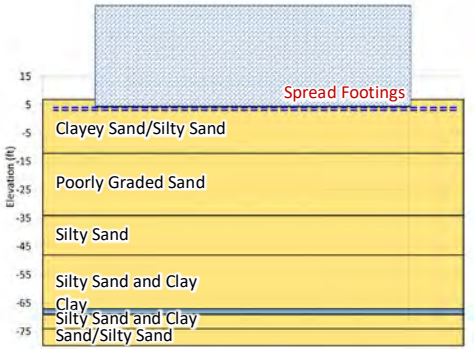
structural components

Foundation Type/Dimensions: Shallow spread at 4.33' elev. (2.67' embedment)
Structure Dimensions: 50 ft x 58 ft
# of Stories: 1 story
Date of Original Construction: 1999
Retrofit (if any): N/A
Projects: J-33-1

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	13 to 18	13 to 17
Lateral Spread (near river, inches)	20 to 29	19 to 28
Lateral Spread (far from river, inches)	18 to 26	17 to 25
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+4 ft-MSL
AWL	5 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 3: Building separation allows pounding	T1	Building separation is only 3/16-inch at walls and ¾-inch at the roof, where the adjacent roof diaphragm is higher than the roof deck. This can result in pounding of the south bearing wall of Headworks Power Building B. Sufficient separation at the roof and walls should be provided.
PFM 5: Building response to differential settlement due to liquefaction	T1/2	5.2" of differential settlement over 60 feet. The differential settlement is 3.7 times that at the exemplar. By inspection, the building walls will likely experience tension failures.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 5: Standard Geotechnical Mitigation B2	$2,970,000	Mitigation required to reduce differential settlement by at least 80% (1" in 60 feet). Ground improvement for settlement mitigation is required from 3 to 53 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 3: Tie the structures together using steel plates and through bolts with epoxy anchors. Steel shapes will need to be sized to promote uniform response of the building to ground shaking. Additional ties at the roof diaphragm of the adjacent building will be required, since that building's diaphragm will be restrained by tying the structures together.	$130,000	Applies at two wall locations and along the low roof of the adjacent 2-15 Headworks Power Building B (30 lineal feet).

Total Geotechnical and Structural Mitigation Cost	**$3,100,000**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

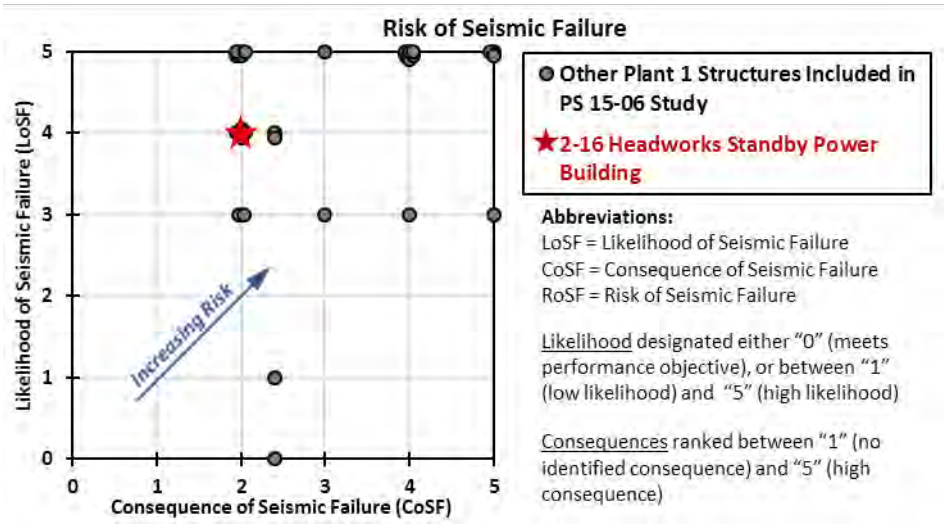
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	4
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	8



comments and clarifications

N/A

Next Planned Project and Date: N/A

CENTRAL POWER GENERATION BUILDING

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-17	2	I	IV	BUILDING

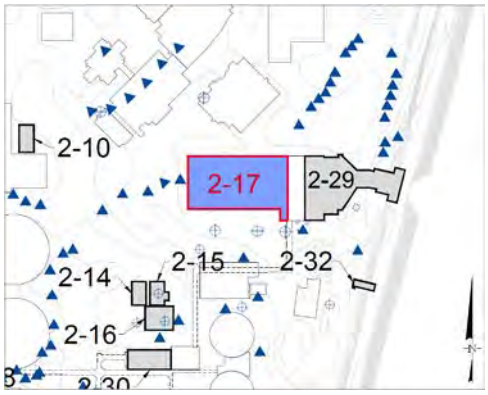
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

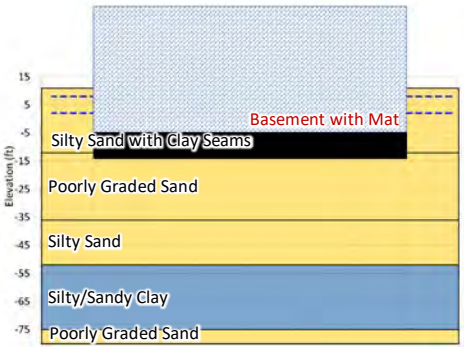
structural components

Foundation Type/Dimensions: Basement with 9' mat at -14.00' elev. (25.00' embedment)
Structure Dimensions: 192 ft x 110 ft
# of Stories: 1 above grade, 1 below grade
Date of Original Construction: 1990 (?)
Retrofit (if any): N/A
Projects: J-19-2 / J-15

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+8 ft-MSL
AWL	9 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 15	8 to 13
Lateral Spread (near river, inches)	26 to 33	21 to 27
Lateral Spread (far from river, inches)	15 to 19	12 to 16
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Discontinuous shear walls along grid line B (mezzanine)	T1	The shear walls along the south side of the mezzanine is not continuous down to the foundation. The first-floor deck does not appear to have been designed for this condition.
PFM 2: Wall anchorage at the north and south walls	T1	(2) ¾" diameter bolts resist wall anchorage force in shear at the top of the pilaster (10 locations). Beam is also slender and requires bracing and/or stiffening. Diaphragm cross ties are also deficient (low capacity compared to wall anchorage force).
PFM 4: Mezzanine at EL 21 lacks bracing	T1	Steel-framed mezzanine at EL 21 has no lateral bracing to resist seismic loads.
PFM 5: In-plane shear in shear walls at shear walls in the east-west direction	T1	East-west seismic governs. North-south was determined to be adequate.

PFM 6: Roof diaphragm shear transfer	T1	The ledger angle bolts cannot develop the diaphragm shear strength.
PFM 7: Roof diaphragm shear	T2	Roof diaphragm shear in both directions exceeds the capacity of the decking.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Provide 50 lineal feet of 12-inch thick cast-in-place concrete shear wall at the basement level and upgrade first floor beams with steel channel tie along the entire building length (190 feet) to serve as a collector.	$600,000	Conduit and piping is suspended from the first floor deck along grid line B. These would need to be removed and replaced or relocated.
PFM 2: Standard Structural Mitigation A2 (High)	$700,000	Occurs at 10 locations.
PFM 4: Provide steel braced frames down to the first floor.	$70,000	Occurs at 4 locations.
PFM 5: Standard Structural Mitigation E	$110,000	Provide at high and low windows at the south wall for 25-ft long x 14.5-ft (364 square feet total).
PFM 6: Standard Structural Mitigation B2	$80,000	Supplement existing anchors at 20" OC (total of 200 epoxy anchors). Provide along the west, interior, and east walls.
PFM 7: Standard Structural Mitigation B1	$2,330,000	Estimated to be required at 50% of the roof diaphragm.
Total Geotechnical and Structural Mitigation Cost	**$3,890,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

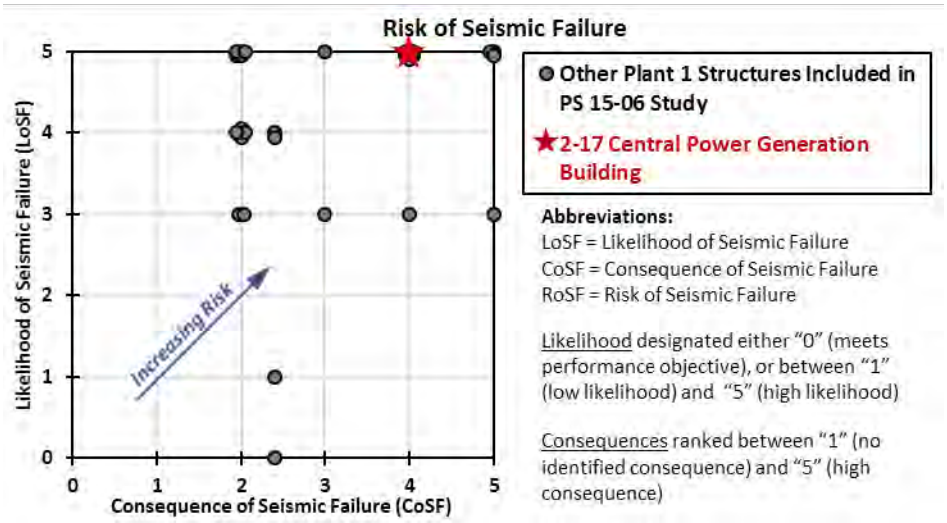
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: P2-119 (09/01/2027)

AERATION BASINS A-H (NORTHWEST)

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-18A	2	I	IV	TANK

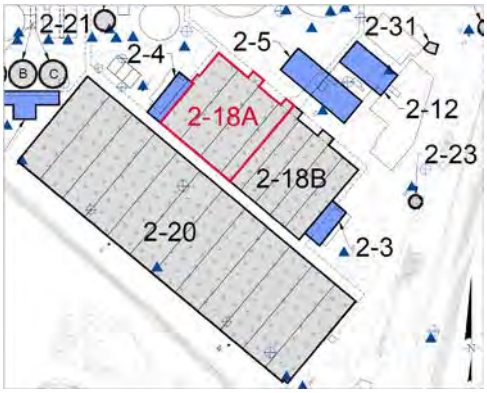
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

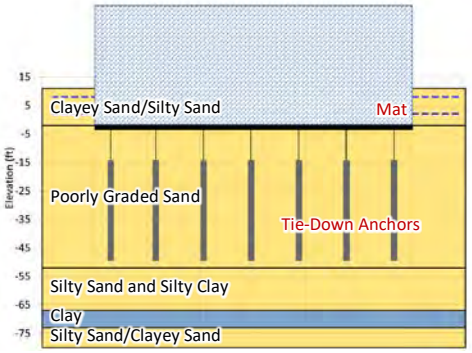
structural components

Foundation Type/Dimensions: 1'-4" mat at -3.33' elev. (14.33' embedment); tie-down anchors (PTA, 1" DIA, 35' bonded length, 46' total length)
Structure Dimensions: 379.5 ft x 192 ft
# of Stories: 1 story
Date of Original Construction: 1977
Retrofit (if any): N/A
Projects: P2-23-6 / P2-23-2

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+8 ft-MSL
AWL	9 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	5 to 6	4 to 6
Lateral Spread (near river, inches)	4 to 5	1 to 3
Lateral Spread (far from river, inches)	3 to 4	1 to 2
Lateral Spread (near marsh, inches)	5 to 7	1 to 3
Lateral Spread (far from marsh, inches)	3 to 4	1 to 2

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 4: Top slab flexure due to response to differential settlement	T3	1.4" differential settlement over 60 feet. Considers a 10% reduction in capacity due to corrosion. Bottom bars govern this check. Bottom side of roof deck did not have signs of rebar corrosion per condition assessment reports. Check is compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).
PFM 5: Wall flexure due to response to differential settlement at the interior basin dividing walls and the north and south perimeter walls	T3	1.4" differential settlement over 60 feet. Occurs at the reinforcing steel dowels at the thickened wall base of the interior basin-dividing walls and the north and south perimeter walls. The north and south perimeter walls are compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).
PFM 6: Out-of-plane shear response to differential settlement	T3	1.4" differential settlement over 60 feet. Occurs at the top slab and base slab. All conditions are compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).

PFM 7: Tension in top slab rebar due to differential settlement	T3	1.4" differential settlement over 60 feet. Considers a 20% reduction in capacity due to corrosion. Occurs at the top slab. Condition is compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).
PFM 8: Tension in interior basin-dividing walls due to differential settlement	T3	1.4" differential settlement over 60 feet. Occurs at the interior basin-dividing walls and the interior transverse walls. Condition is compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 4: Standard Geotechnical Mitigation B1	$18,570,000	Applies to approximately 800 square feet total. Mitigation required to reduce differential settlement by 50% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 67 ft-bgs.
PFM 5: Standard Geotechnical Mitigation B1	--	Occurs over a length of 800 lineal feet. Mitigation required to reduce differential settlement by 50% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 67 ft-bgs.
PFM 6: Standard Geotechnical Mitigation B1	--	Occurs at the top slab and bottom slab. Overstress is occurring at about 3,000 square feet. Mitigation required to reduce differential settlement by 50% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 67 ft-bgs.
PFM 7: Standard Geotechnical Mitigation B1	--	Occurs at the top slab over an area of approximately 36,000 square feet (50% of the top slab area). Mitigation required to reduce differential settlement by 50% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 67 ft-bgs.
PFM 8: Standard Geotechnical Mitigation B1	--	Occurs over about 30% of all interior basin walls. Mitigation required to reduce differential settlement by 50% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 67 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	**$18,570,000**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

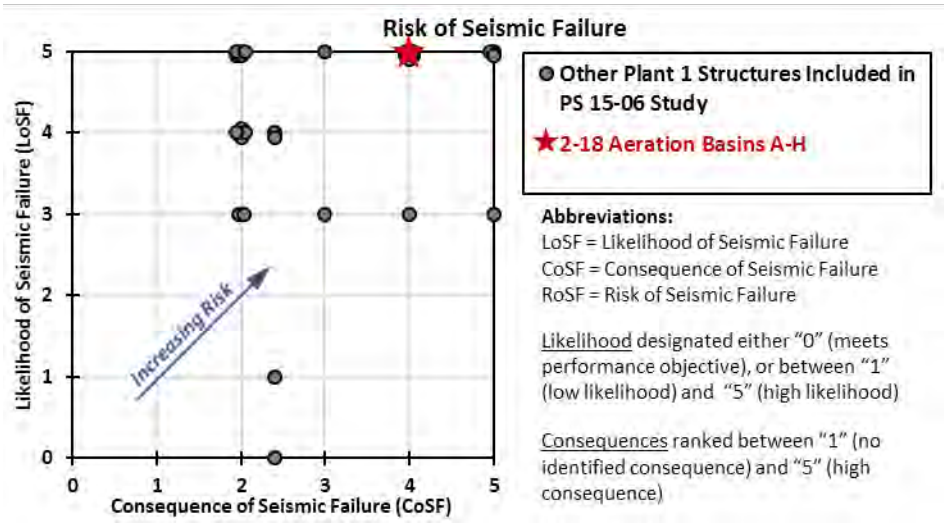
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: X-050 (03/01/2020)

AERATION BASINS A-H (SOUTHEAST)

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-18B	2	I	IV	TANK

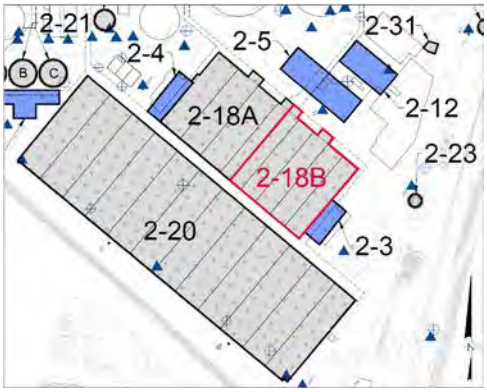
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

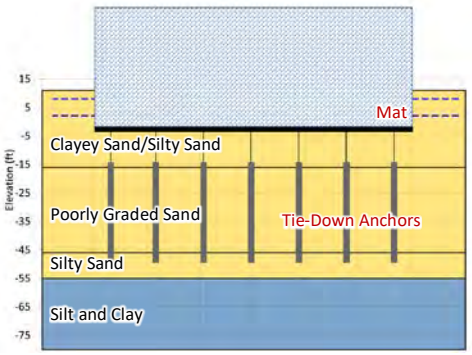
structural components

Foundation Type/Dimensions: 1'-4" mat at -3.33' elev. (14.33' embedment); tie-down anchors (PTA, 1" DIA, 35' bonded length, 46' total length)
Structure Dimensions: 379.5 ft x 192 ft
# of Stories: 1 story
Date of Original Construction: 1977
Retrofit (if any): N/A
Projects: P2-23-6 / P2-23-2

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+8 ft-MSL
AWL	9 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 8	6 to 8
Lateral Spread (near river, inches)	18 to 33	16 to 31
Lateral Spread (far from river, inches)	10 to 19	9 to 18
Lateral Spread (near marsh, inches)	16 to 28	13 to 26
Lateral Spread (far from marsh, inches)	11 to 19	9 to 18

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 4: Top slab flexure due to response to differential settlement	T3	1.8" differential settlement over 60 feet. Considers a 10% reduction in capacity due to corrosion. Bottom bars govern this check. Bottom side of roof deck did not have signs of rebar corrosion per condition assessment reports. Check is compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).
PFM 5: Wall flexure due to response to differential settlement at the interior basin dividing walls and the north and south perimeter walls	T3	1.8" differential settlement over 60 feet. Occurs at the reinforcing steel dowels at the thickened wall base of the interior basin-dividing walls and the north and south perimeter walls. The north and south perimeter walls are compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).
PFM 6: Out-of-plane shear response to differential settlement	T3	1.8" differential settlement over 60 feet. Occurs at the top slab and base slab. All conditions are compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).

PFM 7: Tension in top slab rebar due to differential settlement	T3	1.8" differential settlement over 60 feet. Considers a 20% reduction in capacity due to corrosion. Occurs at the top slab. Condition is compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).
PFM 8: Tension in interior basin-dividing walls due to differential settlement	T3	1.8" differential settlement over 60 feet. Occurs at the interior basin-dividing walls and the interior transverse walls. Condition is compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 4: Standard Geotechnical Mitigation B1	$9,870,000	Applies to approximately 800 square feet total. Mitigation required to reduce differential settlement by 60% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 41 ft-bgs.
PFM 5: Standard Geotechnical Mitigation B1	--	Occurs over a length of 800 lineal feet. Mitigation required to reduce differential settlement by 60% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 41 ft-bgs.
PFM 6: Standard Geotechnical Mitigation B1	--	Occurs at the top slab and bottom slab. Overstress is occurring at about 3,000 square feet. Mitigation required to reduce differential settlement by 60% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 41 ft-bgs.
PFM 7: Standard Geotechnical Mitigation B1	--	Occurs at the top slab over an area of approximately 36,000 square feet (50% of the top slab area). Mitigation required to reduce differential settlement by 60% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 41 ft-bgs.
PFM 8: Standard Geotechnical Mitigation B1	--	Occurs over about 30% of all interior basin walls. Mitigation required to reduce differential settlement by 60% (3/4" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 41 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A		N/A

Total Geotechnical and Structural Mitigation Cost	**$9,870,000**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

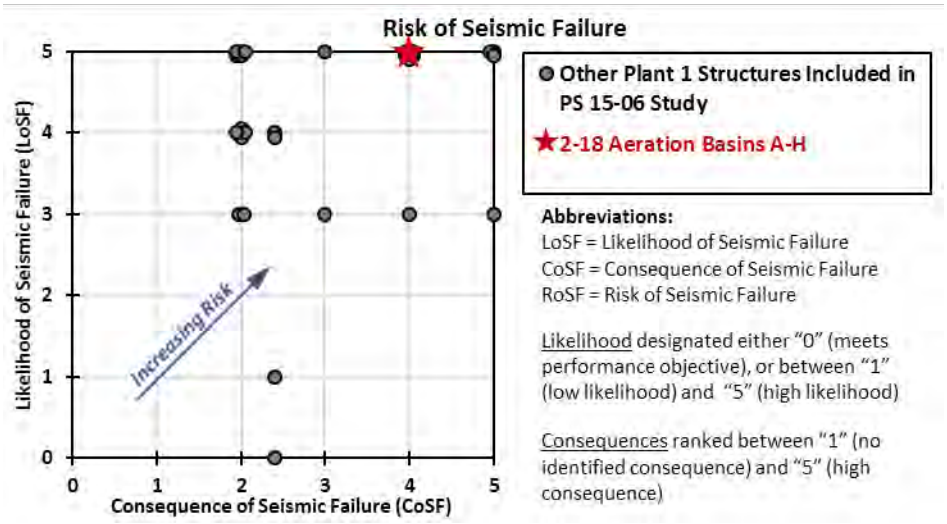
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	20



comments and clarifications

N/A

Next Planned Project and Date: X-050 (03/01/2020)

GAS HOLDER

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-19	2	I	IV	STEEL TANK

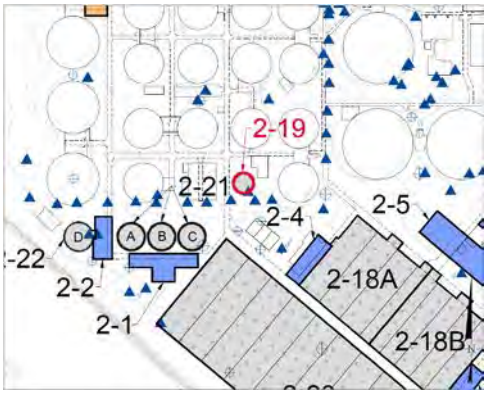
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

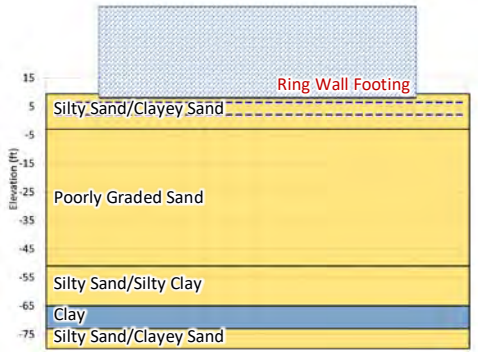
structural components

Foundation Type/Dimensions: Ring wall footing (2' wide) at 8.00' elev. (1.50' embedment)
Structure Dimensions: 42 ft diameter, 31 ft height
# of Stories: 1 story
Date of Original Construction: 1982
Retrofit (if any): N/A
Projects: P2-24-1

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☒ Other Shop Drawings: Gas holder



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+6.5 ft-MSL
AWL	7.5 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	5	4
Lateral Spread (near river, inches)	2 to 3	1
Lateral Spread (far from river, inches)	2	1
Lateral Spread (near marsh, inches)	4 to 5	1 to 2
Lateral Spread (far from marsh, inches)	4 to 5	1 to 2

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 6: Tank shell overstress due to liquefaction-induced lateral spread and settlements	T3	Does not meet **IO (BSE 1E)** performance objectives. Stress in tank shell at the anchor location exceeds yield, may result in gas leakage. Does meet **LS (BSE 2E)** performance objectives, DCR > 1.0, overstress in steel shell at anchor plates may cause some permanent deformation and/or gas leakage, low likelihood of collapse.
PFM 7: Anchor failure overstress due to liquefaction-induced lateral spread and settlements	T3	Does not meet **IO (BSE 1E)** performance objectives. Stress in the anchor plates exceeds yield; corrosion observed, damages to similar plate anchors observed in past earthquakes. Does meet **LS (BSE 2E)** performance objectives, DCR > 1.0, overstress in plate anchors may cause permanent deformation or fracture, low likelihood of collapse.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 6 & 7: Standard Geotechnical Mitigation B2	$2,300,000	Mitigation required to reduce differential settlement.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$2,300,000	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

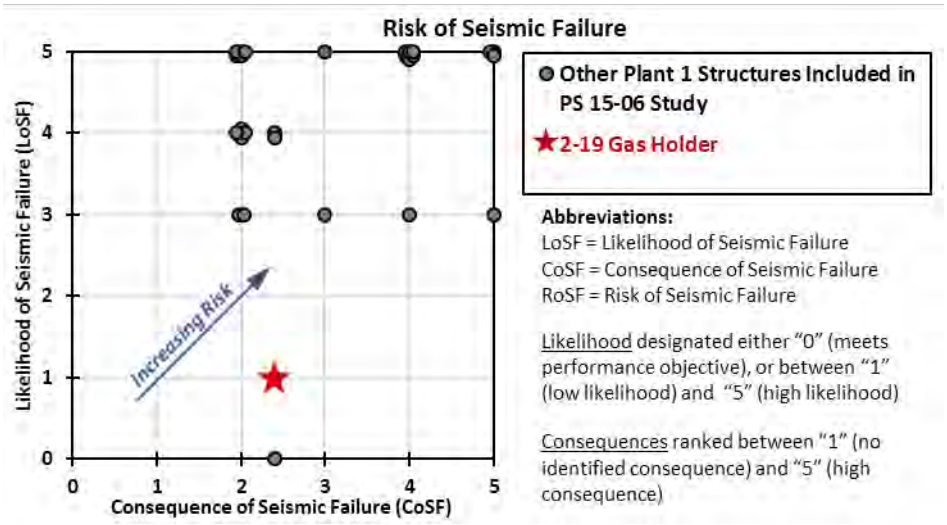
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	1
CoSF, Weighted Score:	2.4
Overall RoSF = LoSF x CoSF =	2.4



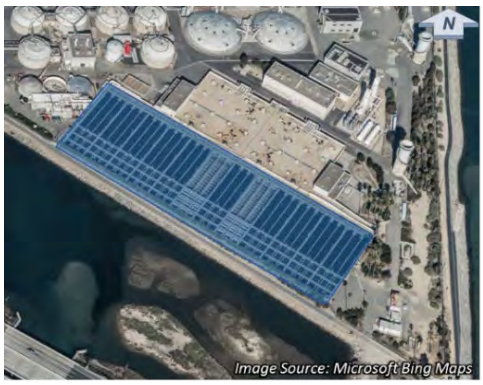
comments and clarifications

N/A

Next Planned Project and Date: J-124 (In Progress)

SECONDARY CLARIFIERS A-L

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-20	2	I	IV	STEEL TANK



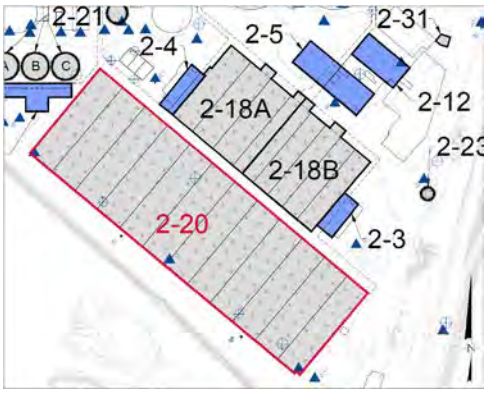
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

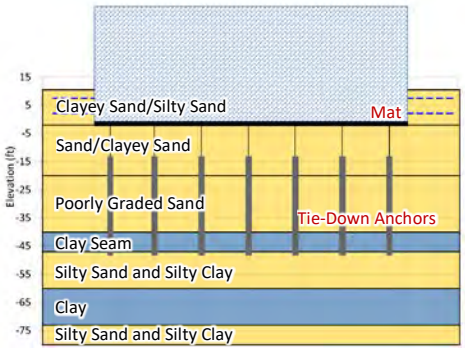
structural components

Foundation Type/Dimensions: 1'-3" Mat at -2.25' elev. (12.75' embedment); tie-down anchors (PTA, 1" DIA, 35' bonded length, 46' total length)
Structure Dimensions: 555 ft x 345 ft
# of Stories: 1 story
Date of Original Construction: 1977
Retrofit (if any): N/A
Projects: P2-23-6 / P2-42-2

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other Shop Drawings: Soil anchors



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+7.5 ft-MSL
AWL	8.5 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 12	6 to 10
Lateral Spread (near river, inches)	15 to 23	12 to 23
Lateral Spread (far from river, inches)	8 to 9	6 to 8
Lateral Spread (near marsh, inches)	45 to 88	36 to 77
Lateral Spread (far from marsh, inches)	15 to 22	12 to 19

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 11: Separation across expansion joints due to differential settlements	T3	3.2" differential settlement over 60 ft. Approximately 1.5 inches of separation may occur at the expansion joints in the walls, possible water-stop damage.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 11: Standard Geotechnical Mitigation B1	$30,240,000	Mitigation is required to reduce differential settlement by 35% (2.1" in 60 feet). Ground improvement for settlement mitigation is required from 9 to 30 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$30,240,000

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

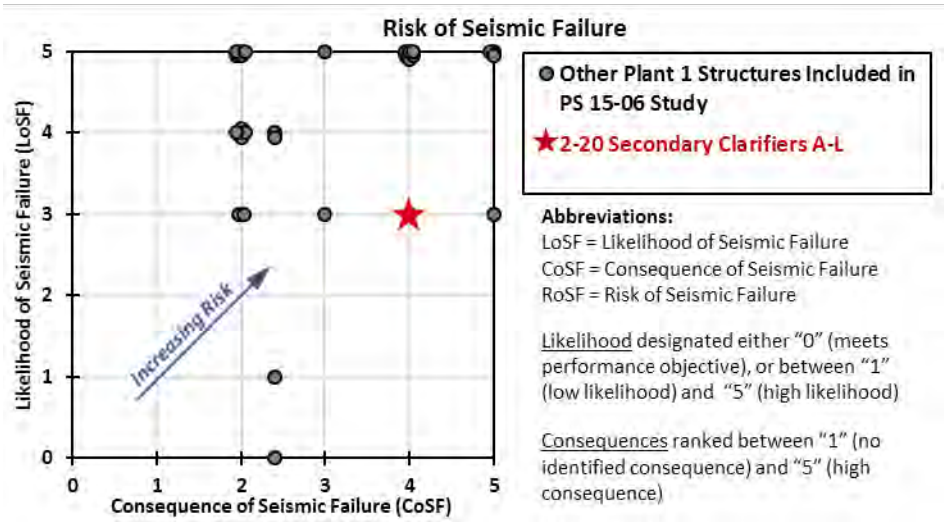
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☒ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	4
Overall RoSF = LoSF x CoSF =	12



comments and clarifications

N/A

Next Planned Project and Date: X-051 (09/01/2027)

DAFTS A-C

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-21	2	I	IV	TANK

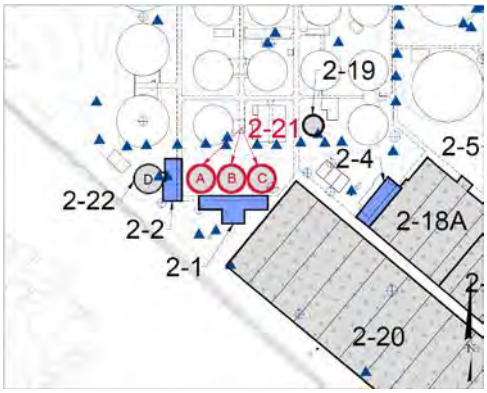
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: 1'-0" Mat at 1.25' elev (9.25' embedment)
Structure Dimensions: 55 ft diameter, 35 ft height
# of Stories: 1 story
Date of Original Construction: 1977
Retrofit (if any): Remodeled in 2011
Projects: P2-23-6

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

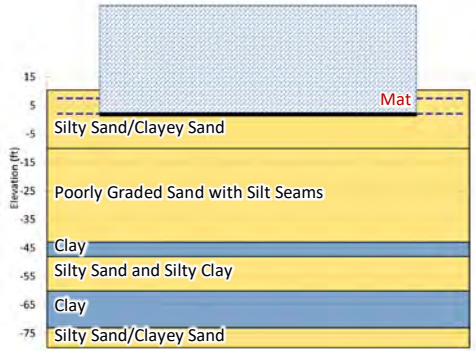
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	7 to 10	6 to 10
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	20 to 34	14 to 24
Lateral Spread (far from marsh, inches)	11 to 19	8 to 13

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+7.5 ft-MSL
AWL	8.5 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-22 DAFT D

PFM and Description[1]	Tier[2]	Assessment Results
PFM 3: Structure response to differential settlement due to liquefaction	T1/2	2.4" differential settlement over 60 feet. Differential settlement is about 83% of exemplar. Members are nearly the same thickness and reinforcing. Refer to exemplar for typical deficiencies.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 3: Standard Geotechnical Mitigation B1	$4,970,000	Mitigation required to reduce differential settlement by 60% (1" in 60 feet). Ground improvement for settlement mitigation is required from 8 to 60 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$4,970,000

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

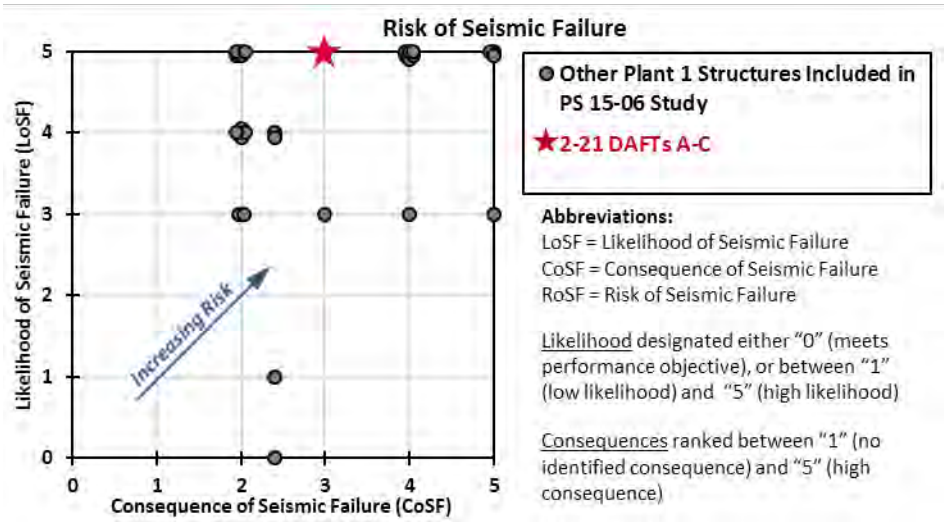
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	3
Overall RoSF = LoSF x CoSF =	15



comments and clarifications

N/A

Next Planned Project and Date: N/A

DAFT D

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-22	2	I	IV	TANK

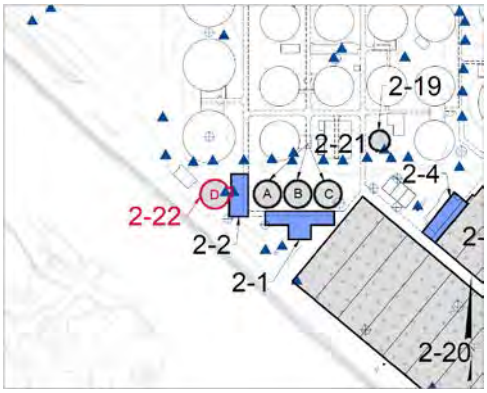
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

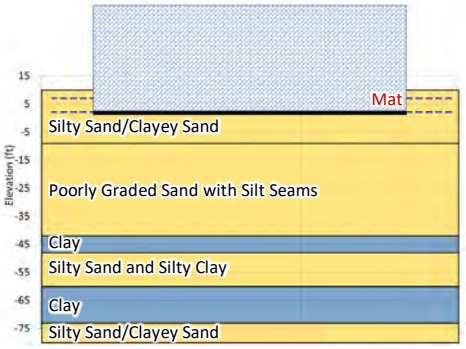
structural components

Foundation Type/Dimensions: 1'-0" Mat at 1.25' elev. (8.75' embedment)
Structure Dimensions: 55 ft diameter, 35 ft height
# of Stories: 1 story
Date of Original Construction: 1993
Retrofit (if any): N/A
Projects: P2-42-2

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☒ Other Shop Drawings: Dome rebar and PT thrust ring



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+7 ft-MSL
AWL	8 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 10	8 to 9
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	40 to 76	28 to 52
Lateral Spread (far from marsh, inches)	20 to 39	14 to 26

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 3: Dome-to-wall Connection	T2	Shear friction on the dome to wall dowels. The existing joint has building paper to limit restraint, so the dowel is resisting all of the dome seismic shear.
PFM 5: Bottom mat flexure due to response to differential settlement	T3	2.9" differential settlement over 60 feet. Bottom bars govern this check. Check is compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).
PFM 6: Bottom mat out-of-plane shear due to differential settlement	T3	2.9" differential settlement over 60 feet. Check is compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft).
PFM 7: Hoop tension in wall and slab due to differential settlement	T3	2.9" differential settlement over 60 feet. Check is still non-compliant if the spring stiffness is assumed to be liquefied (ky = 7.2 ksf/ft) for the wall and mat slab.

PFM 9: Chord/ring tension in the dome trust ring	T2	The diaphragm thrust due to dead load with the potential seismic chord force exceeds the available post-tensioning and mild reinforcement capacity.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 5-7: Standard Geotechnical Mitigation B1	$1,940,000	Mitigation required to reduce differential settlement by 70% (1" in 60 feet). Ground improvement for settlement mitigation is required from 8 to 60 ft-bgs.
Recommended Structural Mitigation[1]	**Cost[2]**	**Comments**
PFM 3: Install additional epoxy dowels that tie the dome into the perimeter wall.	$40,000	Estimated that 40 epoxy dowels are required.
PFM 9: Install a perimeter C6 x 13 member along the circumference of the dome thrust ring.	$70,000	Approximate length of 100 feet. Anchor the steel section to the dome using epoxy bonded anchors (100 anchors).
Total Geotechnical and Structural Mitigation Cost	**$2,050,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

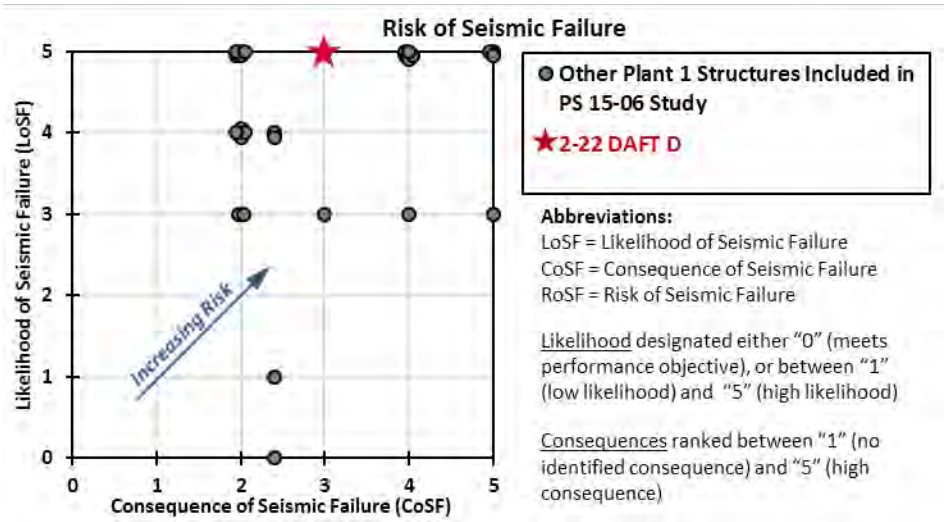
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☒ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	3
Overall RoSF = LoSF x CoSF =	15



comments and clarifications

N/A

Next Planned Project and Date: N/A

SURGE TOWER NO. 1

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-23	2	I	IV	TANK

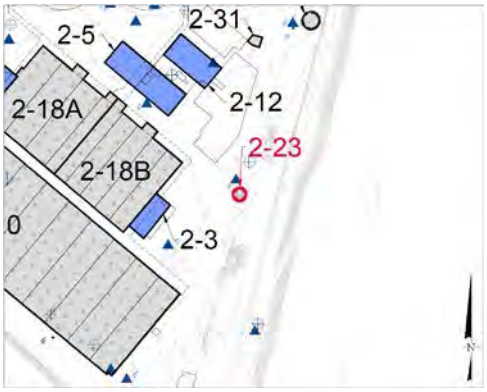
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

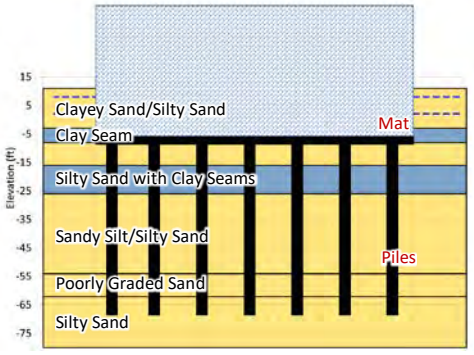
structural components

Foundation Type/Dimensions: 2'-6" Mat at -8.50' elev. (19.50' embedment); piles – PPC (14" SQ, 60' total length)
Structure Dimensions: 28 ft diameter, 104 ft height
# of Stories: N/A
Date of Original Construction: 1996
Retrofit (if any): N/A
Projects: J-34-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☒ Other Shop Drawings: Piles



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+8 ft-MSL
AWL	9 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 10	8 to 9
Lateral Spread (near river, inches)	53 to 66	42 to 64
Lateral Spread (far from river, inches)	44 to 55	35 to 53
Lateral Spread (near marsh, inches)	14 to 18	12 to 17
Lateral Spread (far from marsh, inches)	13 to 17	12 to 16

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-24 Surge Tower No. 2; Digester 16

PFM and Description[1]	Tier[2]	Assessment Results
PFM 9: Permanent displacements due to liquefaction-induced lateral spread and settlements (surface PGD = 64 inches)	T1/2	Permanent horizontal displacements due to lateral spread are likely. LS performance level met, low likelihood of collapse.
PFM 10: Bending/shear failure of piles due to lateral spread (surface PGD = 64 inches)	T1/2	Bending moment in piles exceed ultimate capacity at around 24-inches of lateral spread < best estimate PGD = 64 inches. Low likelihood of collapse even if the piles fail.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 9 & 10: Standard Geotechnical Mitigation A2	See Note 3	Mitigation is required to reduce lateral spread by at least 75% (surface PGD = 15-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$0	(excluding lateral spread mitigation, see Note 3)

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

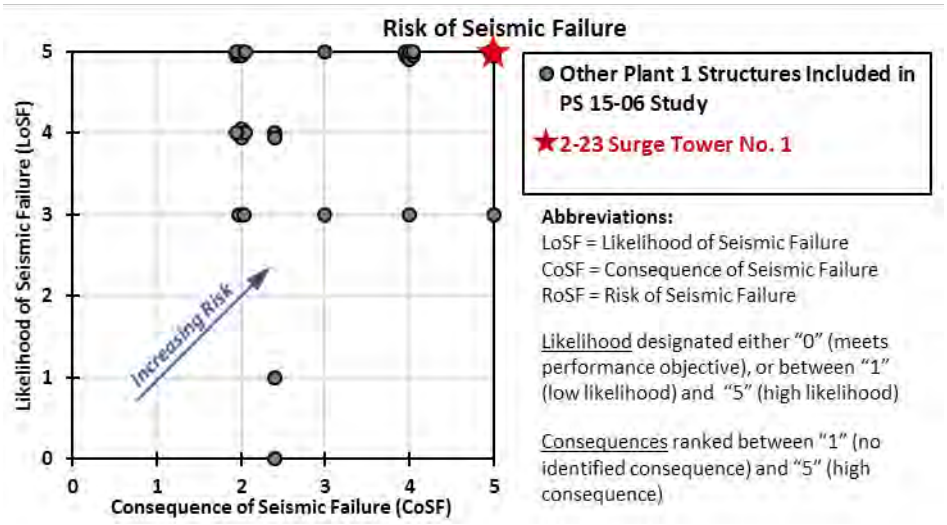
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☒ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	25



comments and clarifications

N/A

Next Planned Project and Date: N/A

SURGE TOWER NO. 2

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-24	2	I	IV	TANK

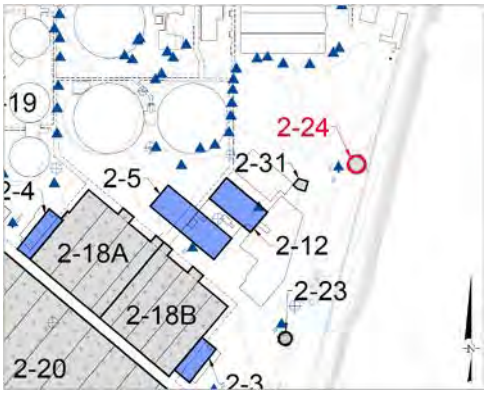
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

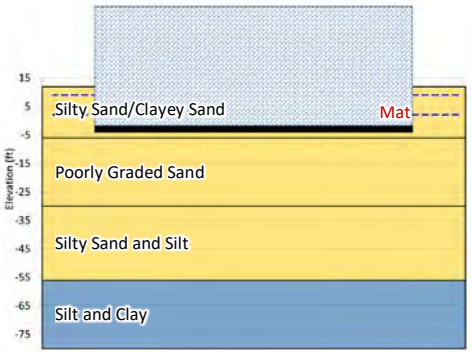
structural components

Foundation Type/Dimensions: 2'-0" Mat at -4.00' elev. (16.00' embedment)
Structure Dimensions: 26-feet diameter, 93-feet height
# of Stories: N/A
Date of Original Construction: 1986
Retrofit (if any): N/A
Projects: J-9 / J-34-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report
☒ Specifications ☒ Other Shop Drawings: Steel extension



Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+9 ft-MSL
AWL	10 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 13	9 to 11
Lateral Spread (near river, inches)	90 to 120	65 to 95
Lateral Spread (far from river, inches)	62 to 82	45 to 65
Lateral Spread (near marsh, inches)	10 to 13	7 to 11
Lateral Spread (far from marsh, inches)	10 to 13	7 to 11

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 9: Permanent displacements due to liquefaction-induced lateral spread and settlements (surface PGD = 65-inches).	T3	Lateral spread and settlements will result in translation and tilting. Low likelihood of collapse. Failure of dresser coupling does not meet IO criteria.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 9: Standard Geotechnical Mitigation A2	See Note 3	Mitigation is required to reduce lateral spread by at least 75% (surface PGD = 15-inches).

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	**$0**	**(excluding lateral spread mitigation, see Note 3)**

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only; 3. Full retrofit of this structure relies on lateral spread mitigation. Refer to TM4 (Geosyntec, 2019) for additional detail.*

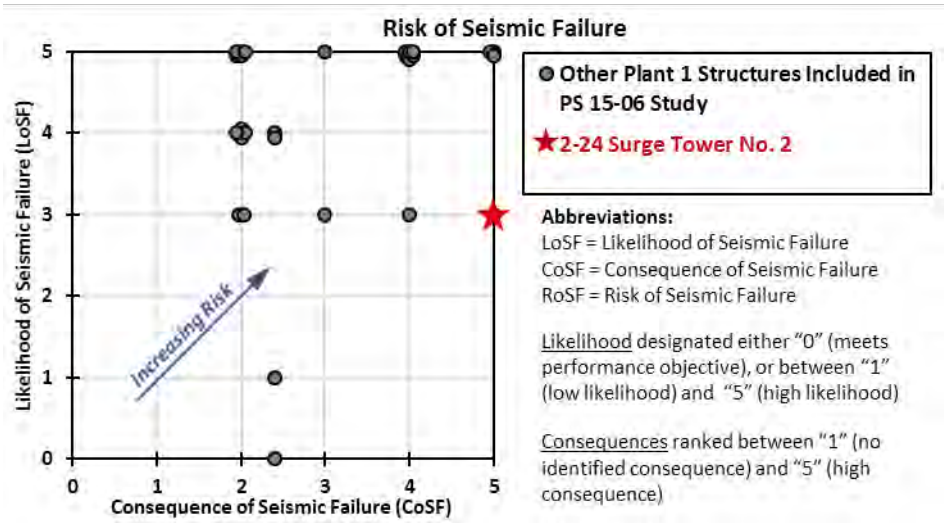
risk ranking

Controlling Failure Type(s):
☐ Ground Shaking
☐ Differential Settlement
☒ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☒ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	3
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	15



comments and clarifications

N/A

Next Planned Project and Date: N/A

TRUCK LOADING

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-26	2	II	II	TANK

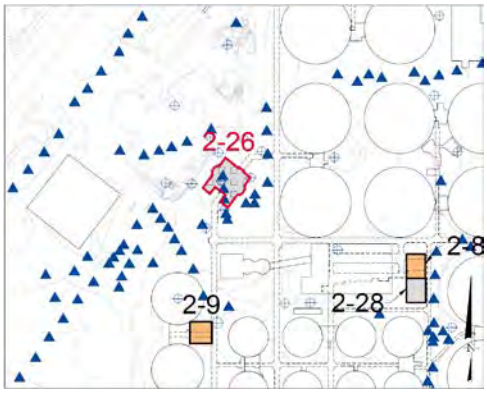
class based performance objectives

Class II: Not directly necessary to preserve wastewater flow through system; loss of life potential is low. Continued occupancy and operation might not be likely before repair.

structural components

Foundation Type/Dimensions: 4'-9" Mat at 1.75' elev. (7.75' embedment); stone columns
Structure Dimensions: 79 ft x 68 ft
# of Stories: 2 stories
Date of Original Construction: 2003
Retrofit (if any): N/A
Projects: P2-60

Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

geohazards and seismicity

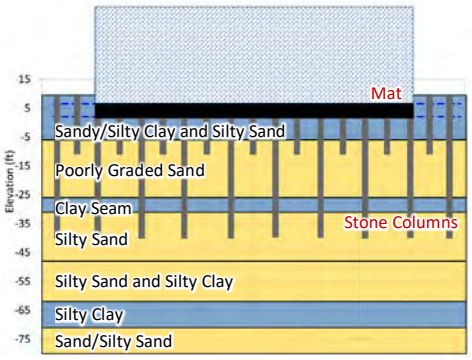
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 11	8 to 10
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+6.5 ft-MSL
AWL	7.5 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
N/A		

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Total Geotechnical and Structural Mitigation Cost	$0

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

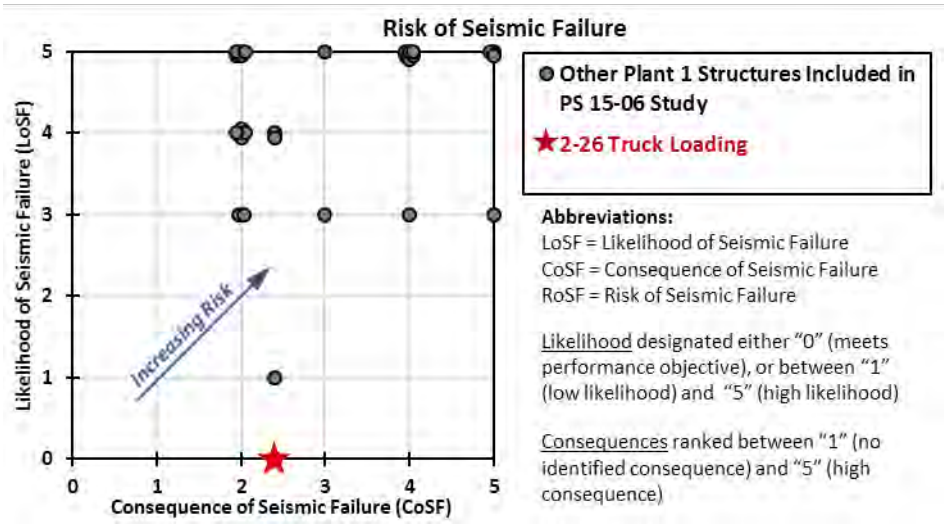
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☒ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	0
CoSF, Weighted Score:	2.4
Overall RoSF = LoSF x CoSF =	0



comments and clarifications

N/A

Next Planned Project and Date: N/A

MAINTENANCE BUILDING

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-27	2	II	II	BUILDING

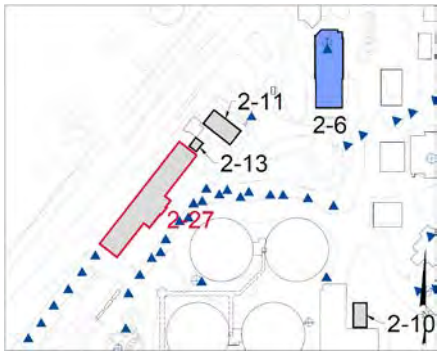
class based performance objectives

Class II: Not directly necessary to preserve wastewater flow through system; loss of life potential is low. Continued occupancy and operation might not be likely before repair.

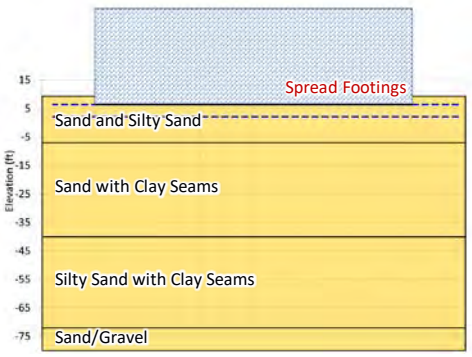
structural components

Foundation Type/Dimensions: Shallow spread at 6.30' elev. (3.00' embedment)
Structure Dimensions: 302 ft x 51 ft
# of Stories: 2 stories
Date of Original Construction: 1996 (?)
Retrofit (if any): N/A
Projects: P2-35-3

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View



Schematic Cross Section

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	12 to 14	11 to 12
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+6.3 ft-MSL
AWL	7.3 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-29 Shop Building A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 2: Flexural stress in moment frame columns	T2	North-south direction flexure in columns has stress of 213 ksi.
PFM 3A: Flexural/axial stress in transverse moment frame beams	T2	Findings apply to all of the transverse moment frame roof beams (W24x62), which are unbraced for their full span of 51 feet. 2nd floor beams in the transverse direction meet the performance objectives.
PFM 3B: Flexural/axial stress in longitudinal moment frame beams	T2	Findings apply to all of the longitudinal moment frame roof beams (W12x26), which are unbraced for their full span of 20 feet. 2nd floor beams along grid line 4 do not meet the performance objectives with slightly higher DCRs.
PFM 4: Precast wall cladding interferes with moment frames	T1	The precast concrete wall cladding is rigidly connected with welds to the moment frame columns. The cladding will serve to restrain the moment frame and can result in excessive damage/collapse of wall panels from the building.
PFM 5: Moment frame beam-column connection	T2	All beam-column moment frame connections at both the roof and 2nd floor levels do not meet the performance objectives.
PFM 7: Moments frames have relatively weak columns	T1	All moment frame connections have strong beams relative to the columns. A Tier 2 evaluation was performed.

PFM 8: Columns are noncompact members	T1	Columns are susceptible to buckling. A Tier 2 evaluation was performed.
PFM 9: Differential settlement due to liquefaction causes failure of precast concrete wall panels	T1/2	4.4" differential settlement over 60 feet. The precast concrete cladding has insufficient connections and joints to accommodate the differential settlement. Brittle failure and spalling of the precast concrete panels is anticipated.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 9: Standard Geotechnical Mitigation B2	$15,300,000	Mitigation required to reduce differential settlement by at least 80% (1" in 60 feet). Ground improvement for settlement mitigation is required from 4 to 64 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 2, 3A, 3B, 7, and 8: Provide steel concentric braced frames from the roof level down to the first floor in the north-south and east-west directions. Braced frames should be either chevron or X braces and may be comprised of tube steel or buckling restrained braced frame members. Add supplemental connections along collector lines with steel hardware as required at the roof and 2nd floor levels. Add columns below existing beam lines in addition to the bracing. New grade beams and pad footings will be required at the foundation level.	$2,890,000	Braced frames required at 14 total bays over 2-stories (28 frames). Will require some interior demo and restoration of interior finishes.
PFM 4: Remove all welded (fully restrained) wall cladding connections to steel columns and replace with connections that have bolts with slotted holes.	$540,000	8 connections per panel x 38 panels (304 connections).
PFM 5: See **PFM 2** Mitigation. The alternative to this option would be to upgrade all of the existing moment frame connections (64 locations), which involves strengthening existing columns over their full height, adding doubler and continuity plates within the column web, and potentially reducing the beam flanges near the joints.	--	Braced frames required at 14 total bays over 2-stories (28 frames). Will require some interior demo and restoration of interior finishes. Cost accounted for in **PFM 1-3**.
Total Geotechnical and Structural Mitigation Cost	**$18,730,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

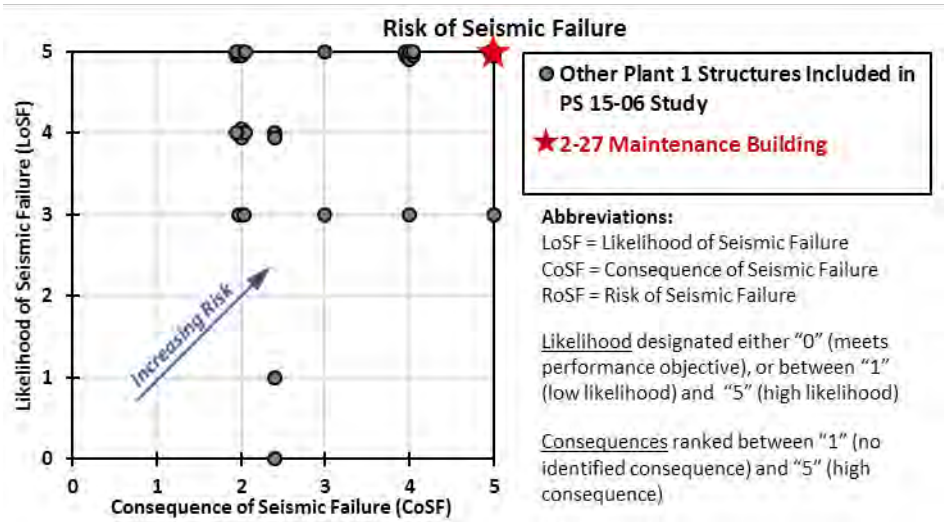
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	25



comments and clarifications

N/A

Next Planned Project and Date: N/A

BOILER BUILDING

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-28	2	II	II	BUILDING

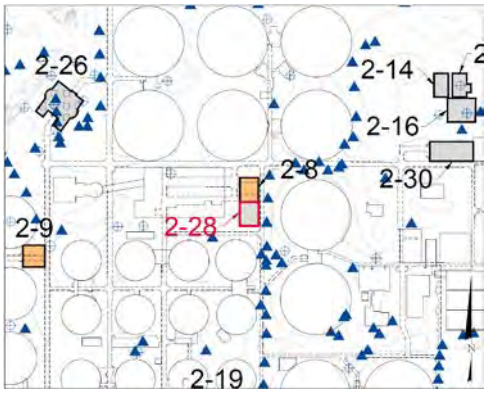
class based performance objectives

Class II: Not directly necessary to preserve wastewater flow through system; loss of life potential is low. Continued occupancy and operation might not be likely before repair.

structural components

Foundation Type/Dimensions: Dropped spread footings at 7.10' elev. (3.90' embedment)
Structure Dimensions: 50.3 ft x 40 ft
# of Stories: 1 story
Date of Original Construction: 1971
Retrofit (if any): Remodeled in 1980 and 1996; 1994: Provision of roof chords and connections, addition of connections between the roof and shear walls, and addition of connections between the shear walls and the floor slab.
Projects: P2-17

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____



Plan View

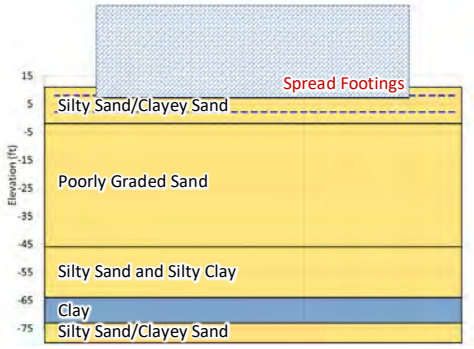
geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	12 to 14	5 to 6
Lateral Spread (near river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from river, inches)	----- *No Lateral Spread* -----	
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+8 ft-MSL
AWL	9 ft-bgs	+2 ft-MSL

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 1-4 City Water Pump Station

PFM and Description[1]	Tier[2]	Assessment Results
PFM 4: Roof diaphragm shear	T2	Diaphragm shear capacity is limiting. Mitigation is recommended to enhance the diaphragm capacity.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
N/A	$0	N/A

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 4: Standard Structural Mitigation B1	$250,000	Applies over the entire roof plan between grid lines 5 and 9 (2,000 sf) and requires the addition of (3) W12x31 beams x 20-ft long.

Total Geotechnical and Structural Mitigation Cost	**$250,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

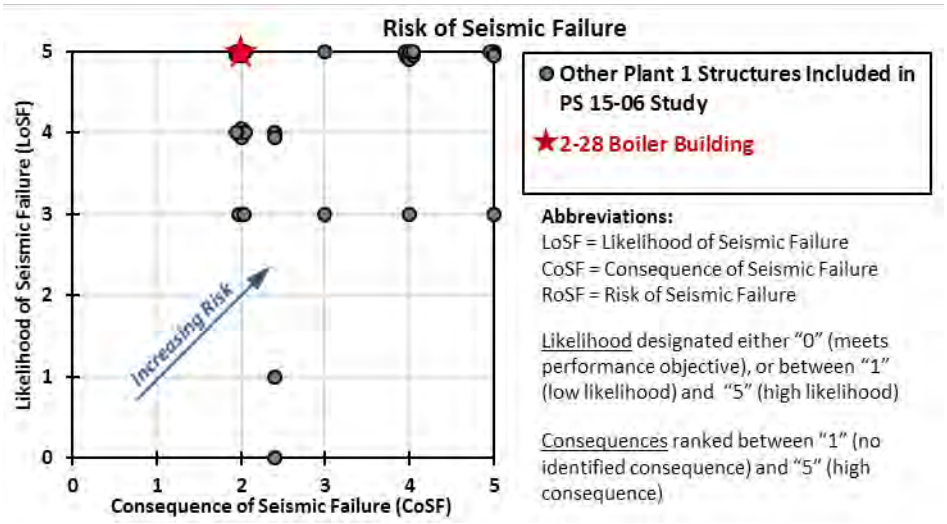
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	10



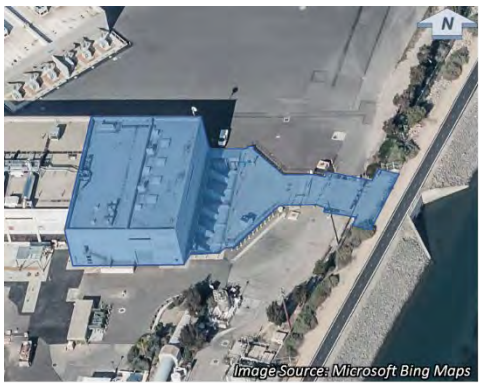
comments and clarifications

N/A

Next Planned Project and Date: N/A

OOBS

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-29	2	I	IV	BUILDING



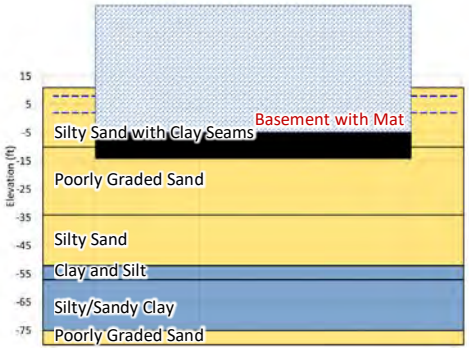
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Basement with 9' thick mat at -14.00' elev. (25.00' embedment)
Structure Dimensions: 132 ft x 190 ft (at base) and 90 ft (at roof)
# of Stories: West End: 2 above grade, one below grade; East End: one below grade
Date of Original Construction: 1990 (?)
Retrofit (if any): N/A
Projects: J-15
Available Information: ☒ Construction Drawings ☒ Geotechnical Report ☒ Specifications ☐ Other _____

Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+8 ft-MSL
AWL	9 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 15	8 to 14
Lateral Spread (near river, inches)	114 to 165	92 to 145
Lateral Spread (far from river, inches)	26 to 38	21 to 33
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): N/A

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Wall anchorage at the roof level at the north and south walls	T1	All framing connections along the north and south walls are non-compliant (13 locations).
PFM 2: Wall anchorage at the roof level at the east, west, and interior wall (grid line G)	T1	All framing connections along the east, west, and interior wall are non-compliant (15 locations).
PFM 5: Roof diaphragm shear	T1	Roof diaphragm shear in the east-west direction is non-compliant.

PFM 8: Uneven buoyant uplift due to liquefaction	T2	The east end of the structure is an open pit that is significantly less massive than the building to the west. Buoyant uplift due to liquefied soils is expected to rotate the east pit upward relative to the building portion, which will result in shear and bending failures in the mat slab and movement of OOBS into the Central Power Generation Building.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 8: Ground improvement under the foundation	$8,230,000	Ground improvement for uplift mitigation is required under the foundation from 25 to 45 ft-bgs.
Recommended Structural Mitigation[1]	**Cost[2]**	**Comments**
PFM 1: Standard Structural Mitigation A2 (High)	$630,000	Applies at 13 locations.
PFM 2: Standard Structural Mitigation A2 (High)	$780,000	Applies at 15 locations.
PFM 5: Standard Structural Mitigation B1 & B2	$1,090,000	Mitigation to include the replacement of the roof deck (or supplement with steel bracing) in the east-west direction for a total of 8,600 sf and provision of supplemental epoxy bonded anchors to the existing north and south wall ledger angels @ 12" OC (180 anchors).
Total Geotechnical and Structural Mitigation Cost	**$10,730,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

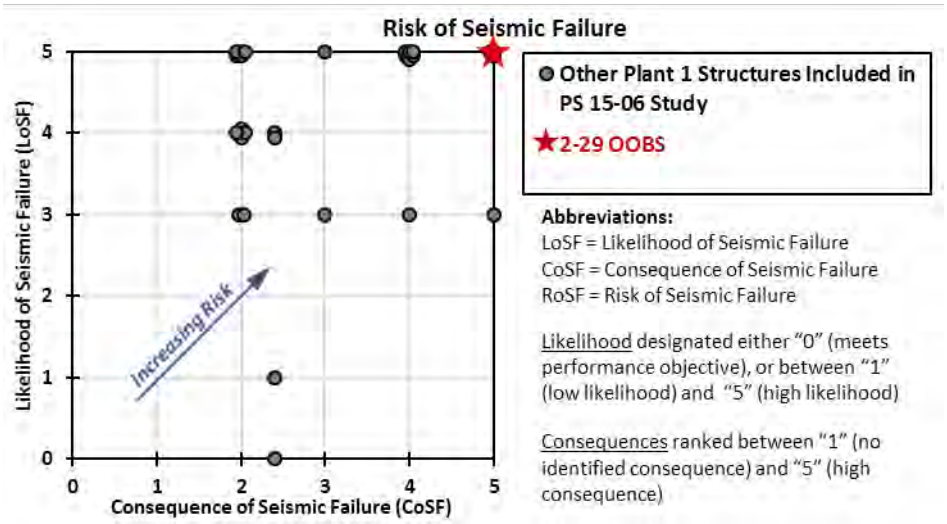
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☐ Life Safety ☒ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	5
Overall RoSF = LoSF x CoSF =	25



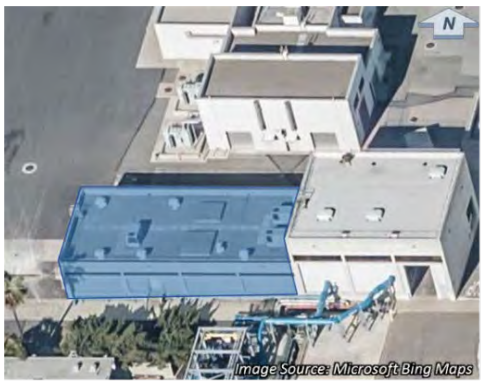
comments and clarifications

N/A

Next Planned Project and Date: N/A

12KV DISTRIBUTION CENTER A

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-30	2	I	IV	BUILDING



class based performance objectives

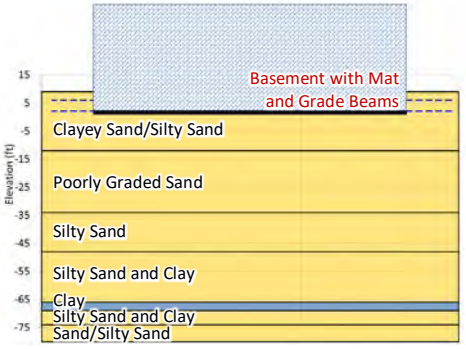
Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Basement with 1' mat and grade beams at 0' elevation (9' embedment)
Structure Dimensions: 92 ft x 41 ft
# of Stories: 1 story
Date of Original Construction: 1977
Retrofit (if any): Remodeled in 1983
Projects: P2-23-3 / P2-23-6 / P2-47-1

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☒ Specifications ☐ Other _____

Plan View



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+6 ft-MSL
AWL	7 ft-bgs	+2 ft-MSL

geohazards and seismicity

Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)		
Lateral Spread (near river, inches)		
Lateral Spread (far from river, inches)		
Lateral Spread (near marsh, inches)		
Lateral Spread (far from marsh, inches)		

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*

structural assessment and failure modes

Exemplar Structure (N/A if Exemplar): 2-5 PEPS & MAC

PFM and Description[1]	Tier[2]	Assessment Results
PFM 1: Wall anchorage to roof at north and south walls	T1	W16x96 anchorage at PWPS (10 locations).
PFM 3: Torsional response due to E-W seismic	T1	Distribution Center A has concrete moment frames along the south side, but shear wall along the north side. Addition of in-fill walls along the north and south sides should mitigate this PFM.
PFM 4: Shear at frame columns	T1	Frame columns along the north and south walls have insufficient shear capacity and cannot develop moment frame behavior due to restraint by the infill wall panels. Conversion of building to shear walls is recommended.
PFM 5: Structure response to differential settlement due to liquefaction	T1/2	4.1" over 60 feet. Differential settlement is on the order of 46% larger compared to the exemplar. Wall tensile forces are estimated to be about the same as the exemplar, which would result in tensile overstress.

PFM 9: Out-of-plane shear on the buried walls due to liquefied soil conditions	T2	Walls may experience shear stresses that are higher than their capacity.

Notes: *1. Potential Failure Modes (PFMs) that meet both the BSE-1E and BSE-2E performance objectives have been omitted from the list. See Technical Memorandum 4 (TM4; Geosyntec, 2019) for additional PFMs considered; 2. T1 = Tier 1 (equivalent to ASCE 41-13 Screening Procedure), T2 = Tier 2 (equivalent to ASCE 41-13 Deficiency-Based Evaluation Procedure, T3 = Tier 3 (Systematic Evaluation Procedure), T1/T2 = Application of Tier 3 exemplar results to a subsidiary structure. See TM4 (Geosyntec, 2019) for more detail.*

mitigation measures and costs

Recommended Geotechnical Mitigation[1]	Cost[2]	Comments
PFM 5: Standard Geotechnical Mitigation B2	$3,160,000	Mitigation required to reduce differential settlement by 75% (1" in 60 feet). Ground improvement for settlement mitigation is required from 7 to 55 ft-bgs.
PFM 9: Standard Geotechnical Mitigation C	$840,000	Mitigation required to reduce soil fluid density by 50% or preclude liquefaction development in backfill altogether. Ground improvement for lateral earth pressure reduction is required from 7 to 15 ft-bgs.

Recommended Structural Mitigation[1]	Cost[2]	Comments
PFM 1: Standard Structural Mitigation A2 (High)	$560,000	Applies at the W16x96 beams at 10 locations at the PWPS.
PFM 3 & 4: Standard Structural Mitigation E	$110,000	Applies at the north and south walls of the Distribution Center (88 square feet infill) and at the Plant Water Pump Station (152 square feet infill).
Total Geotechnical and Structural Mitigation Cost	**$4,670,000**	

Notes: *1. Refer to TM4 (Geosyntec, 2019) for descriptions of Standard Geotechnical and Structural Mitigations; 2. Cost estimates provided are AACEI Class 5 "Order-of-Magnitude" estimates, intended for planning purposes only.*

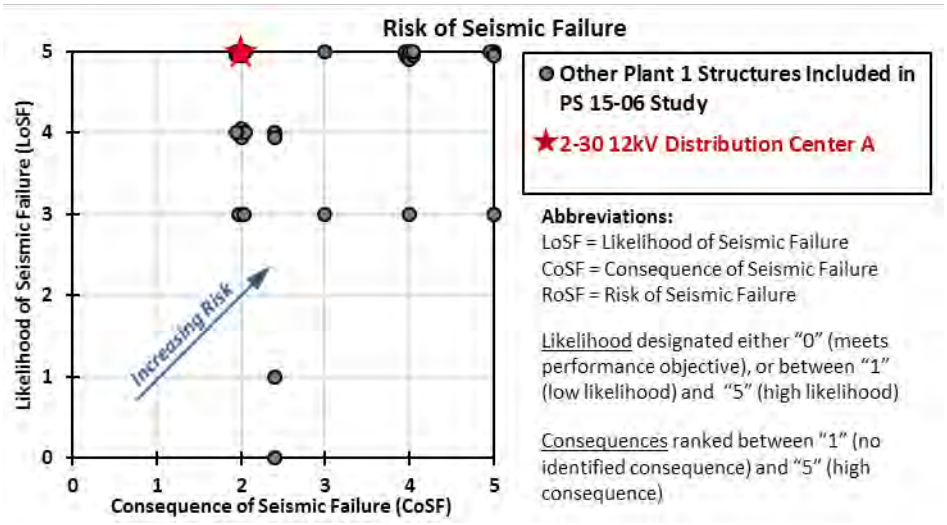
risk ranking

Controlling Failure Type(s):
☒ Ground Shaking
☐ Differential Settlement
☐ Lateral Spread

Controlling Consequence(s):
☒ Life Safety ☐ Primary Treatment
☐ Regulatory ☐ Stakeholder
☐ Financial ☐ Public Impact

Risk Ranking:

LoSF Rating:	5
CoSF, Weighted Score:	2
Overall RoSF = LoSF x CoSF =	10



comments and clarifications

N/A

Next Planned Project and Date: X-047 (09/01/2023)

SEJB

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-31	2	I	IV	BURIED BOX

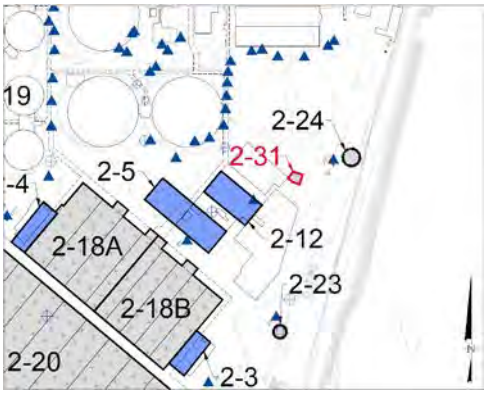
class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Buried structure with 2' thick mat at -19.5' elev. (32.5' embedment)
Structure Dimensions: 21 ft x 20.3 ft
# of Stories: N/A
Date of Original Construction: 2003
Retrofit (if any): N/A
Projects: J-77

Available Information: ☐ Construction Drawings ☐ Geotechnical Report ☐ Specifications ☐ Other _____



Plan View

geohazards and seismicity

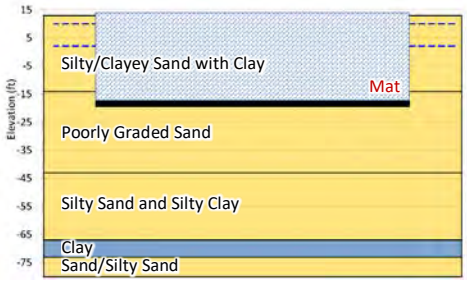
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	9 to 12	8 to 10
Lateral Spread (near river, inches)	27 to 44	21 to 42
Lateral Spread (far from river, inches)	24 to 40	19 to 38
Lateral Spread (near marsh, inches)	8 to 13	6 to 12
Lateral Spread (far from marsh, inches)	8 to 13	6 to 12

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+10 ft-MSL
AWL	11 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Only Geotechnical Evaluation performed for this structure

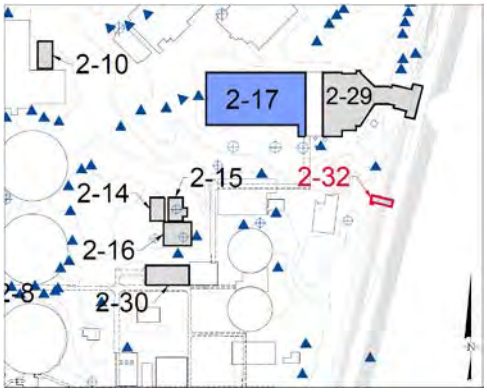
comments and clarifications

N/A

Next Planned Project and Date: N/A

JBC

#	PLANT	CLASS	Risk Category	STRUCTURE TYPE
2-32	2	I	IV	BUILDING



Plan View

class based performance objectives

Class I: Essential to maintenance of wastewater flow and treatment. Structures substantially retain original strength and stiffness and continued occupancy and operation are likely.

structural components

Foundation Type/Dimensions: Buried structure with 2.5' thick mat at -15.50' elev. (27.5' embedment)
Structure Dimensions: 45 ft x 14 ft
# of Stories: N/A
Date of Original Construction: 2003
Retrofit (if any): N/A
Projects: J-77

Available Information: ☒ Construction Drawings ☐ Geotechnical Report ☐ Specifications ☐ Other _____

geohazards and seismicity

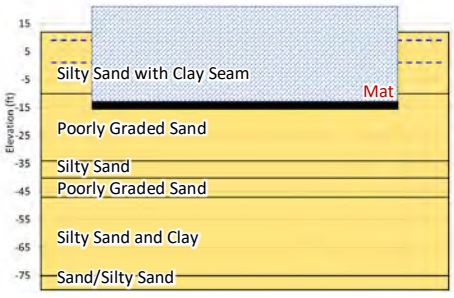
Seismic Site Class: Class D (w/o liquefaction); Class F (with liquefaction)
Liquefaction Potential (High/Med/Low): High

	HHWL[1]	AWL[2,7]
Surface Settlement (inches)	13 to 19	11 to 17
Lateral Spread (near river, inches)	100 to 150	75 to 130
Lateral Spread (far from river, inches)	58 to 87	43 to 75
Lateral Spread (near marsh, inches)	----- *No Lateral Spread* -----	
Lateral Spread (far from marsh, inches)	----- *No Lateral Spread* -----	

Deterministic	Fault Name	M	PGA (g)[3]	Dist. (km)[4]
Near Field	Newport-Inglewood	7.5	0.5	0
Far Field	San Andreas	8.5	0.16	84

Probabilistic[5]	Hazard Level	M[6]	PGA (g)	S_0 (g)	S_S (g)	S_1 (g)
BSE-1E	20% in 50 yr	7.71	0.29	0.29	0.53	0.20
BSE-2E[7]	5% in 50 yr	7.71	0.48	0.48	1.16	0.42

Notes: *1. Historic High Water Level; 2. Analysis Water Level; 3. Median PGA; 4. Approximate distance to center of plant; 5. Probabilistic Seismic Accelerations for Site Class D; 6. Selected as largest magnitude among significant contributors (>1%) to the hazard; 7. Ground deformation inputs to structural analysis based on AWL and BSE-2E seismic ground motions.*



Schematic Cross Section

Ground Water Level	Depth	Elevation
HHWL	3 ft-bgs	+9 ft-MSL
AWL	10 ft-bgs	+2 ft-MSL

structural assessment and failure modes

Only Geotechnical Evaluation performed for this structure

comments and clarifications

N/A

Next Planned Project and Date: N/A

Geosyntec consultants

APPENDIX F

Mitigation Cost Tables

Geosyntec
consultants

APPENDIX F1

Structural Mitigation Cost Tables

Project Name: Waste Sludge Thickener DAFT Pump Room
Project Number: OCSD Plant 1 Project 1-1
Project Construction Duration: 4 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #2	**Mitigation - Standard Structural Mitigation A1**									
Wall anchorage to the roof at east and west walls of the north building	New steel angles at existing wall or perimeter roof beam, 8' OC	165	FT	$ 41	$ 6,765	$ 6	$ 990	$ 7,755		RS Means. 25 lbs/ft Gal Steel. 16 ft long.
	Epoxy anchors at 8' OC	41	EA	$ 71	$ 2,947	$ 38	$ 1,559	$ 4,507		RS Means
	Puddle welding	26	EA			$ 600	$ 15,600	$ 15,600		
	Additional roof framing members	165	FT	$ 41	$ 6,765	$ 6	$ 990	$ 7,755		RS Means. 25 lbs/ft Gal Steel. 16 ft long.
	Construction difficulty, operations and work restrictions	1	LS					$ 35,617		100% of other costs
	Temporary facilities and requirements	4	MONTH			$ 3,000	$ 12,000	$ 12,000		Construct trailer, utilities, protection, and etc.
									$ 83,233	
PFM #3	**Mitigation - Standard Structural Mitigation B1**									
Roof diaphragm shear at the north building	Demo existing roofing	1	LS					$ 9,600		
	Roof Framing	390	FT	$ 62	$ 24,254	$ 7	$ 2,547	$ 26,801		W14X38
	Metal decking, galvanized steel, 1-1/2" deep, 18 gauge	4688	SF	$ 12	$ 56,250	$ 1.5	$ 7,031	$ 63,281		RS Means
	Membrane roof for the entire building	4688	SF	$ 6	$ 29,109	$ 6	$ 29,109	$ 58,219		Carollo database
	Construction difficulty, operations and work restrictions	1	LS					$ 157,901		100% of other costs
									$ 315,802	
PFM #4	**Mitigation**									
Discontinuous shear walls at the interior of the south building in the north-south direction (@grid lines 3 and 5)	Provide steel beam/channel ties for the full width	80	FT	$ 51	$ 4,096	$ 179	$ 14,304	$ 18,400		RS Means. 60 lbs/ft Gal Steel.
	Epoxy anchors at 6" OC for steel channel tie	161	EA	$ 71	$ 11,503	$ 38	$ 6,086	$ 17,589		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 35,989		100% of other costs
									$ 71,979	

	Sub-total	$ 471,013
Sales Tax	8%	$ 18,841
	Sub-total	$ 489,854
Project Level Allowance	30%	$ 146,956
	Sub-total	$ 636,810
GR / GC	15%	$ 95,521
	Sub-total	$ 732,331
Contractor's Profit	10%	$ 73,233
	Sub-total	$ 805,564
Bond	2%	$ 16,111
	Sub-total	$ 821,676
Insurance	2%	$ 16,434
GRAND TOTAL		**$ 838,109**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Blower Building and PEPS
Project Number: OCSD Plant 1 Project 1-2
Project Construction Duration: 5 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #2	**Mitigation - Standard Structural Mitigation A2 (High)**									
Wall anchorage to the roof at the north and south walls of the Blower Building	W33x connections at pilasters	10	EA					$ 150,000		$15000/location. Estimated by James Doering
	Additional roof deck welding	10	EA			$ 2,400	$ 24,000	$ 24,000		
	Construction difficulty, operations and work restrictions	1	LS					$ 174,000		100% of other costs
	Temporary facilities and requirements	5	MONTH			$ 3,000	$ 15,000	$ 15,000		Construct trailer, utilities, protection, and etc.
									$ 363,000	
PFM #3	**Mitigation - Standard Structural Mitigation A1 (SIM)**									
Wall anchorage to the roof at the north and south walls of the PEPS Building	New steel angles at existing wall or perimeter roof beam, 8' OC	560	FT	$ 27	$ 15,366	$ 74	$ 41,608	$ 56,974		RS Means. 25 lbs/ft Gal Steel. 16 ft long.
	Epoxy anchors at 8' OC	140	EA	$ 71	$ 10,003	$ 38	$ 5,292	$ 15,295		RS Means
	Puddle welding	62	EA			$ 600	$ 37,200	$ 37,200		
	Construction difficulty, operations and work restrictions	1	LS					$ 109,469		100% of other costs
									$ 218,939	
PFM #4	**Mitigation - Standard Structural Mitigation A2 (High)**									
Wall anchorage to the roof at the east and west walls of the PEPS Building	W27x connections at pilasters	4	EA					$ 60,000		$15000/location. Estimated by James Doering
	Additional roof deck welding	4	EA			$ 2,400	$ 9,600	$ 9,600		
	Construction difficulty, operations and work restrictions	1	LS					$ 69,600		
									$ 139,200	
PFM #5	**Mitigation - Standard Structural Mitigation B1**									
Roof diaphragm shear in the north-south direction at the blower building	Demo existing roofing	1	LS					$ 9,600		
	Roof Framing	1182	FT	$ 78	$ 92,196	$ 8	$ 8,865	$ 101,061		W14X48
	Metal decking, galvanized steel, 1-1/2" deep, 18 gauge	8370	SF	$ 12	$ 100,440	$ 1.5	$ 12,555	$ 112,995		RS Means
	Membrane roof for the entire building	8370	SF	$ 6	$ 50,220	$ 6	$ 50,220	$ 100,440		Carollo database
	Construction difficulty, operations and work restrictions	1	LS					$ 324,096		100% of other costs
									$ 648,192	

	Sub-total	$ 1,369,331
Sales Tax	8%	$ 54,773
	Sub-total	$ 1,424,104
Project Level Allowance	30%	$ 427,231
	Sub-total	$ 1,851,335
GR / GC	15%	$ 277,700
	Sub-total	$ 2,129,036
Contractor's Profit	10%	$ 212,904
	Sub-total	$ 2,341,939
Bond	2%	$ 46,839
	Sub-total	$ 2,388,778
Insurance	2%	$ 47,776
GRAND TOTAL		**$ 2,436,553**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Plant Water Pump Station and Power Building 6
Project Number: OCSD Plant 1 Project 1-3
Project Construction Duration: 3 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #2	**Mitigation - Standard Structural Mitigation A2 (Medium)**									
Wall anchorage to the roof at east and west walls	Wall anchorage mitigation at W24x94 roof beams	8	EA					$ 80,000		$10000/location. Estimated by James Doering
	Construction difficulty, operations and work restrictions	1	LS					$ 80,000		100% of other costs
	Temporary facilities and requirements	3	MONTH			$ 3,000	$ 9,000	$ 9,000		Construct trailer, utilities, protection, and etc.
									$ 169,000	
PFM #3	**Mitigation**									
Drag connection at the reentrant corner (intersection of grid line 2 and D)	Provide a steel channel or similar shape	88	FT	$ 97	$ 8,488	$ 6	$ 525	$ 9,013		RS Means. 60 lbs/ft Gal Steel.
	Epoxy anchors	176	EA	$ 71	$ 12,575	$ 38	$ 6,653	$ 19,228		Assume 6" OC
	Welding to existing steel W12x35	1	EA			$ 4,800	$ 4,800	$ 4,800		
	Construction difficulty, operations and work restrictions	1	LS					$ 33,041		100% of other costs
									$ 66,081	

	Sub-total	$ 235,081
Sales Tax	8%	$ 9,403
	Sub-total	$ 244,484
Project Level Allowance	30%	$ 73,345
	Sub-total	$ 317,830
GR / GC	15%	$ 47,674
	Sub-total	$ 365,504
Contractor's Profit	10%	$ 36,550
	Sub-total	$ 402,054
Bond	2%	$ 8,041
	Sub-total	$ 410,095
Insurance	2%	$ 8,202
GRAND TOTAL		**$ 418,297**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: City Water Pump Station
Project Number: OCSD Plant 1 Project 1-4
Project Construction Duration: 5.5 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation C1**									
Footings move independent of the wall	Stainless steel angle tie plate, 4' OC	130	FT	$ 30	$ 3,896	$ 7	$ 944	$ 4,840		RS Means. 1.21 ratio for SST. L4x4x1/2, 2' long
	Epoxy anchors at 4' OC	65	EA	$ 71	$ 4,644	$ 38	$ 2,457	$ 7,101		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 23,883		200% of other costs
	Temporary facilities and requirements	5.5	MONTH			$ 3,000	$ 16,500	$ 16,500		Construct trailer, utilities, protection, and etc.
									$ 52,324	
PFM #3	**Mitigation - Standard Structural Mitigation A2 (Low)**									
Wall anchorage at east and west walls	Anchorage at W24x131 to pilasters	6	EA					$ 45,000		$7500/location. Estimated by James Doering
	Construction difficulty, operations and work restrictions	1	LS					$ 45,000		100% of other costs
									$ 90,000	
PFM #4	**Mitigation**									
In-plane shear at south pier between louvers	6" concrete overlay	10	CY	$ 474	$ 4,740	$ 1,453	$ 14,530	$ 19,270		Carollo database
	Special finishes for concrete	1	LS					$ 964		5% of concrete
	Reinforcing steel epoxy dowels	200	EA	$ 39	$ 7,800	$ 45	$ 9,000	$ 16,800		RS Means material cost, $100/dowel, 18" OC
	Construction difficulty, operations and work restrictions	1	LS					$ 37,034		100% of other costs
									$ 74,067	
PFM #5 & 6	**Mitigation - Standard Structural Mitigation D**									
Out-of-plane horizontal bending at east and west walls	Vertical steel tube or steel channel members	6	EA					$ 36,000		$6000/each
	Epoxy anchors at 8" OC	199	EA	$ 71	$ 14,201	$ 38	$ 7,513	$ 21,713		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 57,713		100% of other costs
									$ 115,427	

	Sub-total	$ 331,818
Sales Tax	8%	$ 13,273
	Sub-total	$ 345,091
Project Level Allowance	30%	$ 103,527
	Sub-total	$ 448,618
GR / GC	15%	$ 67,293
	Sub-total	$ 515,911
Contractor's Profit	10%	$ 51,591
	Sub-total	$ 567,502
Bond	2%	$ 11,350
	Sub-total	$ 578,852
Insurance	2%	$ 11,577
GRAND TOTAL		**$ 590,429**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Power Building 2
Project Number: OCSD Plant 1 Project 1-5
Project Construction Duration: 3 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation C1**									
Walls/footing are not tied together	Stainless steel angle tie plate, 4' OC	258	FT	$ 30	$ 7,725	$ 7	$ 1,803	$ 9,528		RS Means. 1.21 ratio for SST. L4x4x1/2, 2' long
	Epoxy anchors at 4' OC	129	EA	$ 71	$ 9,199	$ 38	$ 4,867	$ 14,066		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 47,187		200% of other costs
	Temporary facilities and requirements	3	MONTH			$ 3,000	$ 9,000	$ 9,000		Construct trailer, utilities, protection, and etc.
									$ 79,780	
PFM #2	**Mitigation - Standard Structural Mitigation A1 (SIM)**									
Wall anchorage at the north and south walls of the low roof	New anchorage where W12x27 beams are supported at the CMU walls	4	EA					$ 20,000		$5000 per location
	Demo existing roofing	1	LS					$ 9,600		
	Membrane roof for the entire building	2460	SF	$ 6	$ 14,760	$ 6	$ 14,760	$ 29,520		Carollo database
	Additional roof deck welding	4	EA			$ 2,400	$ 9,600	$ 9,600		
	Construction difficulty, operations and work restrictions	1	LS					$ 68,720		100% of other costs
									$ 137,440	

	Sub-total	$ 217,220
Sales Tax	8%	$ 8,689
	Sub-total	$ 225,909
Project Level Allowance	30%	$ 67,773
	Sub-total	$ 293,682
GR / GC	15%	$ 44,052
	Sub-total	$ 337,734
Contractor's Profit	10%	$ 33,773
	Sub-total	$ 371,508
Bond	2%	$ 7,430
	Sub-total	$ 378,938
Insurance	2%	$ 7,579
GRAND TOTAL		**$ 386,516**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Power Building 4
Project Number: OCSD Plant 1 Project 1-6
Project Construction Duration: 3 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #3	**Mitigation**									
Incomplete load path at the north side of the high roof diaphragm	Demo existing roofing	1	LS					$ 9,600		
	Membrane roof for the entire building	1760	SF	$ 6	$ 10,560	$ 6	$ 10,560	$ 21,120		Carollo database
	Concentric X-braced frames at the existing louver openings	94	FT	$ 78	$ 7,359	$ 8	$ 708	$ 8,066		RS Means. HSS 8X8X1/2. 49lbs/ft.
	Steel framed blockings at the roof level	25	FT	$ 78	$ 1,950	$ 8	$ 188	$ 2,138		RS Means. HSS 8X8X1/2. 49lbs/ft.
	Weld steel framed blocking to roof deck	4	EA			$ 4,800	$ 19,200	$ 19,200		
	New steel member sill	39	FT	$ 78	$ 3,023	$ 8	$ 291	$ 3,313		RS Means. HSS 8X8X1/2. 49lbs/ft.
	Epoxy anchors for the new steel member sill, 6"OC	79	EA	$ 71	$ 5,609	$ 38	$ 2,967	$ 8,576		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 72,013		100% of other costs
	Temporary facilities and requirements	3	MONTH			$ 3,000	$ 9,000	$ 9,000		
									$ 153,026	

	Sub-total	$ 153,026
Sales Tax	8%	$ 6,121
	Sub-total	$ 159,147
Project Level Allowance	30%	$ 47,744
	Sub-total	$ 206,891
GR / GC	15%	$ 31,034
	Sub-total	$ 237,924
Contractor's Profit	10%	$ 23,792
	Sub-total	$ 261,717
Bond	2%	$ 5,234
	Sub-total	$ 266,951
Insurance	2%	$ 5,339
GRAND TOTAL		**$ 272,290**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Power Building 5
Project Number: OCSD Plant 1 Project 1-7
Project Construction Duration: 2 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #2	**Mitigation - Standard Structural Mitigation A2 (Low)**									
Wall anchorage at the east and west walls to the roof diaphragm	Wall anchorage at W24x94 roof beams	8	EA					$ 60,000		$7500/location. Estimated by James Doering
	Construction difficulty, operations and work restrictions	1	LS					$ 60,000		100% of other costs
	Temporary facilities and requirements	2	MONTH			$ 3,000	$ 6,000	$ 6,000		Construct trailer, utilities, protection, and etc.
									$ 126,000	

	Sub-total	$ 126,000
Sales Tax	8%	$ 5,040
	Sub-total	$ 131,040
Project Level Allowance	30%	$ 39,312
	Sub-total	$ 170,352
GR / GC	15%	$ 25,553
	Sub-total	$ 195,905
Contractor's Profit	10%	$ 19,590
	Sub-total	$ 215,495
Bond	2%	$ 4,310
	Sub-total	$ 219,805
Insurance	2%	$ 4,396
GRAND TOTAL		**$ 224,201**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Control Center
Project Number: OCSD Plant 1 Project 1-8
Project Construction Duration: 15 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #2, 4, 5, 6, 10	**Mitigation**									
Moment frame column anchorage is not adequate to resist seismic tension demands, etc…	Concentric X-braced frames from the roof level down to the first floor	1291	FT	$ 78	$ 100,666	$ 8	$ 9,679	$ 110,346		RS Means. HSS 8X8X1/2 - 49lbs/ft.
	Supplement connections along collector at bottom of 2nd floor	80	EA					$ 192,000		6 hr per location
	Puddle welding along collector at roof level	1	LS					$ 16,000		1 week
	Enhancing connections elsewhere for seismic load transfer	1	LS					$ 225,000		$75000/FLOOR
	Interior demo and restoration of interior finishes	8250	SF	$ 25	$ 206,250	50	$ 412,500	$ 618,750		$75/SF. 25% of the entire building.
	Plant SCADA system relocations	2	EA			$ 128,000	$ 256,000	$ 256,000		
	Fire sprinkler system	8250	SF			$ 4	$ 33,000	$ 33,000		25% of the entire building.
	Temporary trailers for control center staff	15	MONTH			$ 24,000	$ 360,000	$ 360,000		Office trailer, locker rooms, restroom and showers, etc.
	Temporary facilities and requirements	15	MONTH			$ 3,000	$ 45,000	$ 45,000		Construct trailer, utilities, protection, and etc.
	Construction difficulty, operations and work restrictions	1	LS					$ 1,856,096		100% of other costs
									$ 3,712,191	

	Sub-total	$ 3,712,191
Sales Tax	8%	$ 148,488
	Sub-total	$ 3,860,679
Project Level Allowance	30%	$ 1,158,204
	Sub-total	$ 5,018,882
GR / GC	15%	$ 752,832
	Sub-total	$ 5,771,715
Contractor's Profit	10%	$ 577,171
	Sub-total	$ 6,348,886
Bond	2%	$ 126,978
	Sub-total	$ 6,475,864
Insurance	2%	$ 129,517
GRAND TOTAL		**$ 6,605,381**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: 12kV Service Center
Project Number: OCSD Plant 1 Project 1-9
Project Construction Duration: 2 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #2	**Mitigation - Standard Structural Mitigation A2 (Low)**									
Wall anchorage to roof at east and west walls	Wall anchorage at W24x84 roof beams	8	EA					$ 60,000		$7500/location. Estimated by James Doering
	Construction difficulty, operations and work restrictions	1	LS					$ 60,000		100% of other costs
	Temporary facilities and requirements	2	MONTH			$ 3,000	$ 6,000	$ 6,000		Construct trailer, utilities, protection, and etc.
									$ 126,000	

	Sub-total	$	126,000
Sales Tax	8%	$	5,040
	Sub-total	$	131,040
Project Level Allowance	30%	$	39,312
	Sub-total	$	170,352
GR / GC	15%	$	25,553
	Sub-total	$	195,905
Contractor's Profit	10%	$	19,590
	Sub-total	$	215,495
Bond	2%	$	4,310
	Sub-total	$	219,805
Insurance	2%	$	4,396
GRAND TOTAL		**$**	**224,201**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Central Power Generation Building
Project Number: OCSD Plant 1 Project 1-10
Project Construction Duration: 7 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation E**									
Lack of lateral bracing along the east side of the high roof diaphragm	Cast-in-place concrete walls	11.6	CY	$ 412	$ 4,769	$ 676	$ 7,824	$ 12,593		Carollo database
	Special finishes for concrete	1	LS					$ 630		5% of cast-in-place concrete
	Reinforcing steel epoxy dowels	92	EA	$ 39	$ 3,575	$ 45	$ 4,125	$ 7,700		RS Means, 18" OC
	Demo windows at 35' above floor	12	EA			$ 800	$ 9,600	$ 9,600		
	Construction difficulty, operations and work restrictions	1	LS					$ 61,044		200% of other costs
	Temporary facilities and requirements	7	MONTH			$ 3,000	$ 21,000	$ 21,000		Construct trailer, utilities, protection, and etc.
									$ 112,567	
PFM #2	**Mitigation**									
Lack of lateral bracing along the west side of the low roof and 2nd floor at the basement level	50', 12" thick cast-in-place concrete shear wall at basement level	37.0	CY	$ 412	$ 15,259	$ 676	$ 25,037	$ 40,296		Carollo database
	Upgrade first floor beams with steel channel tie along building length	140	FT	$ 97	$ 13,580	$ 6	$ 840	$ 14,420		RS Means. 60 lbs/ft Gal Steel.
	Epoxy anchors at 6" OC for steel channel tie	281	EA	$ 71	$ 20,077	$ 38	$ 10,622	$ 30,699		RS Means
	Conduit, piping, valving, and supports demo	1	LS					$ 16,000		
	Replacement allowance for conduit, piping, valving, and supports	1	LS					$ 65,000		
	Construction difficulty, operations and work restrictions	1	LS					$ 166,416		100% of other costs
									$ 332,831	
PFM #3	**Mitigation - Standard Structural Mitigation E**									
Insufficient lateral bracing along the west side of the building	Cast-in-place concrete	10.0	CY	$ 412	$ 4,120	$ 676	$ 6,760	$ 10,880		Carollo database
	Special finishes for concrete	1	LS					$ 544		5% of cast-in-place concrete
	Reinforcing steel epoxy dowels		EA	$ 39	$ -	$ 45	$ -	$ -		RS Means material cost, $100/dowel, 18" OC
	Demo windows at grade	16	EA			$ 800	$ 12,800	$ 12,800		
	Construction difficulty, operations and work restrictions	1	LS					$ 24,224		100% of other costs
									$ 48,448	
PFM #4	**Mitigation - Standard Structural Mitigation A2 (High) (SIM)**									
Wall anchorage at the high roof north and south walls	Demo existing roof	1	LS					$ 9,600		
	New steel welded or bolted connections to existing beams	6	EA					$ 90,000		$15000/location. Estimated by James Doering
	Additional membrane roof	4625	SF	$ 6	$ 28,721	$ 6	$ 28,721	$ 57,443		Carollo database
	Additional roof deck welding	6	EA			$ 2,400	$ 14,400	$ 14,400		
	Construction difficulty, operations and work restrictions	1	LS					$ 171,443		100% of other costs
									$ 342,885	
PFM #5	**Mitigation - Standard Structural Mitigation B1 and B2**									
High roof diaphragm shear	Demo existing roofing	0	LS					$ -		Already included in PFM #4
	Metal decking, galvanized steel, 1-1/2" deep, 18 gauge	3000	SF	$ 12	$ 36,000	$ 2	$ 4,500	$ 40,500		RS Means
	Membrane roof for the entire high roof	7400	SF	$ 6	$ 44,400	$ 6	$ 44,400	$ 88,800		Carollo database
	Supplement existing anchors at 20" OC	90	EA	$ 71	$ 6,431	$ 38	$ 3,402	$ 9,833		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 139,133		100% of other costs
									$ 278,265	
PFM #6	**Mitigation - Standard Structural Mitigation B1 and B2**									
Low roof diaphragm shear	Demo existing roofing	1	LS					$ 4,800		
	Metal decking, galvanized steel, 1-1/2" deep, 18 gauge	1000	SF	$ 12	$ 12,000	$ 2	$ 1,500	$ 13,500		RS Means
	Membrane roof for the entire low roof south of grid line 2	4900	SF	$ 6	$ 29,400	$ 6	$ 29,400	$ 58,800		Carollo database
	Supplement existing anchors at 20" OC	60	EA	$ 71	$ 4,287	$ 38	$ 2,268	$ 6,555		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 83,655		100% of other costs
									$ 167,310	

	Sub-total	$ 1,282,306
Sales Tax	8%	$ 51,292
	Sub-total	$ 1,333,598
Project Level Allowance	30%	$ 400,079
	Sub-total	$ 1,733,677
GR / GC	15%	$ 260,052
	Sub-total	$ 1,993,729
Contractor's Profit	10%	$ 199,373
	Sub-total	$ 2,193,102
Bond	2%	$ 43,862
	Sub-total	$ 2,236,964
Insurance	2%	$ 44,739
GRAND TOTAL		**$ 2,281,703**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Digester 5 & 6 Pump Room
Project Number: OCSD Plant 1 Project 1-14
Project Construction Duration: 3 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation C1**									
Footings move independent of the wall	Stainless steel angle tie plate, 4' OC	78	FT	$ 30	$ 2,323	$ 7	$ 563	$ 2,885		RS Means. 1.21 ratio for SST. L4x4x1/2, 2' long
	Epoxy anchors at 4' OC	39	EA	$ 71	$ 2,769	$ 38	$ 1,465	$ 4,233		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 14,238		200% of other costs
	Temporary facilities and requirements	3	MONTH			$ 3,000	$ 9,000	$ 9,000		Construct trailer, utilities, protection, and etc.
									$ 30,357	
PFM #2	**Mitigation**									
Insufficient separation from adjacent digesters	Provide cast-in-place concrete shear walls	7.5	CY	$ 412	$ 3,090	$ 676	$ 5,070	$ 8,160		Carollo database
	Special finishes for concrete	1	LS					$ 408		5% of cast-in-place concrete
	Reinforcing steel epoxy dowels	43	EA	$ 39	$ 1,658	$ 45	$ 1,913	$ 3,570		RS Means, 18" OC
	Roof connections	1	LS					$ 15,000		Estimated by James Doering
	Construction difficulty, operations and work restrictions	1	LS					$ 54,276		200% of other costs
									$ 81,414	

	Sub-total	$ 111,771
Sales Tax	8%	$ 4,471
	Sub-total	$ 116,242
Project Level Allowance	30%	$ 34,872
	Sub-total	$ 151,114
GR / GC	15%	$ 22,667
	Sub-total	$ 173,781
Contractor's Profit	10%	$ 17,378
	Sub-total	$ 191,159
Bond	2%	$ 3,823
	Sub-total	$ 194,982
Insurance	2%	$ 3,900
	GRAND TOTAL	**$ 198,882**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Digester 7 & 8 Pump Room
Project Number: OCSD Plant 1 Project 1-17
Project Construction Duration: 3 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation C1**									
Footings move independent of the wall	Stainless steel angle tie plate, 4' OC	78	FT	$ 30	$ 2,323	$ 7	$ 563	$ 2,885		RS Means. 1.21 ratio for SST. L4x4x1/2, 2' long
	Epoxy anchors at 4' OC	39	EA	$ 71	$ 2,769	$ 38	$ 1,465	$ 4,233		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 14,238		200% of other costs
	Temporary facilities and requirements	3	MONTH			$ 3,000	$ 9,000	$ 9,000		Construct trailer, utilities, protection, and etc.
									$ 30,357	
PFM #2	**Mitigation**									
Insufficient separation from adjacent digesters	Provide cast-in-place concrete shear walls	15.0	CY	$ 412	$ 6,180	$ 676	$ 10,140	$ 16,320		Carollo database
	Special finishes for concrete	1	LS					$ 816		5% of cast-in-place concrete
	Reinforcing steel epoxy dowels	63	EA	$ 39	$ 2,438	$ 45	$ 2,813	$ 5,250		RS Means, 18" OC
	Roof connections	1	LS					$ 15,000		Estimated by James Doering
	Construction difficulty, operations and work restrictions	1	LS					$ 74,772		200% of other costs
									$ 112,158	

	Sub-total	$ 142,515
Sales Tax	8%	$ 5,701
	Sub-total	$ 148,215
Project Level Allowance	30%	$ 44,465
	Sub-total	$ 192,680
GR / GC	15%	$ 28,902
	Sub-total	$ 221,582
Contractor's Profit	10%	$ 22,158
	Sub-total	$ 243,740
Bond	2%	$ 4,875
	Sub-total	$ 248,615
Insurance	2%	$ 4,972
GRAND TOTAL		**$ 253,587**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Digester 9-10 Pump Room
Project Number: OCSD Plant 1 Project 1-20
Project Construction Duration: 3 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation C1**									
Footings move independent of the wall	Stainless steel angle tie plate, 4' OC	90	FT	$ 30	$ 2,700	$ 7	$ 630	$ 3,330		RS Means. 1.21 ratio for SST. L4x4x1/2, 2' long
	Epoxy anchors at 4' OC	45	EA	$ 71	$ 3,215	$ 38	$ 1,701	$ 4,916		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 16,493		200% of other costs
	Temporary facilities and requirements	3	MONTH			$ 3,000	$ 9,000	$ 9,000		Construct trailer, utilities, protection, and etc.
									$ 33,739	
PFM #2	**Mitigation**									
Insufficient separation from adjacent digesters	Provide cast-in-place concrete shear walls	11.9	CY	$ 412	$ 4,883	$ 676	$ 8,012	$ 12,895		Carollo database
	Special finishes for concrete	1	LS					$ 645		5% of cast-in-place concrete
	Reinforcing steel epoxy dowels	53	EA	$ 39	$ 2,080	$ 45	$ 2,400	$ 4,480		RS Means, 18" OC
	Roof connections	1	LS					$ 15,000		Estimated by James Doering
	Construction difficulty, operations and work restrictions	1	LS					$ 66,039		200% of other costs
									$ 99,059	
PFM #4	**Mitigation**									
Diaphragm connections at re-entrant corner	Stainless steel channel	54	FT	$ 117	$ 6,338	$ 7	$ 392	$ 6,730		RS Means. 60 lbs/ft Gal Steel. 1.21 ratio for SST.
	Epoxy anchors at 6" OC	109	EA	$ 71	$ 7,788	$ 38	$ 4,120	$ 11,908		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 37,277		200% of other costs
									$ 55,915	

	Sub-total	$ 188,712
Sales Tax	8%	$ 7,548
	Sub-total	$ 196,261
Project Level Allowance	30%	$ 58,878
	Sub-total	$ 255,139
GR / GC	15%	$ 38,271
	Sub-total	$ 293,410
Contractor's Profit	10%	$ 29,341
	Sub-total	$ 322,751
Bond	2%	$ 6,455
	Sub-total	$ 329,206
Insurance	2%	$ 6,584
GRAND TOTAL		**$ 335,790**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Digester 11-14 Pump Room
Project Number: OCSD Plant 1 Project 1-22
Project Construction Duration: 5 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation**									
Insufficient separation from adjacent digesters causes structure pounding	Provide cast-in-place concrete shear walls	292	CY	$ 412	$ 120,167	$ 676	$ 197,167	$ 317,333		Carollo database
	Special finishes for concrete	1	LS					$ 15,867		5% of cast-in-place concrete
	Reinforcing steel epoxy dowels	725	EA	$ 39	$ 28,275	$ 45	$ 32,625	$ 60,900		RS Means, 18" OC
	Construction difficulty, operations and work restrictions	1	LS					$ 197,100		50% of other costs
	Temporary facilities and requirements	5	MONTH			$ 3,000	$ 15,000	$ 15,000		Construct trailer, utilities, protection, and etc.
									$ 606,200	

		Sub-total	$ 606,200
Sales Tax		8%	$ 24,248
		Sub-total	$ 630,448
Project Level Allowance		30%	$ 189,134
		Sub-total	$ 819,582
GR / GC		15%	$ 122,937
		Sub-total	$ 942,520
Contractor's Profit		10%	$ 94,252
		Sub-total	$ 1,036,772
Bond		2%	$ 20,735
		Sub-total	$ 1,057,507
Insurance		2%	$ 21,150
GRAND TOTAL			**$ 1,078,657**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Digester 15-16 Pump Room
Project Number: OCSD Plant 1 Project 1-23
Project Construction Duration: 3.5 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation**									
Insufficient separation from adjacent digesters	Provide cast-in-place concrete shear walls	83	CY	$ 412	$ 34,333	$ 676	$ 56,333	$ 90,667		Carollo database
	Special finishes for concrete	1	LS					$ 4,533		5% of cast-in-place concrete
	Reinforcing steel epoxy dowels	225	EA	$ 39	$ 8,775	$ 45	$ 10,125	$ 18,900		RS Means, 18" OC
	Construction difficulty, operations and work restrictions	1	LS					$ 114,100		75% of other costs
	Temporary facilities and requirements	3.5	MONTH			$ 3,000	$ 10,500	$ 10,500		Construct trailer, utilities, protection, and etc.
									$ 238,700	

	Sub-total	$	238,700
Sales Tax	8%	$	9,548
	Sub-total	$	248,248
Project Level Allowance	30%	$	74,474
	Sub-total	$	322,722
GR / GC	15%	$	48,408
	Sub-total	$	371,131
Contractor's Profit	10%	$	37,113
	Sub-total	$	408,244
Bond	2%	$	8,165
	Sub-total	$	416,409
Insurance	2%	$	8,328
GRAND TOTAL		**$**	**424,737**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Solids Storage Facility
Project Number: OCSD Plant Project 1-26
Project Construction Duration: 2.5 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation**									
Building pounding between the north and south structures due to out-of-phase response to ground shaking	Steel plates with slotted connections	53	FT	$ 41	$ 2,153	$ 6	$ 315	$ 2,468		RS Means. 25 lbs/ft Gal Steel.
	Epoxy anchors at 8" OC	80	EA	$ 71	$ 5,680	$ 38	$ 3,005	$ 8,685		RS Means
	Construction difficulty, operations and work restrictions	2	LS					$ 16,800		200% of other costs
	Temporary facilities and requirements	2.5	MONTH			$ 3,000	$ 7,500	$ 7,500		Construct trailer, utilities, protection, and etc.
									$ 35,453	

	Sub-total	$ 35,453
Sales Tax	8%	$ 1,418
	Sub-total	$ 36,871
Project Level Allowance	30%	$ 11,061
	Sub-total	$ 47,932
GR / GC	15%	$ 7,190
	Sub-total	$ 55,122
Contractor's Profit	10%	$ 5,512
	Sub-total	$ 60,634
Bond	2%	$ 1,213
	Sub-total	$ 61,847
Insurance	2%	$ 1,237
GRAND TOTAL		**$ 63,084**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Warehouse
Project Number: OCSD Plant 1 Project 1-28
Project Construction Duration: 5 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation C2**									
Wall panels are not tied to the footings	Excavation allowance to expose footing	1	LS					$ 13,333		$200/CY
	Exterior cast-in-place concrete tie beam	67	CY	$ 285	$ 18,991	$ 446	$ 29,723	$ 48,714		Carollo database.
	Epoxy dowel the tie beam into existing wall and footings, 8"OC	520	EA	$ 21	$ 10,691	$ 39	$ 20,535	$ 31,226		RS Means, 3/4" diameterX12" long
	Construction difficulty, operations and work restrictions	1	LS					$ 69,955		75% of other costs
	Temporary facilities and requirements	5	MONTH			$ 3,000	$ 15,000	$ 15,000		Construct trailer, utilities, protection, and etc.
									$ 178,228	
PFM #6	**Mitigation**									
Wall panels are not tied together to resist overturning	Use steel plates to tie tilt-up wall panels together along their vertical joints	300	FT	$ 97	$ 29,100	$ 6	$ 1,800	$ 30,900		RS Means. 60 lbs/ft Gal Steel.
	Epoxy anchors at 4' OC	90	EA	$ 71	$ 6,431	$ 38	$ 3,402	$ 9,833		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 30,549		75% of other costs
									$ 71,282	
PFM #8	**Mitigation**									
Tension failure in the walls due to differential settlement	Provide continuous supplemental steel chord member along the east and west walls	250	FT	$ 97	$ 24,250	$ 6	$ 1,500	$ 25,750		RS Means. 60 lbs/ft Gal Steel.
	Epoxy anchors at 6" OC	501	EA	$ 71	$ 35,796	$ 38	$ 18,938	$ 54,734		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 60,363		75% of other costs
									$ 140,847	

	Sub-total	$ 390,358
Sales Tax	8%	$ 15,614
	Sub-total	$ 405,972
Project Level Allowance	30%	$ 121,792
	Sub-total	$ 527,764
GR / GC	15%	$ 79,165
	Sub-total	$ 606,928
Contractor's Profit	10%	$ 60,693
	Sub-total	$ 667,621
Bond	2%	$ 13,352
	Sub-total	$ 680,973
Insurance	2%	$ 13,619
GRAND TOTAL		**$ 694,593**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Shop Building A
Project Number: OCSD Plant 1 Project 1-29
Project Construction Duration: 5 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation C2**									
Wall panels are not tied to the footings	Excavation allowance to expose footing	1	LS					$ 10,667		$200/CY
	Exterior cast-in-place concrete tie beam	53	CY	$ 285	$ 15,193	$ 446	$ 23,779	$ 38,971		Carollo database.
	Epoxy dowel the tie beam into existing wall and footings, 8"OC	520	EA	$ 21	$ 10,691	$ 39	$ 20,535	$ 31,226		RS Means, 3/4" diameterX12" long
	Construction difficulty, operations and work restrictions	1	LS					$ 60,648		75% of other costs
	Temporary facilities and requirements	5	MONTH			$ 3,000	$ 15,000	$ 15,000		Construct trailer, utilities, protection, and etc.
									$ 156,512	

	Sub-total	$ 156,512
Sales Tax	8%	$ 6,260
	Sub-total	$ 162,772
Project Level Allowance	30%	$ 48,832
	Sub-total	$ 211,604
GR / GC	15%	$ 31,741
	Sub-total	$ 243,344
Contractor's Profit	10%	$ 24,334
	Sub-total	$ 267,679
Bond	2%	$ 5,354
	Sub-total	$ 273,033
Insurance	2%	$ 5,461
GRAND TOTAL		**$ 278,493**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Shop Building B and Building 3
Project Number: OCSD Plant 1 Project 1-30
Project Construction Duration: 5 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation C2**									
Wall panels are not tied to the footings	Excavation allowance to expose footing	1	LS					$ 17,067		$200/CY
	Exterior cast-in-place concrete tie beam	85	CY	$ 285	$ 24,308	$ 446	$ 38,046	$ 62,354		Carollo database.
	Epoxy dowel the tie beam into existing wall and footings, 8"OC	832	EA	$ 21	$ 17,106	$ 39	$ 32,856	$ 49,962		RS Means, 3/4" diameterX12" long
	Construction difficulty, operations and work restrictions	1	LS					$ 97,037		75% of other costs
	Temporary facilities and requirements	5	MONTH			$ 3,000	$ 15,000	$ 15,000		Construct trailer, utilities, protection, and etc.
									$ 241,419	
PFM #5	**Mitigation**									
Wall anchorage of the roof at the south wall of Bldg 3	Additional nailing to develop the wall anchorage force into the diaphragm	1	LS					$ 1,600		
	Install clip angles and screw into both sides of the strut member and bottom side of the plywood diaphragm	3	EA	$ 6	$ 18	$ 3,200	$ 9,600	$ 1,600		
	Construction difficulty, operations and work restrictions	1	LS					$ 3,200		100% of other costs
									$ 6,400	
								Sub-total	$ 247,819	
							Sales Tax	8%	$ 9,913	
								Sub-total	$ 257,732	
							Project Level Allowance	30%	$ 77,319	
								Sub-total	$ 335,051	
							GR / GC	15%	$ 50,258	
								Sub-total	$ 385,309	
							Contractor's Profit	10%	$ 38,531	
								Sub-total	$ 423,840	
							Bond	2%	$ 8,477	
								Sub-total	$ 432,316	
							Insurance	2%	$ 8,646	
								GRAND TOTAL	**$ 440,963**	

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Building 5 & 6
Project Number: OCSD Plant 1 Project 1-31
Project Construction Duration: 9 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation C2**									
Wall panels are not tied to the footings	Excavation allowance to expose footing	1	LS					$ 44,133		$200/CY
	Exterior cast-in-place concrete tie beam	221	CY	$ 285	$ 62,859	$ 446	$ 98,384	$ 161,243		Carollo database
	Epoxy dowel the tie beam into existing wall and footings, 8"OC	664	EA	$ 21	$ 13,652	$ 39	$ 26,221	$ 39,873		RS Means, 3/4" diameterX12" long
	Construction difficulty, operations and work restrictions	1	LS					$ 122,625		50% of other costs
	Temporary facilities and requirements	9	MONTH			$ 3,000	$ 27,000	$ 27,000		Construct trailer, utilities, protection, and etc.
									$ 394,875	
PFM #4	**Mitigation**									
Wall anchorage of the 2nd floor	Supplement the existing wall anchorage with additional hardware	13	EA					$ 13,000		$1000 for each location
	Supplement the existing wall anchorage with epoxy anchors	13	EA	$ 71	$ 929	$ 38	$ 491	$ 1,420		RS Means
	Remove building finishes (ceiling panels, etc…)	1	LS					$ 5,307		Match replacement installation cost
	Replacement allowance for new building finishes (ceiling panels, etc…)	1300	SF	$ 20	$ 26,536	$ 4	$ 5,307	$ 31,843		Carollo database
	Construction difficulty, operations and work restrictions	1	LS					$ 51,570		100% of other costs
									$ 103,140	
PFM #6B	**Mitigation**									
Bending failure of beams over chevron braced frames	Demo existing finishes	1	LS					$ 2,000		
	Replacement allowance for the finishes	200	SF	$ 20	$ 4,082	$ 4	$ 816	$ 4,899		Carollo database
	Add steel cover plates to the top and bottom flanges of the steel beam	100	FT	$ 97	$ 9,700	$ 6	$ 600	$ 10,300		RS Means. 60 lbs/ft Gal Steel.
	Field welding of the new steel plates to the existing beam	15	EA			$ 2,400	$ 36,000	$ 36,000		
	Construction difficulty, operations and work restrictions	1	LS					$ 53,199		100% of other costs
									$ 106,398	
PFM #6D	**Mitigation**									
2nd floor diaphragm shear	Strengthen existing beam by adding 2 channels along each side	40	FT	$ 24	$ 960	$ 6	$ 240	$ 1,200		RS Means. 13 lbs/ft Gal Steel
	Replace end connections allowance	1	LS					$ 25,000		
	Enhance floor shear transfer allowance	1	LS					$ 25,000		
	Construction difficulty, operations and work restrictions	1	LS					$ 51,200		100% of other costs
									$ 102,400	

	Sub-total	$ 706,813
Sales Tax	8%	$ 28,273
	Sub-total	$ 735,085
Project Level Allowance	30%	$ 220,526
	Sub-total	$ 955,611
GR / GC	15%	$ 143,342
	Sub-total	$ 1,098,952
Contractor's Profit	10%	$ 109,895
	Sub-total	$ 1,208,848
Bond	2%	$ 24,177
	Sub-total	$ 1,233,025
Insurance	2%	$ 24,660
GRAND TOTAL		**$ 1,257,685**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Auto Shop
Project Number: OCSD Plant 1 Project 1-32
Project Construction Duration: 5 months

This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		Total	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation - Standard Structural Mitigation C2**									
Wall panels are not tied to the footings	Excavation allowance to expose footing	1	LS					$ 11,667		$200/CY
	Exterior cast-in-place concrete tie beam	58	CY	$ 285	$ 16,617	$ 446	$ 26,008	$ 42,625		Carollo database.
	Epoxy dowel the tie beam into existing wall and footings, 8"OC	575	EA	$ 21	$ 11,822	$ 39	$ 22,707	$ 34,529		RS Means, 3/4" diameterX12" long
	Construction difficulty, operations and work restrictions	1	LS					$ 66,615		75% of other costs
	Temporary facilities and requirements	5	MONTH			$ 3,000	$ 15,000	$ 15,000		Construct trailer, utilities, protection, and etc.
									$ 170,435	
PFM #4	**Mitigation - Standard Structural Mitigation A1 (SIM)**									
Wall anchorage of the low roof at the north and south side	New steel angles at existing wall at the north and south side, 8' OC	650	FT	$ 41	$ 26,650	$ 6	$ 3,900	$ 30,550		RS Means. 25 lbs/ft Gal Steel. 16 ft long.
	Epoxy anchors at 8' OC	41	EA	$ 71	$ 2,903	$ 38	$ 1,536	$ 4,438		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 26,241		75% of other costs
									$ 61,229	

	Sub-total	$	231,665
Sales Tax	8%	$	9,267
	Sub-total	$	240,931
Project Level Allowance	30%	$	72,279
	Sub-total	$	313,211
GR / GC	15%	$	46,982
	Sub-total	$	360,192
Contractor's Profit	10%	$	36,019
	Sub-total	$	396,212
Bond	2%	$	7,924
	Sub-total	$	404,136
Insurance	2%	$	8,083
GRAND TOTAL		**$**	**412,219**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Project Name: Central Laboratory
Project Number: OCSD Plant 1 Project 1-34
Project Construction Duration: 12 months
This estimate is based on midpoint of construction in 2018

Date Prepared: 4/11/2019
Prepared By: BS / XHK
Date Accepted: 4/19/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation**									
Braced frame column axial stress due to overturning forces	Concentric chevron braced frames from the roof level down to the first floor	485	FT	$ 120	$ 58,200	$ 6	$ 2,910	$ 61,110		RS Means, 2L6x6x1 - 75 lbs/ft
	Saw cut existing concrete slab	725	FT	$ 2	$ 1,552	$ 23	$ 16,313	$ 17,864		RS Means
	Repair concrete slab	5	CY	$ 648	$ 3,552	$ 744	$ 4,078	$ 7,630		Carollo database
	Additional columns below frame beams from roof level down to first floor	675	FT	$ 78	$ 52,650	$ 8	$ 5,400	$ 58,050		RS Means, HSS 8x8x1/2 - 49 lbs/ft
	Demo and restoration of interior finishes	2391	SF	$ 25	$ 59,775	$ 50	$ 119,550	$ 179,325		$75/SF. 25% of the entire building.
	Excavation allowance to expose footing	1	LS					$ 59,259		$200/CY
	Enlarge existing footings below frame columns	175	CY	$ 412	$ 72,176	$ 676	$ 118,425	$ 190,601		Carollo database
	Reinforcing steel epoxy dowels	200	EA	$ 39	$ 7,800	$ 45	$ 9,000	$ 16,800		RS Means
	Add footings below new frame columns	67	CY	$ 412	$ 27,467	$ 676	$ 45,067	$ 72,533		Carollo database
	Construction difficulty, operations and work restrictions	1	LS					$ 663,173		100% of other costs
	Temporary facilities and requirements	12	MONTH			$ 3,000	$ 36,000	$ 36,000		Construct trailer, utilities, protection, and etc.
									$ 1,362,347	
PFM #3	**Mitigation**									
Out-of-plane bracing of braced frame beams	Demo and restoration of interior finishes	215	SF	$ 25	$ 5,375	$ 50	$ 10,750	$ 16,125		$75/SF.
	Beam framing	86	FT	$ 92	$ 7,912	$ 6	$ 516	$ 8,428		RS Means, W21x57 - 57 lbs/ft.
	Beam bolted connections	24	EA					$ 72,000		$3000/location. Estimated by James Doering
	Construction difficulty, operations and work restrictions	1	LS					$ 96,553		100% of other costs
									$ 193,106	
PFM #4	**Mitigation**									
Braces for braced frames are non-compact members	Demo and restoration of interior finishes	1169	SF	$ 25	$ 29,225	$ 50	$ 58,450	$ 87,675		$75/SF.
	Add stiffener plates to existing bracing members	512	FT	$ 41	$ 20,992	$ 6	$ 3,072	$ 24,064		RS Means, 25 lbs/ft.
	Field welding of new stiffener plates to existing bracing members	64	EA			$ 2,400	$ 153,600	$ 153,600		
	Construction difficulty, operations and work restrictions	1	LS					$ 132,670		50% of other costs
									$ 398,009	
PFM #7	**Mitigation - Standard Structural Mitigation B1**									
Roof diaphragm shear	Demo existing roofing	1	LS					$ 32,000		
	Metal decking, galvanized steel, 1-1/2" deep, 18 gauge	17000	SF	$ 12	$ 204,000	$ 2	$ 25,500	$ 229,500		RS Means
	Membrane roof for the entire building	17000	SF	$ 6	$ 102,000	$ 6	$ 102,000	$ 204,000		Carollo database
	Construction difficulty, operations and work restrictions	1	LS					$ 465,500		100% of other costs
									$ 931,000	

	Sub-total	$ 2,884,461
Sales Tax	8%	$ 115,378
	Sub-total	$ 2,999,840
Project Level Allowance	30%	$ 899,952
	Sub-total	$ 3,899,791
GR / GC	15%	$ 584,969
	Sub-total	$ 4,484,760
Contractor's Profit	10%	$ 448,476
	Sub-total	$ 4,933,236
Bond	2%	$ 98,665
	Sub-total	$ 5,031,901
Insurance	2%	$ 100,638
	GRAND TOTAL	**$ 5,132,539**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: RAS PS East
Project Number: OCSD Plant 2 Project 2-3
Project Construction Duration: 3 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation**									
Vertical irregularities in building shear walls	New cast in place concrete columns, square	7.5	CY	$ 638	$ 4,782	$ 709	$ 5,321	$ 10,103		RS means includes forms, 24"
	Strengthen existing members	3	EA					$ 30,000		$10000/each. Estimated by James
	New collector member (steel channel)	64	FT	$ 97	$ 6,208	$ 6	$ 384	$ 6,592		RS Means. 60 lbs/ft Gal Steel
	Construction difficulty, operations and work restrictions	1	LS					$ 46,695		100% of Direct cost
	Temporary facilities and requirements	3	MONTH			$ 3,000	$ 9,000	$ 9,000		Construct trailer, utilities, protection, etc.
									$ 102,389	

	Sub-total	$ 102,389
Sales Tax	8%	$ 4,096
	Sub-total	$ 106,485
Project Level Allowance	30%	$ 31,945
	Sub-total	$ 138,430
GR / GC	15%	$ 20,764
	Sub-total	$ 159,194
Contractor's Profit	10%	$ 15,919
	Sub-total	$ 175,114
Bond	2%	$ 3,502
	Sub-total	$ 178,616
Insurance	2%	$ 3,572
GRAND TOTAL		**$ 182,188**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: RAS PS West
Project Number: OCSD Plant 2 Project 2-4
Project Construction Duration: 3 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation**									
Vertical irregularities in building shear walls	New cast in place concrete columns, square	7.5	CY	$ 638	$ 4,782	$ 709	$ 5,321	$ 10,103		RS means includes forms, 24"
	Strengthen existing members	3	EA					$ 30,000		$10000/each. Estimated by James
	New collector member (steel channel)	64	FT	$ 97	$ 6,208	$ 6	$ 384	$ 6,592		RS Means. 60 lbs/ft Gal Steel
	Construction difficulty, operations and work restrictions	1	LS					$ 46,695		100% of direct cost
	Temporary facilities and requirements	3	MONTH			$ 3,000	$ 9,000	$ 9,000		Construct trailer, utilities, protection, etc.
									$ 102,389	

	Sub-total	$ 102,389
Sales Tax	8%	$ 4,096
	Sub-total	$ 106,485
Project Level Allowance	30%	$ 31,945
	Sub-total	$ 138,430
GR / GC	15%	$ 20,764
	Sub-total	$ 159,194
Contractor's Profit	10%	$ 15,919
	Sub-total	$ 175,114
Bond	2%	$ 3,502
	Sub-total	$ 178,616
Insurance	2%	$ 3,572
GRAND TOTAL		**$ 182,188**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: Operations Control Center
Project Number: OCSD Plant 2 Project 2-6
Project Construction Duration: 9 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation**									
Wall anchorage at east and west walls (original building)	New stiffeners to existing joist bearing seats	32	EA					$ 64,000		$2000/each. Estimated by James
	Field welding in place	32	EA			$ 2,400	$ 76,800	$ 76,800		
	Construction difficulty, operations and work restrictions	1	LS					$ 140,800		100% of direct cost
	Temporary facilities and requirements	9	MONTH			$ 3,000	$ 27,000	$ 27,000		Construct trailer, utilities, protection, etc.
									$ 308,600	
PFM #3	**Mitigation**									
Wall anchorage at east and west walls (addition)	New stiffeners to existing joist bearing seats	28	EA					$ 56,000		$2000/each. Estimated by James
	Field welding in place	28	EA			$ 2,400	$ 67,200	$ 67,200		
	New bolts	28	EA	$ 71	$ 1,988	$ 38	$ 1,064	$ 3,052		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 126,252		100% of direct cost
									$ 252,504	
PFM #5	**Mitigation**									
Incomplete load path at the south entrance canopy addition for resisting seismic loads	Steel braced frames	80	FT	$ 97	$ 7,760	$ 6	$ 480	$ 8,240		RS Means. 60 lbs/ft Gal Steel
	Grade Beams	14	CY	$ 412	$ 5,860	$ 676	$ 9,614	$ 15,474		Carollo database
	Steel Columns	64	FT	$ 82	$ 5,248	$ 3	$ 212	$ 5,460		RS means (6x6x3/8)
	Demo finishes	1	LS					$ 6,400		
	Replacement for finishes	1	LS					$ 8,000		
	Construction difficulty, operations and work restrictions	1	LS					$ 43,574		100% of direct cost
									$ 87,149	
PFM #6	**Mitigation-Standard Structural Mitigation E**									
In-plane shear at shear walls	Cast-in-place concrete	1.4	CY	$ 412	$ 572	$ 676	$ 939	$ 1,511		Carollo Database
	Special finishes for concrete	1	LS					$ 76		5% of total concrete
	Reinforcing steel epoxy dowels	27	EA	$ 39	$ 1,040	$ 45	$ 1,200	$ 2,240		RS Means material cost, $100/dowel, 18" OC
	Demo windows at EL 20.00	2	EA			$ 800	$ 1,600	$ 1,600		
	Construction difficulty, operations and work restrictions	1	LS					$ 5,427		100% of direct cost
									$ 10,853	
PFM #7	**Mitigation**									
Drag connection at roof to east and west shear walls	New through bolts, plates and anchors	10	EA	$ 233	$ 2,330	$ 68	$ 680	$ 3,010		RS means for bolts, plates and anchors
	Demo existing connections	10	EA					$ 680		Same as installation for new
	Construction difficulty, operations and work restrictions	1	LS					$ 3,690		100% of direct cost
									$ 7,379	
PFM #8	**Mitigation-Standard Structural Mitigation C1**									
Precast wall panel connection to foundation walls	Steel angles with steel hardware at 8' OC	528	FT	$ 41	$ 21,648	$ 6	$ 3,168	$ 24,816		RS Means. 1.21 ratio for SST. L4x4x1/2, 2' long
	Epoxied anchors at 8' OC	2112	EA	$ 71	$ 149,952	$ 38	$ 80,256	$ 230,208		RS means
	Construction difficulty, operations and work restrictions	1	LS					$ 255,024		100% of direct cost
									$ 510,048	

	Sub-total	$ 1,176,533
Sales Tax	8%	$ 47,061
	Sub-total	$ 1,223,595
Project Level Allowance	30%	$ 367,078.37
	Sub-total	$ 1,590,673
GR / GC	15%	$ 238,601
	Sub-total	$ 1,829,274
Contractor's Profit	10%	$ 182,927
	Sub-total	$ 2,012,201
Bond	2%	$ 40,244
	Sub-total	$ 2,052,445
Insurance	2%	$ 41,049
GRAND TOTAL		**$ 2,093,494**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: 12 kV Service Center
Project Number: OCSD Plant 2 Project 2-7
Project Construction Duration: 4.5 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation-Standard Structural Mitigation A1**									
Wall Anchorage to roof at north and south walls	Steel angle with steel hardware at 8' OC	245	FT	$ 41	$ 10,045	$ 6	$ 1,470	$ 11,515		RS Means. 25 lbs/ft Gal Steel. 16 ft long.
	Roof framing members	245	FT	$ 41	$ 10,045	$ 6	$ 1,470	$ 11,515		
	Epoxied anchors at 8' OC	61	EA	$ 71	$ 4,349	$ 38	$ 2,328	$ 6,676		RS Means
	Field weld struts to roof deck	8	EA			$ 2,400	$ 18,375	$ 18,375		
	Construction difficulty, operations and work restrictions	1	LS					$ 48,081		100% of direct cost
	Temporary facilities and requirements	4.5	MONTH			$ 3,000	$ 13,500	$ 13,500		Construct trailer, utilities, protection, etc.
									$ 109,663	
PFM #4	**Mitigation**									
Roof Diaphragm Shear	Demo roofing	1	LS					$ 9,600		
	Membrane roof	2788	SF	$ 6.00	$ 16,728	$ 6.00	$ 16,728	$ 33,456		
	Demo 7.5 inch deep steel roof deck	1	LS					$ 4,182		Installation cost of new
	New standard corrugated steel deck	2788	SF	$ 12	$ 33,456	$ 2	$ 4,182	$ 37,638		RS Means
	New steel beams	246	SF	$ 135	$ 33,210	$ 5	$ 1,304	$ 34,514		RS Means. 87lbs/ft Gal Steel.
	Construction difficulty, operations and work restrictions	1	LS					$ 119,390		100% of direct cost
									$ 238,780	
PFM #5	**Mitigation-Standard Structural Mitigation E**									
Shear at frame columns	Cast-in-place concrete	4.1	CY	$ 412	$ 1,679	$ 676	$ 2,754	$ 4,433		Carollo database
	Special finishes for concrete	1	LS					$ 222		5% of cast-in-place concrete
	Reinforcing steel epoxy dowels, 8" OC	288	EA	$ 39	$ 11,232	$ 45	$ 12,960	$ 24,192		RS Means material cost, $100/dowel, 18" OC
	Demo windows at EL 20.00	2	EA			$ 800	$ 1,600	$ 1,600		
	Construction difficulty, operations and work restrictions	1	LS					$60,892		200% of direct cost
									$ 91,339	

	Sub-total	$ 439,781
Sales Tax	8%	$ 17,591
	Sub-total	$ 457,372
Project Level Allowance	30%	$ 137,212
	Sub-total	$ 594,584
GR / GC	15%	$ 89,188
	Sub-total	$ 683,771
Contractor's Profit	10%	$ 68,377
	Sub-total	$ 752,148
Bond	2%	$ 15,043
	Sub-total	$ 767,191
Insurance	2%	$ 15,344
GRAND TOTAL		**$ 782,535**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: Power Building B
Project Number: OCSD Plant 2 Project 2-8
Project Construction Duration: 4 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 4/17/2019
Prepared By: XHK/KR
Date Accepted: 4/19/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #4	**Mitigation - Standard Structural Mitigation B1**									
Roof diaphragm shear	Demo existing roofing	1	LS					$ 6,400		
	Metal decking, galvanized steel, 1-1/2" deep, 18 gauge	1600	SF	$ 12	$ 19,200	$ 2	$ 2,400	$ 21,600		RS Means
	Membrane roof for the entire building	1950	SF	$ 6	$ 11,700	$ 6	$ 11,700	$ 23,400		Carollo database
	Addition of (2) W12X31 beams	50	FT	$ 50	$ 2,500	$ 6	$ 300	$ 2,800		RS Means.
	Construction difficulty, operations and work restrictions	1	LS					$ 54,200		100% Direct Cost
	Temporary facilities and requirements	4	MONTH			$ 3,000	$ 12,000	$ 12,000		Construct trailer, utilities, protection, etc.
									$ 120,400	

	Sub-total	$ 120,400
Sales Tax	8%	$ 4,816
	Sub-total	$ 125,216
Project Level Allowance	30%	$ 37,565
	Sub-total	$ 162,781
GR / GC	15%	$ 24,417
	Sub-total	$ 187,198
Contractor's Profit	10%	$ 18,720
	Sub-total	$ 205,918
Bond	2%	$ 4,118
	Sub-total	$ 210,036
Insurance	2%	$ 4,201
GRAND TOTAL		**$ 214,237**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: Power Building C
Project Number: OCSD Plant 2 Project 2-9
Project Construction Duration: 4 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation**									
Incomplete lateral load resisting system in the east-west direction	New cast in place concrete shear wall	19.0	CY	$ 412	$ 7,828	$ 676	$ 12,844	$ 20,672		Carollo database
	Epoxy dowels, 8" OC	192	EA	$ 21	$ 4,032	$ 39	$ 7,488	$ 11,520		RS Means, 3/4" diameterX12" long
	Continuous footing	9.5	CY	$ 412	$ 3,906	$ 676	$ 6,409	$ 10,316		Carollo database
	Excavation	1	LS					$ 10,000		Estimated by James
	Construction difficulty, operations and work restrictions	1	LS					$ 52,508		100% direct cost
	Temporary facilities and requirements	4	MONTH			$ 3,000	$ 12,000	$ 12,000		Construct trailer, utilities, protection, etc.
									$ 117,016	
PFM #8	**Mitigation-Standard Structural Mitigation C1**									
Footings move independent of the wall	Stainless steel angle tie plates, 4' OC	148	FT	$ 30	$ 4,425	$ 7	$ 1,033	$ 5,458		RS Means. 1.21 ratio for SST. L4x4x1/2, 2' long
	New epoxy anchors at 4' OC	74	EA	$ 71	$ 5,236	$ 38	$ 2,803	$ 8,039		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$26,993		200% direct cost
									$ 40,489	
								Sub-total	$ 157,504	
							Sales Tax	8%	$ 6,300	
								Sub-total	$ 163,805	
							Project Level Allowance	30%	$ 49,141	
								Sub-total	$ 212,946	
							GR / GC	15%	$ 31,942	
								Sub-total	$ 244,888	
							Contractor's Profit	10%	$ 24,489	
								Sub-total	$ 269,377	
							Bond	2%	$ 5,388	
								Sub-total	$ 274,764	
							Insurance	2%	$ 5,495	
								GRAND TOTAL	**$ 280,260**	

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: Power Building D
Project Number: OCSD Plant 2 Project 2-10
Project Construction Duration: 3.5 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation**									
Incomplete load path at the south side of the high roof diaphragm	Concentric X braced frames at louver openings	76	FT	$ 78	$ 5,928	$ 8	$ 608	$ 6,536		RS Means. HSS 8X8X1/2. 49lbs/ft.
	Steel framed blocking	25	FT	$ 78	$ 1,950	$ 8	$ 200	$ 2,150		RS Means. HSS 8X8X1/2. 49lbs/ft.
	Welding in field	4	EA			$ 4,800	$ 19,200	$ 19,200		
	New steel member sill	31	FT	$ 78	$ 2,418	$ 8	$ 248	$ 2,666		RS Means. HSS 8X8X1/2. 49lbs/ft.
	Epoxy anchors	47	EA	$ 71	$ 3,302	$ 38	$ 1,767	$ 5,069		RS Means
	Membrane roof for entire building	1827	SF	$ 6	$ 10,962	$ 6	$ 10,962	$ 21,924		Carollo Database
	Demo existing roofing	1	LS					$ 9,600		
	Construction difficulty, operations and work restrictions	1	LS					$ 67,145		100% Direct Cost
	Temporary facilities and requirements	3.5	MONTH			$ 3,000	$ 10,500	$ 10,500		
									$ 144,789	
PFM #5	**Mitigation-Standard Structural Mitigation D**									
Out-of-plane horizontal bending	Vertical steel tube or steel channel members	12	EA					$ 48,000		Estimated by James
	New epoxy anchors at 8" OC	176	EA	$ 71	$ 12,514	$ 38	$ 6,698	$ 19,211		RS Means
	Additional bracing hardware and framing members	12	EA					$ 48,000		$4000/brace
	Construction difficulty, operations and work restrictions	1	LS					$ 115,211		100% Direct Cost
									$ 230,423	

	Sub-total	$	375,212
Sales Tax	8%	$	15,008
	Sub-total	$	390,220
Project Level Allowance	30%	$	117,066
	Sub-total	$	507,286
GR / GC	15%	$	76,093
	Sub-total	$	583,379
Contractor's Profit	10%	$	58,338
	Sub-total	$	641,717
Bond	2%	$	12,834
	Sub-total	$	654,551
Insurance	2%	$	13,091
GRAND TOTAL		**$**	**667,642**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: City Water Pump Station
Project Number: OCSD Plant 2 Project 2-11
Project Construction Duration: 3 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation-Standard Structural Mitigation A1 (SIM)**									
Wall anchorage at north and south walls	New steel angles at existing wall or perimeter roof beam, 8' OC	480	FT	$ 27	$ 12,960	$ 74	$ 35,520	$ 48,480		RS Means. 25 lbs/ft Gal Steel. 16 ft long.
	Epoxy anchors at 8' OC	120	EA	$ 71	$ 8,520	$ 38	$ 4,560	$ 13,080		RS means
	Construction difficulty, operations and work restrictions	1	LS					$ 30,780		100% Direct Cost
	Temporary facilities and requirements	3	MONTH			$ 3,000	$ 9,000	$ 9,000		
									$ 101,340	
PFM #5	**Mitigation-Standard Structural Mitigation D**									
Out-of-plane horizontal bending	Vertical steel tube or steel channel members	17	EA					$ 68,500		$4000/each. Estimated by James
	New epoxy anchors at 8" OC	200	EA	$ 71	$ 14,200	$ 38	$ 7,600	$ 21,800		RS Means
	Additional bracing hardware and framing members	17	EA					$ 68,000		$4000/brace
	Construction difficulty, operations and work restrictions	1	LS					$ 158,300		100% Direct Cost
									$ 316,600	

	Sub-total	$ 417,940
Sales Tax	8%	$ 16,718
	Sub-total	$ 434,658
Project Level Allowance	30%	$ 130,397
	Sub-total	$ 565,055
GR / GC	15%	$ 84,758
	Sub-total	$ 649,813
Contractor's Profit	10%	$ 64,981
	Sub-total	$ 714,794
Bond	2%	$ 14,296
	Sub-total	$ 729,090
Insurance	2%	$ 14,582
GRAND TOTAL		**$ 743,672**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: Headworks Power Building A
Project Number: OCSD Plant 2 Project 2-14
Project Construction Duration: 2 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #3	**Mitigation**									
Building separation allows pounding into adjacent building (2-16 Headworks Standby Power Building)	New steel plates	3	EA					$ 12,000		$4000/connection. Estimated by James
	New through bolts	8	EA	$ 6	$ 50	$ 3	$ 27	$ 77		RS means
	New epoxy anchors	8	EA	$ 71	$ 568	$ 38	$ 304	$ 872		RS means
	Construction difficulty, operations and work restrictions	1	LS					$ 12,949		100% Direct Cost
	Temporary facilities and requirements	2	MONTH			$ 3,000	$ 6,000	$ 6,000		
									$ 31,898	

	Sub-total	$ 31,898
Sales Tax	8%	$ 1,276
	Sub-total	$ 33,174
Project Level Allowance	30%	$ 9,952
	Sub-total	$ 43,126
GR / GC	15%	$ 6,469
	Sub-total	$ 49,594
Contractor's Profit	10%	$ 4,959
	Sub-total	$ 54,554
Bond	2%	$ 1,091
	Sub-total	$ 55,645
Insurance	2%	$ 1,113
GRAND TOTAL		**$ 56,758**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: Headworks Power Building B
Project Number: OCSD Plant 2 Project 2-15
Project Construction Duration: 2 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #3	**Mitigation**									
Building separation allows pounding into adjacent building (2-16 Headworks Standby Power Building)	New steel plates	3	EA					$ 12,000		$4000/connection. Estimated by James
	New through bolts	8	EA	$ 6	$ 48	$ 3	$ 24	$ 72		RS means
	New epoxy anchors	8	EA	$ 71	$ 568	$ 38	$ 304	$ 872		RS means
	Ties at roof diaphragm	58	FT	$ 30	$ 1,740	$ 7	$ 406	$ 2,146		RS Means. 1.21 ratio for SST. L4x4x1/2, 2' long 4' OC
	Ties to existing roof deck	1	LS					$ 5,000		Estimated by James
	Epoxy anchors, 6"OC	116	EA	$ 71	$ 8,236	$ 38	$ 4,408	$ 12,644		RS means
	Construction difficulty, operations and work restrictions	1	LS					$ 32,734		100% Direct Cost
	Temporary facilities and requirements	2	MONTH			$ 3,000	$ 6,000	$ 6,000		
									$ 71,468	

	Sub-total	$ 71,468
Sales Tax	8%	$ 2,859
	Sub-total	$ 74,327
Project Level Allowance	30%	$ 22,298
	Sub-total	$ 96,625
GR / GC	15%	$ 14,494
	Sub-total	$ 111,118
Contractor's Profit	10%	$ 11,112
	Sub-total	$ 122,230
Bond	2%	$ 2,445
	Sub-total	$ 124,675
Insurance	2%	$ 2,493
GRAND TOTAL		**$ 127,168**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: Headworks Standby Power Building
Project Number: OCSD Plant 2 Project 2-16
Project Construction Duration: 2 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #3	**Mitigation**									
Building separation allows pounding into adjacent building (2-15 Headworks Power Building B)	New steel plates	3	EA					$ 12,000		$4000/connection. Estimated by James
	New through bolts	8	EA	$ 6	$ 48	$ 3	$ 24	$ 72		RS means
	New epoxy anchors	8	EA	$ 71	$ 568	$ 38	$ 304	$ 872		RS means
	Ties at roof diaphragm	60	EA	$ 30	$ 1,800	$ 7	$ 420	$ 2,220		RS Means. 1.21 ratio for SST. L4x4x1/2, 2' long 4' OC
	Ties to existing roof deck	1	LS					$ 5,000		Estimated by James
	Epoxy anchors, 6" OC	116	EA	$ 71	$ 8,236	$ 38	$ 4,408	$ 12,644		RS means
	Construction difficulty, operations and work restrictions	1	LS					$ 32,808		100% Direct Cost
	Temporary facilities and requirements	2	MONTH			$ 3,000	$ 6,000	$ 6,000		
									$ 71,616	
								Sub-total	$ 71,616	
							Sales Tax	8%	$ 2,865	
								Sub-total	$ 74,481	
							Project Level Allowance	30%	$ 22,344	
								Sub-total	$ 96,825	
							GR / GC	15%	$ 14,524	
								Sub-total	$ 111,349	
							Contractor's Profit	10%	$ 11,135	
								Sub-total	$ 122,483	
							Bond	2%	$ 2,450	
								Sub-total	$ 124,933	
							Insurance	2%	$ 2,499	
								GRAND TOTAL	**$ 127,432**	

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: Central Power Generation Building
Project Number: OCSD Plant 2 Project 2-17
Project Construction Duration: 8 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation**									
Discontinuous shear walls along grid line B (mezzanine)	Cast-in-place concrete shear wall	29.6	CY	$ 412	$ 12,207	$ 676	$ 20,030	$ 32,237		Carollo Database
	Upgrade first floor beams with steel channel tie along building length	190	FT	$ 51	$ 9,690	$ 179	$ 34,010	$ 43,700		RS Means. 60 lbs/ft Gal Steel.
	Demo conduit and piping	1	LS					$ 16,000		
	Replace conduit and piping	1	LS					$ 65,000		
	Construction difficulty, operations and work restrictions	1	LS					$ 156,937		100% of direct cost
	Temporary facilities and requirements	8	MONTH			$ 3,000	$ 24,000	$ 24,000		Construct trailer, utilities, protection, and etc.
									$ 337,874	
PFM #2	**Mitigation-Standard Structural Mitigation A2 (High)**									
Wall anchorage at the north, south, and interior wall along grid line B	New steel welded or bolted connections	10	EA			$ 15,000	$ 150,000	$ 150,000		Estimated by James Doering
	Additional roof deck welding	10	EA			$ 4,800	$ 48,000	$ 48,000		
	Construction difficulty, operations and work restrictions	1	LS					$ 198,000		100% Direct Cost
									$ 396,000	
PFM #4	**Mitigation**									
Mezzanine at EL 21 lacks bracing	New steel x-braced frames	186	FT	$ 78	$ 14,514	$ 8	$ 1,489	$ 16,002		RS Means. HSS 8X8X1/2. 49lbs/ft.
	Epoxy anchors	32	EA	$ 71	$ 2,272	$ 38	$ 1,216	$ 3,488		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 19,490		100% Direct Cost
									$ 38,981	
PFM #5	**Mitigation-Standard Structural Mitigation E**									
In-plane shear in shear walls at shear walls in the east-west direction	Cast in place concrete	16.9	CY	$ 412	$ 6,943	$ 676	$ 11,392	$ 18,335		Carollo Database
	Reinforcing steel epoxy dowels	66	EA	$ 39	$ 2,568	$ 45	$ 2,963	$ 5,530		RS Means material cost, $100/dowel, 18" OC
	Special finishes for concrete	1	LS					$ 917		5% of cast-in-place concrete
	Demo existing window at grade and at EL 33.00	2	EA			$ 800	$ 1,600	$ 6,400		
	Construction difficulty, operations and work restrictions	1	LS					$ 31,182		100% Direct Cost
									$ 62,363	
PFM #6	**Mitigation-Standard Structural Mitigation B2**									
Roof diaphragm shear transfer	Supplement existing anchors at 20" OC	420	EA	$ 71	$ 29,820	$ 38	$ 15,960	$ 45,780		RS means
									$ 45,780	
PFM #7	**Mitigation-Standard Structural Mitigation B1**									
Roof diaphragm shear in both directions	Membrane roof for the entire building	26125	SF	$ 6	$ 156,750	$ 6	$ 156,750	$ 313,500		
	New steel roof framing	432	FT	$ 41	$ 17,712	$ 6	$ 2,592	$ 20,304		RS Means. 25 lbs/ft Gal Steel.
	Metal decking, galvanized steel, 1-1/2" deep, 18 gauge	18000	SF	$ 12	$ 216,000	$ 2	$ 27,000	$ 243,000		RS Means
	Demo existing steel roof deck	1	LS					$ 38,400		
	Demo existing roofing	1	LS					$ 38,400		
	Construction difficulty, operations and work restrictions	1	LS					$ 653,604		100% Direct Cost
									$ 1,307,208	

	Sub-total	$ 2,188,206
Sales Tax	8%	$ 87,528
	Sub-total	$ 2,275,734
Project Level Allowance	30%	$ 682,720
	Sub-total	$ 2,958,455
GR / GC	15%	$ 443,768
	Sub-total	$ 3,402,223
Contractor's Profit	10%	$ 340,222
	Sub-total	$ 3,742,445
Bond	2%	$ 74,849
	Sub-total	$ 3,817,294
Insurance	2%	$ 76,346
GRAND TOTAL		**$ 3,893,640**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: DAFT D
Project Number: OCSD Plant 2 Project 2-22
Project Construction Duration: 4 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	References
PFM #3	**Mitigation**									
Dome-to-wall connection	Install new epoxy dowels	40	EA	$ 42	$ 1,680	$ 78	$ 3,120	$ 4,800		RS Means, 3/4" diameterX24" long
	Construction difficulty, operations and work restrictions	1	LS					$ 9,600		200% of direct cost
	Temporary facilities and requirements	2	MONTH			$ 3,000	$ 6,000	$ 6,000		Construct trailer, utilities, protection, and etc.
									$ 20,400	
PFM #9	**Mitigation**									
Out-of-plane bending on the buried walls due to liquefied soil conditions	New C6X13 member anchored to the existing thrust ring	100	FT	$ 24	$ 2,400	$ 6	$ 600	$ 3,000		RS Means. 13 lbs/ft Gal Steel
	Anchor to the dome with epoxy anchors (3/4" diameter X 8" long) spaced at 12" OC	100	EA	$ 71	$ 7,100	$ 38	$ 3,800	$ 10,900		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 27,800		200% of direct cost
									$ 41,700	

	Sub-total	$ 62,100
Sales Tax	8%	$ 2,484
	Sub-total	$ 64,584
Project Level Allowance	30%	$ 19,375
	Sub-total	$ 83,959
GR / GC	15%	$ 12,594
	Sub-total	$ 96,553
Contractor's Profit	10%	$ 9,655
	Sub-total	$ 106,208
Bond	2%	$ 2,124
	Sub-total	$ 108,333
Insurance	2%	$ 2,167
GRAND TOTAL		**$ 110,499**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: Maintenance Building
Project Number: OCSD Plant 2 Project 2-27
Project Construction Duration: 12 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #2, 3A, 3B, 5, 7, and 8	**Mitigation**									
Building drift at elevated floors in the north-south direction	Steel concentric x-braced frames	1737	FT	$ 78	$ 135,495	$ 8	$ 13,897	$ 149,392		RS Means. HSS 8X8X1/2. 49lbs/ft.
	Supplemental connections with steel hardware	112	EA					$ 448,000		$4000 per brace, James
	New grade beams	84	CY	$ 412	$ 34,608	$ 676	$ 56,784	$ 91,392		Carollo database
	Saw cut existing slab and footing	412	FT	$ 2	$ 881	$ 23	$ 9,261	$ 10,142		RS Means.
	Replace existing slab and footing	167	CY	$ 324	$ 53,992	$ 248	$ 41,390	$ 95,382		Carollo database.
	Construction difficulty, operations and work restrictions	1	LS					$ 794,309		100% of direct cost
	Temporary facilities and requirements	12	MONTH			$ 3,000	$ 36,000	$ 36,000		Construct trailer, utilities, protection, and etc.
									$ 1,624,617	
PFM #4	**Mitigation**									
Precast wall cladding interferes with moment frames	Remove all welded wall cladding connections	304	EA					$ 152,000		$500/each
	Construction difficulty, operations and work restrictions	1	LS					$ 152,000		100% of direct cost
									$ 304,000	

	Sub-total	$ 1,928,617
Sales Tax	8%	$ 77,145
	Sub-total	$ 2,005,762
Project Level Allowance	30%	$ 601,729
	Sub-total	$ 2,607,490
GR / GC	15%	$ 391,124
	Sub-total	$ 2,998,614
Contractor's Profit	10%	$ 299,861
	Sub-total	$ 3,298,475
Bond	2%	$ 65,970
	Sub-total	$ 3,364,445
Insurance	2%	$ 67,289
GRAND TOTAL		**$ 3,431,734**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: Boiler Building
Project Number: OCSD Plant 2 Project 2-28
Project Construction Duration: 4 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 4/17/2019
Prepared By: XHK/KR
Date Accepted:
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #4	**Mitigation - Standard Structural Mitigation B1**									
Roof diaphragm shear	Demo existing roofing	1	LS					$ 9,600		
	Metal decking, galvanized steel, 1-1/2" deep, 18 gauge	2000	SF	$ 12	$ 24,000	$ 2	$ 3,000	$ 27,000		RS Means
	Membrane roof for the entire building	2000	SF	$ 6	$ 12,000	$ 6	$ 12,000	$ 24,000		Carollo database
	Addition of (3) W12X31 beams	60	FT	$ 50	$ 3,000	$ 6	$ 360	$ 3,360		RS Means. 31 lbs/ft
	Construction difficulty, operations and work restrictions	1	LS					$ 63,960		100% Direct Cost
	Temporary facilities and requirements	4	MONTH			$ 3,000	$ 12,000	$ 12,000		Construct trailer, utilities, protection, etc.
									$ 139,920	

	Sub-total	$ 139,920
Sales Tax	8%	$ 5,597
	Sub-total	$ 145,517
Project Level Allowance	30%	$ 43,655
	Sub-total	$ 189,172
GR / GC	15%	$ 28,376
	Sub-total	$ 217,548
Contractor's Profit	10%	$ 21,755
	Sub-total	$ 239,302
Bond	2%	$ 4,786
	Sub-total	$ 244,088
Insurance	2%	$ 4,882
GRAND TOTAL		**$ 248,970**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: OOBS
Project Number: OCSD Plant 2 Project 2-29
Project Construction Duration: 8 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation-Standard Structural Mitigation A2 (High)**									
Wall anchorage at the roof level at the north and south walls	New steel welded or bolted connections	13	EA			$ 15,000	$ 195,000	$ 195,000		$15000/location. Estimated by James Doering
	Additional roof deck welding	13	EA			$ 2,400	$ 31,200	$ 31,200		
	Construction difficulty, operations and work restrictions	1	LS					$ 113,100		100 % of direct cost
	Temporary facilities and requirements	4	MONTH			$ 3,000	$ 12,000	$ 12,000		Construct trailer, utilities, protection, and etc.
									$ 351,300	
PFM #2	**Mitigation-Standard Structural Mitigation A2 (High)**									
Wall anchorage at the roof level at the east, west, and interior wall (Grid line G)	New steel welded or bolted connections	15	EA			$ 15,000	$ 225,000	$ 225,000		Estimated by James Doering
	Additional roof deck puddle welds	82	EA			$ 600	$ 49,200	$ 49,200		
	Roof demo	1	LS					$ 9,600		
	Roof replacement	1	LS					$ 9,600		
	Construction difficulty, operations and work restrictions	1	LS					$ 146,700		100 % of direct cost
									$ 440,100	
PFM #5	**Mitigation - Standard Structural Mitigation B1 and B2**									
Low roof diaphragm shear	Demo existing roofing	1	LS					$ 28,800		
	Metal decking, galvanized steel, 1-1/2" deep, 18 gauge	8600	SF	$ 12	$ 103,200	$ 2	$ 12,900	$ 116,100		RS Means
	Membrane roof for the entire building	11880	SF	$ 6	$ 71,280	$ 6	$ 71,280	$ 142,560		Carollo database
	Supplement existing anchors at 20" OC	180	EA	$ 71	$ 12,861	$ 38	$ 6,804	$ 19,665		RS Means
	Construction difficulty, operations and work restrictions	1	LS					$ 307,125		100% Direct Cost
									$ 614,250	

		Sub-total	$ 1,405,650
	Sales Tax	8%	$ 56,226
		Sub-total	$ 1,461,876
	Project Level Allowance	30%	$ 438,563
		Sub-total	$ 1,900,439
	GR / GC	15%	$ 285,066
		Sub-total	$ 2,185,505
	Contractor's Profit	10%	$ 218,550
		Sub-total	$ 2,404,055
	Bond	2%	$ 48,081
		Sub-total	$ 2,452,136
	Insurance	2%	$ 49,043
	GRAND TOTAL		**$ 2,501,179**

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

ORANGE COUNTY SANITATION DISTRICT
PS15-06 SEISMIC EVALUATION
FUTURE PROJECT COST ESTIMATE

Project Name: 12 kV Distribution Center A
Project Number: OCSD Plant 2 Project 2-30
Project Construction Duration: 4 months
This estimate is based on midpoint of construction in Nov, 2018

Date Prepared: 12/31/2018
Prepared By: XHK/KR
Date Accepted: 1/8/2019
Accepted By: JAD

				MATERIALS		INSTALLATION		TOTAL	TOTAL	
		QTY.	Unit	Unit Cost	Amount	per UM	Amount	Direct Cost	PFM Direct Cost	Reference
PFM #1	**Mitigation-Standard Structural Mitigation A2 (High)**									
Wall anchorage to roof at north and south walls	New steel welded or bolted connections	10	EA			$ 15,000	$ 150,000	$ 150,000		$15000/location. Estimated by James Doering
	Construction difficulty, operations and work restrictions	1	LS					$ 150,000		100% of direct cost
	Temporary facilities and requirements	4	MONTH			$ 3,000	$ 12,000	$ 12,000		Construct trailer, utilities, protection, and etc.
									$ 312,000	
PFM #3	**Mitigation-Standard Structural Mitigation E**									
Shear at frame columns in the E-W direction	Cast in place concrete	11.1	CY	$ 412	$ 4,578	$ 676	$ 7,511	$ 12,089		RS Means. Assume 12"
	Reinforcing steel epoxy dowels	157	EA	$ 39	$ 6,110	$ 45	$ 7,050	$ 13,160		RS Means material cost, $100/dowel, 18" OC
	Demo existing window	4	EA					$ 6,400		
	Special finishes for concrete	1	LS					$ 604		5% of cast-in-place concrete
	Construction difficulty, operations and work restrictions	1	LS					$ 32,253		100% of direct cost
									$ 64,507	
							Sub-total		$ 376,507	
							Sales Tax	8%	$ 15,060	
							Sub-total		$ 391,567	
							Project Level Allowance	30%	$ 117,470	
							Sub-total		$ 509,037	
							GR / GC	15%	$ 76,356	
							Sub-total		$ 585,393	
							Contractor's Profit	10%	$ 58,539	
							Sub-total		$ 643,932	
							Bond	2%	$ 12,879	
							Sub-total		$ 656,810	
							Insurance	2%	$ 13,136	
							GRAND TOTAL		**$ 669,947**	

CONSTRUCTION COST ONLY

NOTES:
1. This cost estimate only includes structural elements.

Geosyntec consultants

APPENDIX F2

Geotechnical Mitigation Cost Tables

DIFFERENTIAL SETTLEMENT AND INCREASED LATERAL EARTH PRESSURE MITIGATION COST ESTIMATE
PS15-06 SEISMIC EVALUATION
ORANGE COUNTY, CALIFORNIA

			Total Quantities					Unit Costs* ($/LF and $/CY)					Addt'l Costs		Cost Estimate ($)							
Structure No.	Structure Name	Treatment Depth	Drilling - Standard Rig	Drilling - Directional	Drilling - Limited Access	Access Shafts	Total Grout Volume	Standard Rig Drilling Cost[2]	Directional Drilling Cost[2]	Limited Access Drilling Cost[2]	Access Shaft	Grouting Cost[3]	Savings due to Economies of Scale	Structure-specific Modification & Access Costs	Sub-Total, Construction Costs	Sales Tax	Project Level Allowance	GR/GC	Contractor's Profit	Bond	Insurance	Structure Total
		(FT)	(LF)	(LF)	(LF)	(QTY)	(CY)	70	125	95	600,000	900				8%	30%	15%	10%	2%	2%	
1-4	City Water Pump Station	27	2,910	0	0	0	521	203,695	0	0	0	469,200	0	0	672,895	26,916	209,943	136,463	104,622	23,017	23,477	$1,197,332
1-5	Power Building 2	47	6,662	0	0	0	1,221	466,358	0	0	0	1,098,800	0	0	1,565,158	62,606	488,329	317,414	243,351	53,537	54,608	$2,785,003
1-7	Power Building 5	46	0	0	3,022	0	415	0	0	287,109	0	373,050	0	0	660,159	26,406	205,970	133,880	102,642	22,581	23,033	$1,174,671
1-10	Central Power Generation Building	19	2,858	0	0	0	1,108	200,067	0	0	0	997,500	0	0	1,197,567	47,903	373,641	242,867	186,198	40,963	41,783	$2,130,920
1-14	Digester 5 Pump Room	42	0	0	3,043	0	563	0	0	289,076	0	506,900	0	0	795,976	31,839	248,344	161,424	123,758	27,227	27,771	$1,416,339
1-24	Gas Holder	51	0	0	3,638	0	735	0	0	345,570	0	661,500	0	0	1,007,070	40,283	314,206	204,234	156,579	34,447	35,136	$1,791,955
1-33	PEDB2	29	1,122	0	0	0	435	78,508	0	0	0	391,500	0	0	470,008	18,800	146,643	95,318	73,077	16,077	16,398	$836,321
2-1	DAFT A, B, & C Gallery	59	0	0	12,625	0	1,890	0	0	1,199,330	0	1,701,000	0	0	2,900,330	116,013	904,903	588,187	450,943	99,208	101,192	$5,160,775
2-3	RAS PS East	40	626	0	3,717	0	692	43,844	0	353,115	0	622,790	0	0	1,019,749	40,790	318,162	206,805	158,551	34,881	35,579	$1,814,517
2-4	RAS PS West	66	697	0	6,712	0	1,317	48,780	0	637,659	0	1,184,880	0	0	1,871,319	74,853	583,852	379,504	290,953	64,010	65,290	$3,329,780
2-5	PEPS & MAC	60	2,029	0	15,957	0	3,267	142,050	0	1,515,915	0	2,940,608	-326,734	0	4,271,838	170,874	1,332,814	866,329	664,185	146,121	149,043	$7,601,204
2-6	Operations/Control Center Bldg	61	18,213	0	0	0	3,170	1,274,915	0	0	0	2,852,998	-317,000	0	3,810,913	152,437	1,189,005	772,853	592,521	130,355	132,962	$6,781,045
2-7	12 kV Service Center	50	5,738	0	0	0	989	401,625	0	0	0	889,700	0	0	1,291,325	51,653	402,893	261,881	200,775	44,171	45,054	$2,297,752
2-9	Power Building C	61	0	0	5,902	0	964	0	0	560,666	0	867,420	0	0	1,428,086	57,123	445,563	289,616	222,039	48,849	49,826	$2,541,101
2-11	City Water Pump Station	65	0	0	8,219	0	1,657	0	0	780,829	0	1,491,360	0	0	2,272,189	90,888	708,923	460,800	353,280	77,722	79,276	$4,043,077
2-12	12 kV Distribution Center B	59	1,676	0	9,664	0	2,078	117,318	0	918,099	0	1,870,585	0	0	2,906,002	116,240	906,673	589,337	451,825	99,402	101,390	$5,170,869
2-13	12 kV Distribution Center D	63	0	0	3,062	0	614	0	0	290,871	0	552,920	0	0	843,791	33,752	263,263	171,121	131,193	28,862	29,440	$1,501,421
2-14	Headworks Power Bldg A	54	0	0	4,508	0	867	0	0	428,227	0	780,520	0	0	1,208,747	48,350	377,129	245,134	187,936	41,346	42,173	$2,150,814
2-15	Headworks Power Bldg B	53	0	0	4,961	0	1,003	0	0	471,276	0	902,700	0	0	1,373,976	54,959	428,681	278,642	213,626	46,998	47,938	$2,444,819
2-16	Headworks Standby Power Building	53	0	0	6,082	0	1,213	0	0	577,766	0	1,091,510	0	0	1,669,276	66,771	520,814	338,529	259,539	57,099	58,241	$2,970,269
2-18A	Aeration Basins A-H (Northwest)	67	28,375	0	0	0	10,563	1,986,215	0	0	0	9,506,290	-1,056,254	0	10,436,250	417,450	3,256,110	2,116,472	1,622,628	356,978	364,118	$18,570,006
2-18B	Aeration Basins A-H (Southeast)	41	17,364	0	0	0	5,412	1,215,445	0	0	0	4,870,395	-541,155	0	5,544,685	221,787	1,729,942	1,124,462	862,088	189,659	193,452	$9,866,076
2-19	Gas Holder	66	0	0	4,678	0	951	0	0	444,386	0	856,320	0	0	1,300,706	52,028	405,820	263,783	202,234	44,491	45,381	$2,314,445
2-20	Secondary Clarifiers A-L	30	58,605	0	0	0	15,950	4,102,350	0	0	0	14,354,846	-1,594,983	130,000	16,992,213	679,689	5,301,571	3,446,021	2,641,949	581,229	592,853	$30,235,525
2-21	DAFTs A-C	60	12,056	0	0	0	2,168	843,885	0	0	0	1,951,452	0	0	2,795,337	111,813	872,145	566,894	434,619	95,616	97,529	$4,973,954
2-22	DAFT D	60	4,712	0	0	0	846	329,805	0	0	0	761,292	0	0	1,091,097	43,644	340,422	221,274	169,644	37,322	38,068	$1,941,471
2-27	Maintenance Building	64	37,627	0	0	0	7,457	2,633,904	0	0	0	6,711,390	-745,710	0	8,599,584	343,983	2,683,070	1,743,996	1,337,063	294,154	300,037	$15,301,887
2-29	OOBS	45	0	16,330	0	1	2,483	0	2,041,250	0	600,000	2,234,600	-248,289	0	4,627,561	185,102	1,443,799	938,469	719,493	158,289	161,454	$8,234,168
2-30	12kV Distribution Center A	55	1,131	0	7,648	0	1,607	79,166	0	726,536	0	1,446,500	0	0	2,252,202	90,088	702,687	456,747	350,172	77,038	78,579	$4,007,513

[1]Column footing widths, where applicable, provided in parentheses.

[2]Drilling rates include Sleeve Port Grout Pipe (SPGP) installation.

[3]Grout cost includes labor and material. Unit cost is per CY of grout delivered, as measured by flow meters, not CY of soil treated.

LATERAL SPREAD MITIGATION COST ESTIMATE
PS15-06 SEISMIC EVALUATION
ORANGE COUNTY, CALIFORNIA

Plant	Wall Length (ft)	Column Diameter (ft)	Wall Depth (ft)	No. Columns (1ft. separation)	Cost per Pile[1] ($)	Sub-Total Construction Costs ($)	Sales Tax	Project Level Allowance	GR/GC	Contractor's Profit	Bond	Insurance	Total	AACEI Class 5 Cost Estimate Range (rounded to the nearest $25M)		
							8%	30%	15%	10%	2%	2%	(Upper end of Est. Range)	+50%	Best Estimate	-50%
1	2,775	4	90	555	$ 150,000	$ 83,250,000	3,330,000	25,974,000	16,883,100	12,943,710	2,847,616	2,904,569	148,132,995	$ 150,000,000	$ 100,000,000	$ 50,000,000
2	1,385	4	90	277	$ 150,000	$ 41,550,000	1,662,000	12,963,600	8,426,340	6,460,194	1,421,243	1,449,668	73,933,044	$ 75,000,000	$ 50,000,000	$ 25,000,000
2 - Full Frontage	6,667	4	90	1,333	$ 150,000	$ 200,010,000	8,000,400	62,403,120	40,562,028	31,097,555	6,841,462	6,978,291	355,892,856	$ 350,000,000	$ 225,000,000	$ 125,000,000

[1] Estimated cost per 4ft diameter, concrete-filled steel pile, 90ft deep, as described in Lateral Spread Mitigation Memo. Per pile cost estimate based on average of costs provided by two geotechnical contractors.

Geosyntec
consultants

APPENDIX G

Lateral Spread Wall Concept Memorandum

Geosyntec consultants

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Memorandum

Date:	19 July 2019
To:	Orange County Sanitation District (OCSD)
Copies to:	Chris Conkle, P.E., G.E., Geosyntec Consultants
From:	Jacquelyn Allmond, Ph.D., P.E, Project Engineer Christopher Hunt, Ph.D., P.E., G.E., Senior Principal
Subject:	Lateral Spread Wall Concept Seismic Evaluation of Structures at Plant Nos. 1 and 2 Project No. PS15-06 Geosyntec Project Number: HL1635

Geosyntec Consultants (Geosyntec) is pleased to present findings and recommendations from the evaluation of the lateral spread mitigation alternative proposed at Orange County Sanitation District (OCSD) Plant Nos. 1 and 2. This memorandum summarizes the liquefaction-induced lateral spreading hazard, the idealized cross-section developed for assessing liquefaction-induced lateral earth pressures and deformations, the analyses performed to develop an embedded wall mitigation concept, and an associated cost estimate. The lateral spreading hazard was evaluated at Plant 1 and 2 as part of Task 3 and the liquefaction mitigation alternatives and costs were developed in Task 4 of PS15-06[1].

1. LIQUEFACTION AND LATERAL SPREAD HAZARD

Liquefaction is the term used to describe the sudden loss of soil strength due to pore pressure buildup in response to a loading event such as earthquake shaking. Experiences from previous earthquakes have demonstrated that loose granular soils located near the ground surface and saturated by a high-water table are the most susceptible to liquefaction. The loss of strength associated with liquefaction can cause settlement, flotation of buried structures, increase in lateral soil pressures, and bearing capacity reduction below shallow foundations or around deep foundation elements. A related phenomenon is lateral spreading, where liquefied soil located near an exposed free-face or sloping ground, such as near the Santa Ana River and Talbert Marsh, moves as a mass towards the face and can apply lateral forces to structures and their foundations.

[1] A summary of the work executed by the Geosyntec team as part of PS15-06 Tasks 3 and 4 are provided in Technical Memorandum 3 (TM3) and 4 (TM4), respectively.

Lateral spread deformation profiles with depth were developed for each subject-structure in PS15-06 at the analysis ground water level (AWL, see Section 4.1.3 of TM3 for design ground water levels). Contours of the liquefaction induced lateral spread at the ground surface at Plant 1 and Plant 2 are shown in Figures 4.19 and 4.24 of TM3, respectively, and are based on the lateral spread predicted at the ground surface at each structure. At Plant 1, the best estimate lateral spreading displacement was on the order of 3 feet (ft) for the subject-structures nearest the Santa Ana River frontage. At Plant 2, the best estimate lateral spreading displacement was on the order of 4 to 6 ft for structures near the Santa Ana River frontage, and 5 ft for structures near the Talbert Marsh frontage. The free-field liquefaction induced lateral spread deformation profiles for each structure at the AWL and the 5% probability of exceedance in 50-year earthquake hazard level (Basic Safety Earthquake 2E) are provided in Appendix C of TM3. Lateral spread deformations were calculated without consideration of influences from the structure, foundation, surrounding structures, or surrounding ancillary features such as buried pipes or utility conduits and are therefore referred to as "free-field".

At both plant locations, assessments indicated that lateral spread would likely affect only a portion of each site, with lateral spread unlikely to extend to locations distant from the river or marsh frontages. Ground surface deformations near the river and marsh frontages were assessed to be greater than what many subject-structures could tolerate in order to meet performance objectives[2]. Therefore, lateral spread mitigation was recommended at both Plants 1 and 2 for structures which are subject to lateral spreading displacements larger than their capacity. This memorandum documents the evaluation of one potential mitigation option for these lateral spreads, an embedded wall concept proposed to limit excessive lateral displacements towards the river and marsh. The embedded wall is envisioned as consisting of a series of large diameter steel pipes installed at close spacings along the perimeter of the plants between the subject-structures and sloped frontages. A plan and oblique view of the lateral spread wall concept are shown in Figure 1 relative to the Digesters at Plant 1 and the Santa Ana River. The idealized soil conditions and development of the wall geometry and material properties are described in greater detail below.

2. IDEALIZED CROSS SECTION

Liquefaction-induced lateral spreading deformations were evaluated at each structure in this study based on the structure-specific subsurface idealized profile and proximity to the Talbert Marsh and/or Santa Ana River frontages; however, for this planning level evaluation, one cross-section was selected to develop the target lateral loads and allowable deflection of the lateral spread wall. The idealized soil profile at 1-21A Digesters 13-16 at Plant 1 was chosen based on the exemplar structure's proximity to the Santa Ana River and because movement of the relatively thick unliquefied "crust" at the surface would place a large demand on the mitigation wall concept. The

[2] The probable failure mode (PFM) associated with excessive lateral spreading and recommended levels of mitigation (e.g., 60% reduction in lateral spread deformation) to meet performance level objectives for each subject-structure are provided in the PFM and Mitigation Tables in TM3.

analysis of the lateral spread wall targeted a maximum deflection of 12 inches at the ground surface, which, based on a Tier 3 structural analysis of Digester 16, was a tolerable amount of ground displacement for the pile-supported digesters to meet their target performance criteria.

A "typical ground water level" (TWL) of 16 ft below ground surface was selected for the lateral spread wall analyses. The TWL is deeper than the Historic High Water Level (HHWL) or AWL used in other analyses in this study, but captures the majority of the historical ground water data at Plant 1, and represents a "typical" condition that may be present during an earthquake. The deeper TWL results in a stronger soil profile near the surface (i.e., less liquefiable soil) and forms a thicker soil crust that can displace over deeper liquefiable layers during an earthquake event. On the backside of the wall, this thicker soil cap applies a high driving force on the wall near the ground surface while providing no lateral resistance on the river-side as the cap spreads laterally towards the river. This TWL scenario results in greater wall deflection than under the HHWL or AWL with thinner soil crusts and was therefore considered conservative for this evaluation.

The idealized soil profile at 1-21A is shown in Figure 2 and consists of a 16-ft thick layer of non-liquefiable (i.e., dry above groundwater) silty sand at the surface over 1 foot of liquefiable sand and silty sand. These layers overlie a 20-ft thick partially liquefiable clay layer with thin silt and sandy silt layers, though only the soils in the upper 13 ft of this layer were considered to contribute to lateral spread deformation (i.e., soils above the "lateral spread cut-off" described in TM3). The bottom sand and silty sand layers (between EL. -10 ft and -40 ft) are considered liquefiable, and may contribute to settlement, but are not anticipated to contribute significantly to lateral spread. The best estimate lateral spread profile was developed following the same procedures outlined in Section 4.1.4 of TM3 using the 1-21A idealized profile, the TWL, and an assumed distance to free-face of 65 ft, which is the approximate distance from the Santa Ana River free-face to the river-side edge of the access/perimeter road of Plant 1 (see Figure 1). Based on review of existing utility as-builts the lateral spread wall concept was developed to allow for construction between existing underground utilities near the Plant 1 digesters at this 65-ft offset from the river[3]. Figure 2 shows the idealized soil profile (at left), the assumed lateral spread cut-off depth, and the best estimate free-field lateral spread profile at the wall location (at right, red line on displacement plot).

3. LATERAL EARTH PRESSURE

The movement of the soil towards the river after liquefaction will impose additional lateral load on the back side of the wall (structure-side of the wall). In addition, soil will move away from the wall on the river-side, reducing lateral capacity from surrounding soil. This creates a cantilever condition with a distributed load along the back of the wall and no resisting load over most of the upper 30 ft of laterally spreading soil.

[3] An underground clearance assessment was made at both Plant 1 and Plant 2 based on review of as-built drawings provided by OCSD. Utility related constraints should be taken into consideration in the ultimate design and construction of the lateral displacement wall at Plant 1 and Plant 2.

The distributed lateral earth pressure from liquefaction was calculated following the methods presented in Section 5 of TM3. Active lateral earth pressure corresponds to the pressure experienced at the soil-wall interface when a wall moves away from the adjacent soil and the soil relaxes as it moves into the space behind the wall, and passive lateral earth pressure is applicable when soil is compressed as it moves towards a stationary wall (or more conventionally, when the wall moves into the soil). The crust behind the lateral spread wall will move laterally towards the river on top of the deeper liquefied soil and as the wall is not completely rigid, the resulting soil pressure acting on the wall is considered to be neither fully active or fully passive. For these simplified analyses, the crust was considered to impart at most a lateral load equivalent to its weight, resulting in an earth pressure coefficient (K) of 1 (i.e., horizontal and vertical stresses are equal). For liquefied soil, the equivalent fluid pressure applied by the liquefied soil (e.g., fluid with an estimated soil unit weight of 120 pounds per cubic foot (pcf) vs water unit weight of 62.4 pcf), and a corresponding hydrodynamic increment of the liquefied soil against the wall were considered. The following loads were used to develop the lateral earth pressure imposed on the embedded wall due to liquefaction:

- Above Water Table (Passive Scenario): Earth Pressure with K = 1
- Below Water Table (Liquefied Soil): Hydrostatic (Dense Fluid) + Hydrodynamic Pressure

The resulting liquefied lateral earth pressure is shown in Figure 2 (at left, green line on earth pressure plot) and was used as the distributed driving load in the lateral spread wall model. Note that as the soil between elevations 10 ft and -3 ft (lateral spread cutoff) is considered only partially liquefiable, the use of hydrostatic and hydrodynamic pressures is likely conservative.

4. LATERAL SPREAD WALL MODEL AND RESULTS

The embedded wall concept consists of large diameter drilled pipe piles installed at close spacings along the perimeter of the Plants between the subject-structures and sloped frontages. The pipe geometry and material parameters were evaluated given the 1-21A Digester 13-16 idealized soil profile and liquefied lateral loading scenarios described in previous sections in order to meet the 12-inch target pipe deflection at the ground surface. These analyses were performed using the program GROUP by ENSOFT, Inc.[4] The program is used for pushover analysis of pile groups and includes the ability to apply a distributed lateral load and extract deflection profiles along the piles. The soil models and parameters used in the GROUP model are shown in Table 1.

[4] Reese, L.C., Wang, S.-T., and Vasquez, L. [2016] "Computer Program GROUP – Version 2016 – A Program for the Analysis of a Group of Piles Subjected to Vertical and Lateral Loading – Technical Manual." Prepared for ENSOFT, Inc., Austin, TX, May 2016.

Table 1: GROUP Model Soil Material Properties

GROUP Soil Model	Layer Depth Top (ft)	Layer Depth Bottom (ft)	Effective Unit Weight, γ' (pcf)	Friction Angle, φ' (deg)	Cohesion, c (psf)
Sand (Reese)	0	16	115	35	0
Sand (Reese)	16	17	57.5	35	0
Soft Clay (Matlock)	17	37	52.6	0	800
Sand (Reese)	37	53	62.6	35	0
Sand (Reese)	53	67	67.6	35	0
Sand (Reese)	67	150	67.6	40	0

Several pipe configurations and characteristics were analyzed as part of the parametric study, including the following:

- **Pile length:** The critical pipe pile length was selected based on stabilization of the surface deflection. Load case scenarios were analyzed in GROUP starting with a pipe pile length of 74 ft and incrementally increased to 125 ft. The resulting deflection at the ground surface started to stabilize after a pile length of 85 ft as the calculated surface deflection was unaffected by using longer piles. Based on these evaluations, a 90-ft pile was considered to provide stable embedment with regard to surface deflection.

- **Pile Layout:** Two pipe pile diameters, three center-to-center spacings, and two layout configurations were analyzed to select a wall design to meet the target deflection. Multiple rows of piles offset at closer spacings were considered; however, the multi-row offset pattern did not significantly improve deflection at the ground surface with the added cost of requiring more underground utility clearance. A single line of 4-ft diameter piles at 5-ft center-to-center spacing (the smallest pipe diameter analyzed at the closest spacing) was selected as a feasible configuration for construction purposes while meeting the target surface displacement.

- **Liquefaction-Induced Soil Strength Loss:** Consideration was given to the effect of soil strength loss due to liquefaction on the wall lateral capacity. A typical value of a "p-multiplier" to account for strength loss is 0.1 (i.e., liquefied soil strength is 10% of unliquefied soil strength), though this value should be selected based on soil and site

conditions[5]. Lateral soil resistance was reduced in the GROUP analysis by applying the following p-multipliers:

- **0.0** for all soils which displace further than the deflection of the pipe. This represents the near surface soil flowing away from the wall, creating a gap at the pipe-soil interface, and providing no lateral support to the wall.
- **0.1** for liquefied material in contact with the pipe. This represents either liquefied soil at depth or laterally spreading soil which displaces less than the deflection of the pipe (i.e., pipe is still in contact with the flowing soil).
- **1.0** for unliquefied soil (i.e., no strength reduction).

Based on parametric iterations of the pipe geometry and material properties, a 4-foot diameter, 90-foot long Grade 52 steel pipe with 1" wall thickness, spaced at 5 ft on center with a rebar cage with twenty-four #18 Grade 75 vertical bars, and filled with 5,000 pounds per square inch (psi) concrete was found to limit pipe deflection at the ground surface to approximately 12 inches. A sketch of the non-deformed pipe, deflection of the laterally loaded design pipe (at right, purple line on displacement plot), and p-multiplier values (at right, blue line on p-multiplier plot) used in these analyses are shown in Figure 2. Plan and section views of the design pipe and wall configurations are shown in Figure 3.

5. DRILLED PIPE PILE LATERAL SPREAD MITIGATION COST ESTIMATE

Lateral spread mitigation cost estimates are an element of the final deliverable (TM4) of the current project. These estimates will be used for long range planning purposes and are to be prepared at the American Association of Cost Engineers International (AACEI) Class 5 level. Estimates prepared at this class are generally prepared at a very early stage of project definition and are therefore expected to have a wide accuracy range (-50% to +50%).

A cost estimate was formulated by making use of the conceptual approach to the embedded lateral spread wall using the large diameter drilled pipe piles at the 1-21A location as described in Section 4. Concept-level rough order pricing was solicited from two separate drilling contractors, both experienced with performing this type of work in Southern California. According to the cost estimates received, the average cost for materials and installation is on the order of $150,000 per pile, which equates to $30,000 per lineal foot of river/marsh frontage for lateral spread mitigation using the design pipe diameter and spacing pattern described above.

[5] California Department of Transportation (Caltrans). [2013] "Guidelines on Foundation Loading and Deformation Due to Liquefaction Induced Lateral Spreading" internal design guideline www.dot.ca.gov/research/structures/peer_lifeline_program/docs/guidelines_on_foundation_loading_jan2012.pdf

This memorandum outlines the analyses performed to assess an embedded wall concept for lateral spread mitigation at OCSD Plants 1 and 2. The concept for the lateral spread wall utilizes a single line of fully embedded 4-foot diameter Grade 52 steel pipes, 90 ft in length with 1" wall thickness and spaced at 5 ft on center. Within the steel pipe is a rebar cage of 24 EA. #18 Grade 75 vertical bars and filled with 5,000 psi concrete. Evaluations indicate this configuration limits the deflection of the wall at the ground surface to approximately 12 inches.

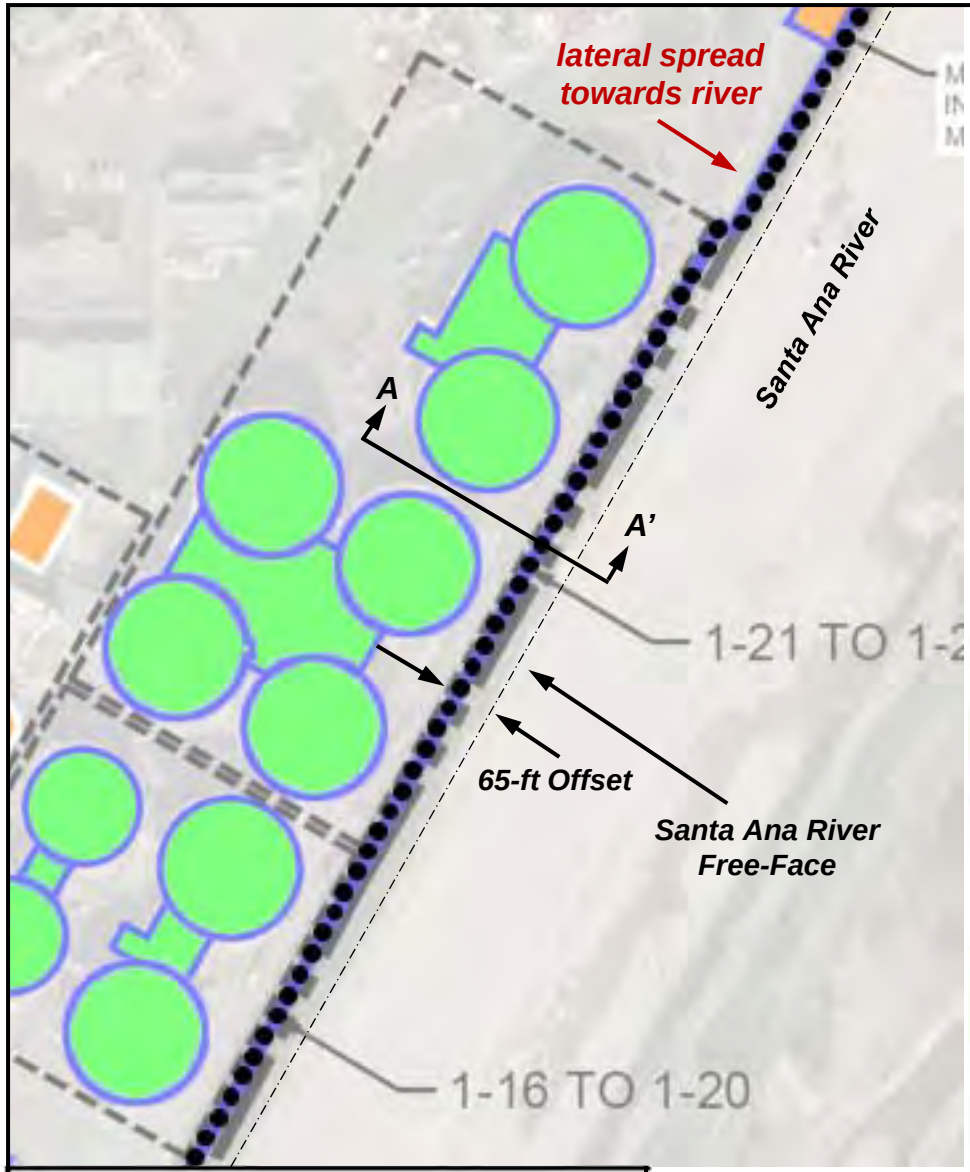
The analyses presented herein were performed for this planning level study using one cross-section at Plant 1 (1-21A Digester 13-16) and a simplified GROUP model. A more comprehensive geotechnical and structural analysis should be performed for design and construction of the walls at Plant 1 and 2 and should at a minimum include consideration of soil and lateral spread variability, underground utilities and clearances, variability in target pipe pile deflection at the ground surface, and arching and stability of soils between piles. Note also that slope movement along the Santa Ana River and Talbert Marsh frontages beyond the mitigation wall was not considered and would not be mitigated by this approach. Lateral spread mitigation alternatives like the lateral spread wall concept described in this memorandum will help reduce detrimental ground deformations on buried structures, foundations, and utilities susceptible to the excessive liquefaction-induced lateral spread hazard at Plant 1 and 2.

Attachments: Figure 1: Lateral Spread Wall Concept (shown at Plant 1 Digesters)

Figure 2: Idealized Soil Profile, Lateral Spread Displacement, Lateral Earth Pressure Distribution, and Pipe Deflection

Figure 3: Design Pipe Sections

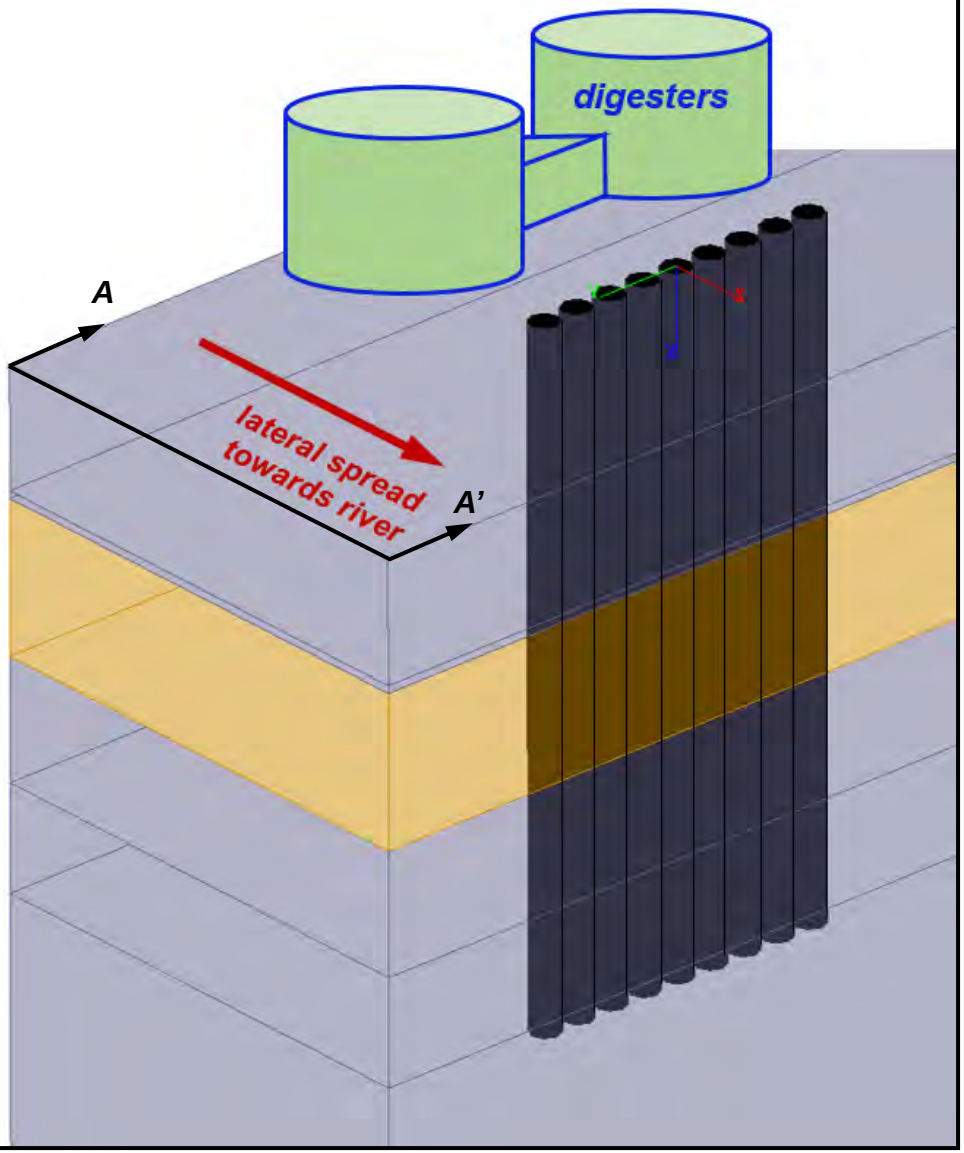
* * * * *



Note: drawings not shown to scale

Oblique View

(only portion of lateral spread wall shown)



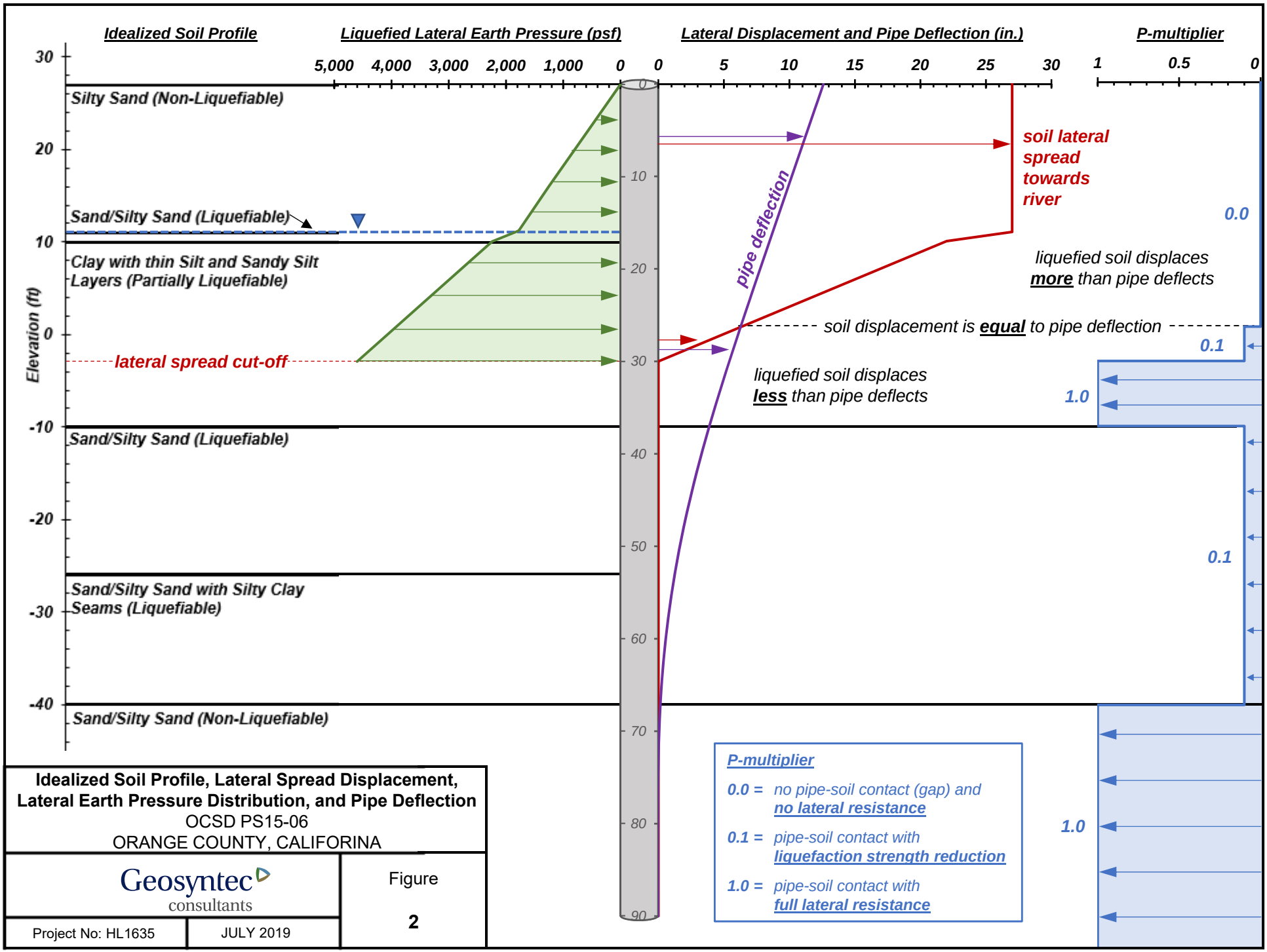
Plan View

Lateral Spread Wall Concept
(shown at Plant 1 Digesters)
OCSD PS15-06
ORANGE COUNTY, CALIFORINA

Geosyntec consultants

Figure **1**

Project No: HL1635 | JULY 2019

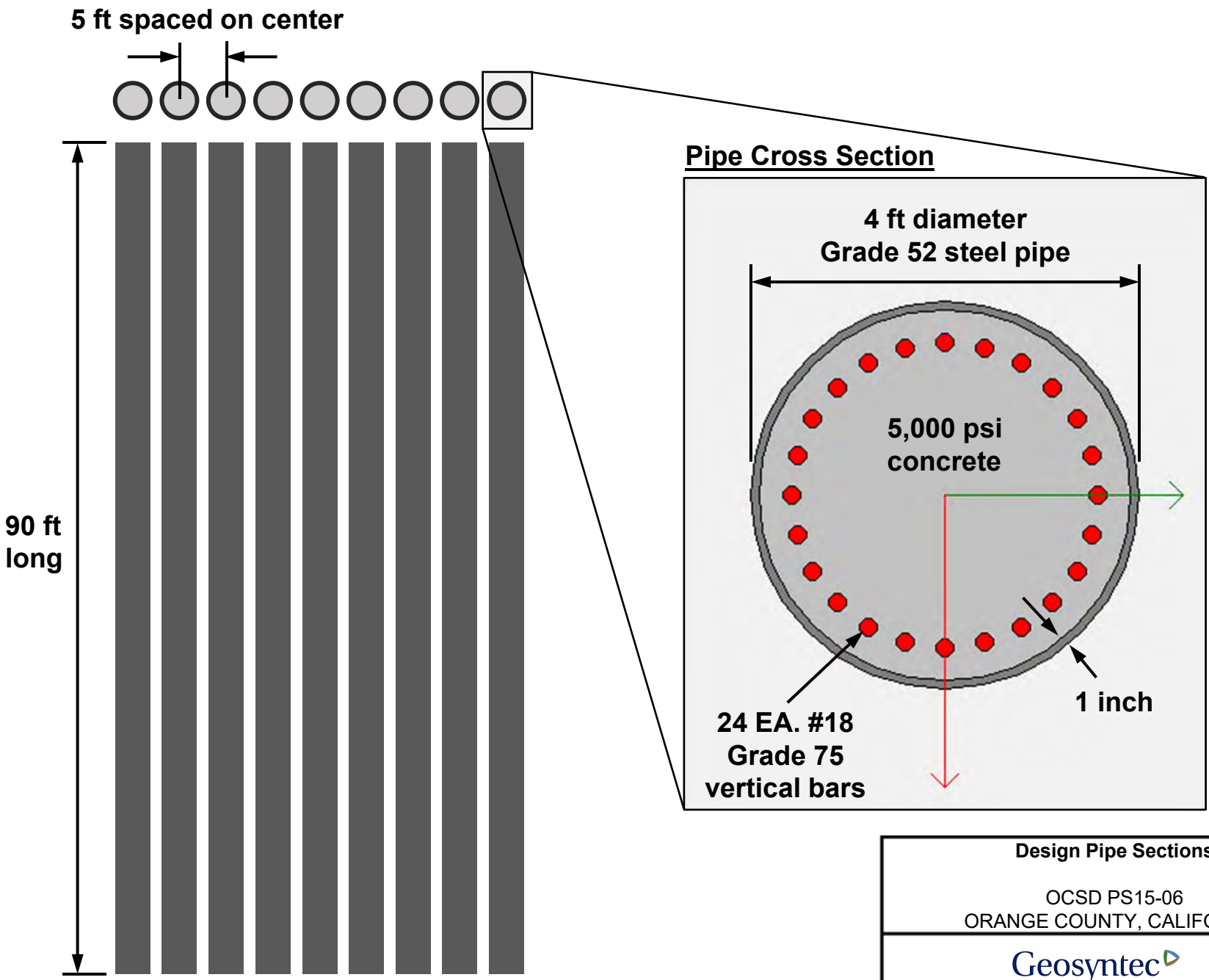


Idealized Soil Profile, Lateral Spread Displacement, Lateral Earth Pressure Distribution, and Pipe Deflection
OCSD PS15-06
ORANGE COUNTY, CALIFORINA

Geosyntec consultants

Figure 2

Project No: HL1635 | JULY 2019



Design Pipe Sections

OCSD PS15-06
ORANGE COUNTY, CALIFORINA

Geosyntec consultants

Figure 3

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Geosyntec
consultants

APPENDIX H

Likelihood and Consequence of Each PFM, by Structure

General Notes and Legend

1 GS = ground shaking, DS = differential settlement, LS = lateral spread

2 Equals CoSF score times weighting percentage

CoSF Weighting	
Category	**Percentage**
Life Safety	100.0%
Primary Treatment	100.0%
Regulatory	80.0%
Stakeholder	37.5%
Financial	80.0%
Public Impact	0.0%

3 LoSF score index:
0 = meets performance objective
1 = low likelihood
3 = medium likelihood
5 = high likelihood

4 CoSF score index for Life Safety:
1 = Meets performance objectives for life safety.
2 =Failure presenting life safety risk for structures with occupancy less than 2,000 person-hours per year.
3 =Failure presenting life safety risk for structures with occupancy from 2,000 to 10,000 person-hours per year.
4 = Failure presenting life safety risk for structures with occupancy from 10,000 to 20,000 person-hours per year.
5 = Failure presenting life safety risk for structures with occupancy greater than 20,000 person-hours per year.

5 CoSF score index for Primary Treatment and Primary Solids Handling (Digestion/Thickening/Hauling):
1=Meets objectives for receiving wastewater into the plant and discharging wastewater from the plant with at least a primary level of treatment plus primary solids handling, without interruption.
2=Minor impact to receiving wastewater into the plant and/or discharging wastewater from the plant with at least a primary level of treatment plus primary solids handling.
3=Short term (~1 week) failure to receive wastewater into the plant and/or discharge wastewater from the plant with at least a primary level of treatment plus primary solids handling.
4=Medium term (1-6 weeks) failure to receive wastewater into the plant and/or discharge wastewater from the plant with at least a primary level of treatment plus primary solids handling.
5=Long term (>6 weeks) failure to receive wastewater into the plant and/or discharge wastewater from the plant with at least a primary level of treatment plus primary solids handling.

6 CoSF score index for Regulatory Attainment:
1=Meets LOS targets for spill management secondary treatment standards, effluent water quality, and health and safety goals, including release of digester gas.
2=Minor impact to meeting LOS targets for spill management secondary treatment standards, effluent water quality, and health and safety goals,including release of digester gas.
3=Short term (~1 month) failure to meet LOS targets for spill management, secondary treatment standards, effluent water quality, and health and safety goals, including release of digester gas
4=Medium term (1-6 months) failure to meet LOS targets for spill management secondary treatment standards, effluent water quality, and health and safety goals, including release of digester gas.
5=Long term (>6 months) failure to meet LOS targets for spill management, secondary treatment standards, effluent water quality, and health and safety goals, including release of digester gas

7 CoSF score index for Stakeholder Commitments
1=Meets LOS targets for GWRS source water quality and quantity and other stakeholder expectations.
2=Minor impact to meeting LOS targets for GWRS source water quality and quantity and other stakeholder expectations.
3=Short term (~1 month) failure to meet LOS targets for GWRS source water quality and quantity and other stakeholder expectations.
4=Medium term (1-6 months) failure to meet LOS targets for GWRS source water quality and quantity and other stakeholder expectations.
5=Long term (>6 months) failure to meet LOS targets for GWRS source water quality and quantity and other Stakeholder expectations.

8 CoSF score for Financial Impacts:
1 =No identified financial impact. Meets LOS target for balanced O&M budget and maintains AAA bond rating.
2 =Low costs (to repair or replace facility and address other financial impacts).
3 = Medium costs (to repair or replace facility and address other financial impacts).
4 = High costs (to repair or replace facility and address other financial impacts).
5 = Very high costs (to repair or replace facility and address other financial impacts).

9 CoSF score for Public Impacts:
1=Meets LOS targets for odor complaints and response time.
2=Minor impact to meeting LOS targets for odor complaints and response time.
3=Short term (~1 month) failure to meet LOS targets for odor complaints and response time.
4=Medium term (1-6 months) failure to meet LOS targets for odor complaints and response time.
5=Long term (>6 months) failure to meet LOS targets for odor complaints and response time.

Risk Ranking Analysis

Structure 1-1 Waste Sludge Thickeners (DAFT) Pump Room

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
2	Wall anchorage to the roof at east and west walls of the north building	0.7	1.1	1	GS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.2	3.0	3.0
3	Roof diaphragm shear	10.3	6.5	5	GS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.2	3.0	15.0
4	Discontinuous shear walls	> 1.0	> 1.0	3	GS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.2	3.0	9.0
7	Bending/shear failure of piles due to lateral spread (surface PGD = 27-inches)	2.2	3.4	5	LS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.2	3.0	15.0

Facility Notes:

1 to 9 See General Notes and Legend

Inability to trasfer WAS to thicking has moderate regulatory impact for secondary treatment (e.g. Regulatory)

Overall Score	**15.0**
GS Score	15.0
DS Score	0.0
LS Score	15.0

Risk Ranking Analysis

Structure 1-1 Waste Sludge Thickeners (DAFT) Pump Room

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
2	Wall anchorage to the roof at east and west walls of the north building	1.1	N/A	1	GS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.2	3.0	3.0
3	Roof diaphragm shear	10.1	N/A	5	GS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.2	3.0	15.0
4	Discontinuous shear walls	> 1.0	N/A	3	GS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.2	3.0	9.0
7	Bending/shear failuer of piles due to lateral spread (surface PGD = 27-inches)	2.2	N/A	5	LS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.2	3.0	15.0

Facility Notes:

1 to 9 See General Notes and Legend

Inability to trasfer WAS to thicking has moderate regulatory impact for secondary treatment (e.g. Regulatory)

Overall Score	**15.0**
GS Score	15.0
DS Score	0.0
LS Score	15.0

Risk Ranking Analysis

Structure 1-2 Blower Building and PEPS

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
2	Wall anchorage to the roof at the north and south walls of the Blower Building	8.3	12.4	5	GS	3	1	5	5	5	1	3.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0
3	Wall anchorage to the roof at the north and south walls of the PEPS Building	0.8	1.2	2	GS	3	1	5	5	5	1	3.0	1.0	4.0	1.9	4.0	0.2	4.0	8.0
4	Wall anchorage to the roof at the east and west walls of the PEPS Building	9.3	14.0	5	GS	3	1	5	5	5	1	3.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0
5	Roof diaphragm shear	1.5	2.3	5	GS	3	1	5	5	5	1	3.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Inability to provide full secondary treatment at Plant 1 has severe impacts for regulatory compliance and ability to deliver secondary effluent to OCWD stakeholder

Overall Score	**20.0**
GS Score	20.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-2 Blower Building and PEPS

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
2	Wall anchorage to the roof at the north and south walls of the Blower Building	12.4	N/A	5	GS	3	1	5	5	5	1	3.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0
3	Wall anchorage to the roof at the north and south walls of the PEPS Building	1.2	N/A	2	GS	3	1	5	5	5	1	3.0	1.0	4.0	1.9	4.0	0.2	4.0	8.0
4	Wall anchorage to the roof at the east and west walls of the PEPS Building	14.0	N/A	5	GS	3	1	5	5	5	1	3.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0
5	Roof diaphragm shear	2.3	N/A	5	GS	3	1	5	5	5	1	3.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Inability to provide full secondary treatment at Plant 1 has severe impacts for regulatory compliance and ability to deliver secondary effluent to OCWD stakeholder

Overall Score	**20.0**
GS Score	20.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-3 Plant Water Pump Station and Power Building 6

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
2	Wall anchorage to the roof at east and west walls	1.7	2.6	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
3	Drag connection at the re-entrant corner	< 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
6	Bending/shear failure of piles due to lateral spread (surface PGD = 40-inches)	3.0	4.6	5	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	0.0
LS Score	10.0

Risk Ranking Analysis

Structure 1-3 Plant Water Pump Station and Power Building 6

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
2	Wall anchorage to the roof at east and west walls	2.6	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
3	Drag connection at the re-entrant corner	< 1.0	N/A	0	GS	1	1	1	1	1	1	1.0	1.0	0.8	0.4	0.8	0.2	1.0	0.0
6	Bending/shear failure of piles due to lateral spread (surface PGD = 40-inches)	3.0	N/A	5	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	0.0
LS Score	10.0

Risk Ranking Analysis

Structure 1-4 City Water Pump Station

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Footings move independent of the wall	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
3	Wall anchorage at east and west walls	3.9	5.9	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
4	In-plane shear at south pier between louvers	1.0	1.5	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
5	Out-of-plane horizontal bending at east and west walls due to ground shaking	1.2	1.8	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
6	Out-of-plane horizontal bending in east and west walls due to ground deformation	2.0	2.0	5	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
7	Tension failure in the CMU walls due to ground deformation	2.8	2.8	5	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
8	Tension failure in the concrete stem wall due to ground deformation	0.9	1.4	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	8.0
9	Lateral spread toward the Santa Ana River	> 1.0	> 1.0	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0

	Overall Score	**10.0**
	GS Score	10.0
	DS Score	10.0
	LS Score	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Risk Ranking Analysis

Structure 1-4 City Water Pump Station

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Footings move independent of the wall	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
3	Wall anchorage at east and west walls	5.9	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
4	In-plane shear at south pier between louvers	2.2	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
5	Out-of-plane horizontal bending at east and west walls due to ground shaking	1.8	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
6	Out-of-plane horizontal bending in east and west walls due to ground deformation	2.0	N/A	5	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
7	Tension failure in the CMU walls due to ground deformation	2.8	N/A	5	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
8	Tension failure in the concrete stem wall due to ground deformation	2.7	N/A	5	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
9	Lateral spread toward the Santa Ana River	> 1.0	N/A	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	10.0
LS Score	6.0

Risk Ranking Analysis

Structure 1-5 Power Building 2

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Walls/footing are not tied together	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
2	Wall anchorage at the north and south walls of the low roof	> 1.0	> 1.0	1	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	2.0
7	Tension failure in the CMU walls due to ground deformation	> 1.0	> 1.0	3	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
8	Lateral spread toward the Santa Ana River due to liquefaction	> 1.0	> 1.0	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	6.0
DS Score	6.0
LS Score	6.0

Risk Ranking Analysis

Structure 1-5 Power Building 2

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Walls/footing are not tied together	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
2	Wall anchorage at the north and south walls of the low roof	> 1.0	N/A	1	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	2.0
7	Tension failure in the CMU walls due to ground deformation	> 1.0	N/A	3	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
8	Lateral spread toward the Santa Ana River due to liquefaction	> 1.0	N/A	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	6.0
DS Score	6.0
LS Score	6.0

Risk Ranking Analysis

Structure 1-6 Power Building 4

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
3	Incomplete load path at the north side of the high roof diaphragm	> 1.0	> 1.0	4	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**8.0**
GS Score	8.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-6 Power Building 4

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
3	Incomplete load path at the north side of the high roof diaphragm	> 1.0	N/A	4	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**8.0**
GS Score	8.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-7 Power Building 5

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
2	Wall anchorage at the east and west walls to the roof diaphragm	1.5	2.2	5	GS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	10.0
5	Structure response to differential settlement due to liquefaction	< 1.0	> 1.0	3	DS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	6.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-7 Power Building 5

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
2	Wall anchorage at the east and west walls to the roof diaphragm	2.2	N/A	5	GS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	10.0
5	Structure response to differential settlement due to liquefaction	> 1.0	N/A	3	DS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	6.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-8 Control Center

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
2	Moment frame column anchorage is not adequate to resist seismic tension demands	9.9	9.9	5	GS	5	2	2	2	2	1	5.0	2.0	1.6	0.8	1.6	0.2	5.0	25.0
4	2nd Floor diaphragm shear transfer	> 1.0	> 1.0	2	GS	5	2	2	2	2	1	5.0	2.0	1.6	0.8	1.6	0.2	5.0	10.0
5	Moment frame connection strength	3.2	3.2	5	GS	5	2	2	2	2	1	5.0	2.0	1.6	0.8	1.6	0.2	5.0	25.0
6	Moment frame panel zone shear strength	0.5	2.8	5	GS	5	2	2	2	2	1	5.0	2.0	1.6	0.8	1.6	0.2	5.0	25.0
10	Moment frame beam flexure	0.6	1.9	5	GS	5	2	2	2	2	1	5.0	2.0	1.6	0.8	1.6	0.2	5.0	25.0

Facility Notes:

1 to 9 See General Notes and Legend

Control Building out of service will have minor impact to Primary Treatment and ability to meet regulatory requirements

Overall Score	**25.0**
GS Score	25.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-8 Control Center

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
2	Moment frame column anchorage is not adequate to resist seismic tension demands	15.4	N/A	5	GS	5	2	2	2	2	1	5.0	2.0	1.6	0.8	1.6	0.2	5.0	25.0
4	2nd Floor diaphragm shear transfer	> 1.0	N/A	2	GS	5	2	2	2	2	1	5.0	2.0	1.6	0.8	1.6	0.2	5.0	10.0
5	Moment frame connection strength	5.0	N/A	5	GS	5	2	2	2	2	1	5.0	2.0	1.6	0.8	1.6	0.2	5.0	25.0

Facility Notes:		Overall Score	**25.0**
1 to 9	See General Notes and Legend	GS Score	25.0
	Control Building out of service will have minor impact to Primary Treatment and ability to meet regulatory requirements	DS Score	0.0
		LS Score	0.0

Risk Ranking Analysis

Structure 1-9 12kV Service Center

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
2	Wall anchorage to roof at east and west walls	3.3	5.0	5	GS	2	5	5	5	3	1	2.0	5.0	4.0	1.9	2.4	0.2	5.0	25.0

Facility Notes:

1 to 9 See General Notes and Legend

Loss of 12 KV service center will severly impact all plant operations, particularly if CenGen is damaged (See Structure 1-10)

Overall Score	**25.0**
GS Score	25.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-9 12kV Service Center

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
2	Wall anchorage to roof at east and west walls	5.0	N/A	5	GS	2	5	5	3	3	1	2.0	5.0	4.0	1.1	2.4	0.2	5.0	25.0

Facility Notes:

1 to 9 See General Notes and Legend

Loss of 12 KV service center will severly impact all plant operations, particularly if CenGen is damaged (See Structure 1-10)

Overall Score	**25.0**
GS Score	25.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure: 1-10 Central Power Generation Building

Seismic Hazard Level: BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Lack of lateral bracing along the east side of the high roof diaphragm	> 1.0	> 1.0	5	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	20.0
2	Lack of lateral bracing along the west side of the low roof and 2nd floor at the basement level	> 1.0	> 1.0	4	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	16.0
3	Insufficient lateral bracing along the west side of the building	1.1	1.4	4.0	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	16.0
4	Wall anchorage at the high roof north and south walls	13.3	20.0	5.0	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	20.0
5	High roof diaphragm shear	1.6	1.6	5.0	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	20.0
6	Low roof diaphragm shear	1.6	1.6	5.0	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	20.0
9	Out-of-plane bending on the buried walls due to liquefied soil conditions	0.8	1.1	1	LS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	4.0

Facility Notes:		Overall Score	**20.0**
1 to 9	See General Notes and Legend	GS Score	20.0
	Extreemly high financial risk due to value of CenGen	DS Score	0.0
		LS Score	4.0

Risk Ranking Analysis

Structure 1-10 Central Power Generation Building

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Lack of lateral bracing along the east side of the high roof diaphragm	> 1.0	N/A	5	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	20.0
2	Lack of lateral bracing along the west side of the low roof and 2nd floor at the basement level	> 1.0	N/A	4	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	16.0
3	Insufficient lateral bracing along the west side of the building	1.7	N/A	5.0	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	20.0
4	Wall anchorage at the high roof north and south walls	20.0	N/A	5.0	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	20.0
5	High roof diaphragm shear	2.5	N/A	5.0	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	20.0
6	Low roof diaphragm shear	2.5	N/A	5.0	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	20.0
10	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.1	N/A	1	LS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.2	4.0	4.0

Facility Notes:

1 to 9 See General Notes and Legend

Extreemly high financial risk due to value of CenGen

Overall Score	**20.0**
GS Score	20.0
DS Score	0.0
LS Score	4.0

Risk Ranking Analysis

Structure 1-11 Aeration Basins 1-10

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
	No PFM Found	< 1.0	< 1.0	0	GS	1	1	5	5	5	1	1.0	1.0	4.0	1.9	4.0	0.2	4.0	0.0

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Risk Ranking Analysis

Structure 1-11 Aeration Basins 1-10

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
	No PFM Found	< 1.0	N/A	0	GS	1	1	5	5	5	1	1.0	1.0	4.0	1.9	4.0	0.2	4.0	0.0

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Risk Ranking Analysis

Structure 1-12 Secondary Clarifiers 1-26

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
6	Separation across expansion joints due to lateral spread towards the Santa Ana River	> 1.0	> 1.0	5	LS	2	1	5	5	5	1	2.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0
8	Failure of conveyor supporting structure due to lateral spread towards the Santa Ana River	> 1.0	> 1.0	5	LS	2	1	5	5	5	1	2.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0
12	Bending/shear failure of piles due to lateral spread	2.0	2.5	5	LS	2	1	5	5	5	1	2.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	0.0
DS Score	0.0
LS Score	20.0

Risk Ranking Analysis

Structure 1-12 Secondary Clarifiers 1-26

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
6	Separation across expansion joints due to lateral spread towards the Santa Ana River	> 1.0	N/A	5	LS	2	1	5	5	5	1	2.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0
8	Failure of conveyor supporting structure due to lateral spread towards the Santa Ana River	> 1.0	N/A	5	LS	2	1	5	5	5	1	2.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0
12	Bending/shear failure of piles due to lateral spread	2.4	N/A	5	LS	2	1	5	5	5	1	2.0	1.0	4.0	1.9	4.0	0.2	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	0.0
DS Score	0.0
LS Score	20.0

Risk Ranking Analysis

Structure	**1-13 Digester 5**
Seismic Hazard Level	**BSE 1E**

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	**Description**	**DCR/m (LS)**	**DCR/m (IO)**	**LoSF Score[3]**	**PFM Type[1]**	**Life Safety**	**Primary Treatment**	**Regulatory**	**Stakeholder**	**Financial**	**Public Impacts**	**Life Safety 100.0%**	**Primary Trtmnt 100.0%**	**Regulatory 80.0%**	**Stakeholder 37.5%**	**Financial 80.0%**	**Public Impacts 16.5%**	**CoSF Score**	**RoSF Score**
	No PFM Found	< 1.0	< 1.0	0	GS	1	1	1	1	2	1	1.0	1.0	0.8	0.4	1.6	0.2	1.6	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-13 Digester 5

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
	No PFM Found	< 1.0	N/A	0	GS	1	1	1	1	2	1	1.0	1.0	0.8	0.4	1.6	0.2	1.6	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-14 Digester 5 & 6 Pump Room

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Footings move independent of the wall	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
2	Insufficient separation from adjacent digesters	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
3	Torsional response of roof diaphragm	>1.0	> 1.0	2	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	4.0
5	Tension failure in the concrete walls due to ground deformation	>1.0	> 1.0	3	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	6.0
DS Score	6.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-14 Digester 5 & 6Pump Room

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Footings move independent of the wall	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
2	Insufficient separation from adjacent digesters	> 1.0	N/A	3	GS	2	1	1	1	1	2	2.0	1.0	0.8	0.4	0.8	0.3	2.0	6.0
3	Torsional response of roof diaphragm	> 1.0	N/A	2	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	4.0
5	Tension failure in the concrete walls due to ground deformation	> 1.0	N/A	3	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	6.0
DS Score	6.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-15 Digester 6

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
	No PFM Found	< 1.0	< 1.0	0	GS	1	1	1	1	2	1	1.0	1.0	0.8	0.4	1.6	0.2	1.6	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-15 Digester 6

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
	No PFM Found	< 1.0	N/A	0	GS	1	1	1	1	2	1	1.0	1.0	0.8	0.4	1.6	0.2	1.6	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-16 Digester 7

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
10	Bending/shear failure of piles due to lateral spread (surface PGD = 19-inches)	0.8	1.3	3	LS	2	1	3	1	2	1	2.0	1.0	2.4	0.4	1.6	0.2	2.4	7.2

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**7.2**
GS Score	0.0
DS Score	0.0
LS Score	7.2

Risk Ranking Analysis

Structure 1-16 Digester 7

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
10	Bending/shear failure of piles due to lateral spread (surface PGD = 19-inches)	1.3	N/A	3	LS	2	1	3	1	2	1	2.0	1.0	2.4	0.4	1.6	0.2	2.4	7.2

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**7.2**
GS Score	0.0
DS Score	0.0
LS Score	7.2

Risk Ranking Analysis

Structure 1-17 Digester 7 & 8 Pump Room

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
1	Footings move independent of the wall	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
2	Insufficient separation from adjacent digesters	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
6	Differential lateral spread between Digesters nos. 7 and 8 due to liquefaction	> 1.0	> 1.0	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	6.0
DS Score	0.0
LS Score	6.0

Risk Ranking Analysis

Structure 1-17 Digester 7 & 8 Pump Room

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
1	Footings move independent of the wall	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
2	Insufficient separation from adjacent digesters	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
6	Differential lateral spread between Digesters nos. 7 and 8 due to liquefaction	> 1.0	N/A	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	6.0
DS Score	0.0
LS Score	6.0

Risk Ranking Analysis

Structure 1-18 Digester 8

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
10	Bending/shear failure of piles due to lateral spread (surface PGD = 18-inches)	0.8	1.3	3	LS	2	1	3	1	2	1	2.0	1.0	2.4	0.4	1.6	0.2	2.4	7.2

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**7.2**
GS Score	0.0
DS Score	0.0
LS Score	7.2

Risk Ranking Analysis

Structure 1-18 Digester 8

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
10	Bending/shear failure of piles due to lateral spread (surface PGD = 18-inches)	1.2	N/A	2	LS	2	1	3	1	2	1	2.0	1.0	2.4	0.4	1.6	0.2	2.4	4.8

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**4.8**
GS Score	0.0
DS Score	0.0
LS Score	4.8

Risk Ranking Analysis

Structure 1-19 Digesters 9-10

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
10	Bending/shear failure of piles due to lateral spread (surface PGD = 40-inches)	2.0	3.0	5	LS	2	1	3	1	2	1	2.0	1.0	2.4	0.4	1.6	0.2	2.4	12.0

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**12.0**
GS Score	0.0
DS Score	0.0
LS Score	12.0

Risk Ranking Analysis

Structure 1-19 Digesters 9-10

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
10	Bending/shear failure of piles due to lateral spread (surface PGD = 40-inches)	2.7	N/A	5	LS	2	1	3	1	2	1	2.0	1.0	2.4	0.4	1.6	0.2	2.4	12.0

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**12.0**
GS Score	0.0
DS Score	0.0
LS Score	12.0

Risk Ranking Analysis

Structure 1-20 Digesters 9-10 Pump Room

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Footings move independent of the wall	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
2	Insufficient separation from adjacent digesters	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
3	Torsional response of roof diaphragm	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
4	Diaphragm connections at re-entrant corner	> 1.0	> 1.0	1	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	2.0
7	Lateral spread toward the Santa Ana River due to liquefaction	> 1.0	> 1.0	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
8	Differential lateral spread between Digesters nos. 9 and 10 due to liquefaction	> 1.0	> 1.0	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	6.0
DS Score	0.0
LS Score	6.0

Risk Ranking Analysis

Structure 1-20 Digesters 9-10 Pump Room

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
1	Footings move independent of the wall	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
2	Insufficient separation from adjacent digesters	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
3	Torsional response of roof diaphragm	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
4	Diaphragm connections at re-entrant corner	> 1.0	N/A	1	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	2.0
7	Lateral spread toward the Santa Ana River due to liquefaction	> 1.0	N/A	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
8	Differential lateral spread between Digesters nos. 9 and 10 due to liquefaction	> 1.0	N/A	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	6.0
DS Score	0.0
LS Score	6.0

Risk Ranking Analysis

Structure 1-21 Digesters 11-16

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
10	Digesters 11-12: Bending/shear failure of piles due to lateral spread (surface PGD = 16-inches)	0.8	>1.0	1	LS	2	1	3	1	4	1	2.0	1.0	2.4	0.4	3.2	0.2	3.2	3.2
10	Digesters 13-16: Bending/shear failure of piles due to lateral spread (surface PGD > 35-inches)	1.7	2.5	5	LS	2	1	3	1	4	1	2.0	1.0	2.4	0.4	3.2	0.2	3.2	16.0

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**16.0**
GS Score	0.0
DS Score	0.0
LS Score	16.0

Risk Ranking Analysis

Structure 1-21 Digesters 11-16

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
10	Digesters 11-12: Bending/shear failure of piles due to lateral spread (surface PGD = 16-inches)	1.1	N/A	1	LS	2	1	3	1	4	1	2.0	1.0	2.4	0.4	3.2	0.2	3.2	3.2
10	Digesters 13-16: Bending/shear failure of piles due to lateral spread (surface PGD > 35-inches)	2.3	N/A	5	LS	2	1	3	1	4	1	2.0	1.0	2.4	0.4	3.2	0.2	3.2	16.0

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**16.0**
GS Score	0.0
DS Score	0.0
LS Score	16.0

Risk Ranking Analysis

Structure 1-22 Digester 11-14 Pump Room

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Insufficient separation from adjacent digesters causes structure pounding	> 1.0	> 1.0	3	GS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	6.0
2	In-plane wall shear at shear walls	1.1	1.7	5	GS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	10.0
3	Column shear at moment frames	2.9	4.4	5	GS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	10.0
5	Bending/shear sailure of piles due to lateral spread (surface PGD = 26-inches)	1.0	1.5	5	LS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	10.0
6	Differential lateral spread between Digesters nos. 11-14 due to liquefaction	> 1.0	> 1.0	3	LS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	0.0
LS Score	10.0

Risk Ranking Analysis

Structure 1-22 Digester 11-14 Pump Room

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Insufficient separation from adjacent digesters causes structure pounding	> 1.0	N/A	3	GS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	6.0
2	In-plane wall shear at shear walls	1.3	N/A	3	GS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	6.0
3	Column shear at moment frames	4.4	N/A	5	GS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	10.0
6	Differential lateral spread between Digesters nos. 11-14 due to liquefaction	> 1.0	N/A	3	LS	2	1	1	1	2	1	2.0	1.0	0.8	0.4	1.6	0.2	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	0.0
LS Score	6.0

Risk Ranking Analysis

Structure 1-23 Digester 15-16 Pump Room

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Insufficient separation from adjacent digesters	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
2	Discontinuous shear walls at the south elevation	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
3	In-plane wall shear at shear walls	0.7	1.3	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
4	Column shear at moment frames	2.6	3.9	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0
6	Bending/shear failure of piles due to lateral spread (surface PGD = 20-inches)	0.9	1.4	4	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	0.0
LS Score	8.0

Risk Ranking Analysis

Structure 1-23 Digester 15-16 Pump Room

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
1	Insufficient separation from adjacent digesters	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
2	Discontinuous shear walls at the south elevation	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	6.0
3	In-plane wall shear at shear walls	1.0	N/A	0	GS	1	1	1	1	1	1	1.0	1.0	0.8	0.4	0.8	0.2	1.0	0.0
4	Column shear at moment frames	3.9	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.2	2.0	10.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-24 Gas Holder

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
6	Tank shell overstress due to liquefaction-induced lateral spread and settlements	1.1	1.1	1	DS	2	1	3	1	1	1	2.0	1.0	2.4	0.4	0.8	0.2	2.4	2.4
7	Anchor failure overstress due to liquefaction-induced lateral spread and settlements	1.2	1.2	1	DS	2	1	3	1	1	1	2.0	1.0	2.4	0.4	0.8	0.2	2.4	2.4

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**2.4**
GS Score	0.0
DS Score	2.4
LS Score	0.0

Risk Ranking Analysis

Structure 1-24 Gas Holder

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
6	Tank shell overstress due to liquefaction-induced lateral spread and settlements	1.0	N/A	0	DS	1	1	3	1	1	1	1.0	1.0	2.4	0.4	0.8	0.2	2.4	0.0
7	Anchor failure overstress due to liquefaction-induced lateral spread and settlements	1.0	N/A	0	DS	1	1	3	1	1	1	1.0	1.0	2.4	0.4	0.8	0.2	2.4	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-25 Effluent Junction Box

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
4	Shear failure of piles due to lateral spread towards the Santa Ana River	1.1	1.1	1	LS	2	5	5	1	1	1	2.0	5.0	4.0	0.4	0.8	0.2	5.0	5.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**5.0**
GS Score	0.0
DS Score	0.0
LS Score	5.0

Risk Ranking Analysis

Structure 1-25 Effluent Junction Box

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
4	Shear failure of piles due to lateral spread towards the Santa Ana River	1.2	N/A	2	LS	2	5	5	1	1	1	2.0	5.0	4.0	0.4	0.8	0.2	5.0	10.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	0.0
DS Score	0.0
LS Score	10.0

Risk Ranking Analysis

Structure	**1-26 Solids Storage Facility**
Seismic Hazard Level	**BSE 1E**

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	**Description**	**DCR/m (LS)**	**DCR/m (CP)**	**LoSF Score[3]**	**PFM Type[1]**	**Life Safety**	**Primary Treatment**	**Regulatory**	**Stakeholder**	**Financial**	**Public Impacts**	**Life Safety 100.0%**	**Primary Trtmnt 100.0%**	**Regulatory 80.0%**	**Stakeholder 37.5%**	**Financial 80.0%**	**Public Impacts 16.5%**	**CoSF Score**	**RoSF Score**
1	Building pounding due to response to ground shaking	> 1.0	N/A	2	GS	3	1	1	1	3	1	3.0	1.0	0.8	0.4	2.4	0.2	3.0	6.0
5	Bending/shear failure of piles at the south structure due to lateral spread (surface PGD = 18-inches)	1.1	N/A	1	LS	3	1	1	1	3	1	3.0	1.0	0.8	0.4	2.4	0.2	3.0	3.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	6.0
DS Score	0.0
LS Score	3.0

Risk Ranking Analysis

Structure 1-26 Solids Storage Facility

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
1	Building pounding due to response to ground shaking	N/A	> 1.0	2	GS	3	1	1	1	3	1	3.0	1.0	0.8	0.4	2.4	0.2	3.0	6.0
5	Bending/shear failure of piles at the south structure due to lateral spread (surface PGD = 18-inches)	N/A	1.5	5	LS	3	1	1	1	3	1	3.0	1.0	0.8	0.4	2.4	0.2	3.0	15.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**15.0**
GS Score	6.0
DS Score	0.0
LS Score	15.0

Risk Ranking Analysis

Structure 1-27 Chiller Building

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
	No PFM Found	< 1.0	N/A	0	GS	1	1	1	1	1	1	1.0	1.0	0.8	0.4	0.8	0.2	1.0	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-27 Chiller Building

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
	No PFM Found	N/A	< 1.0	0	GS	1	1	1	1	1	1	1.0	1.0	0.8	0.4	0.8	0.2	1.0	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-28 Warehouse Building

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Wall panels are not tied to the footings	> 1.0	> 1.0	3	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	15.0
6	Wall panels are not tied together to resist overturning	>1.0	> 1.0	3	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	15.0
8	Tension failure in the walls due to differential settlement	> 1.0	> 1.0	3	DS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	15.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**15.0**
GS Score	15.0
DS Score	15.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-28 Warehouse Building

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Wall panels are not tied to the footings	> 1.0	N/A	3	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	15.0
6	Wall panels are not tied together to resist overturning	< 1.0	N/A	0	GS	1	1	1	1	1	1	1.0	1.0	0.8	0.4	0.8	0.2	1.0	0.0
8	Tension failure in the walls due to differential settlement	> 1.0	N/A	3	DS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	15.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**15.0**
GS Score	15.0
DS Score	15.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-29 Shop Building A

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
1	Wall panels are not tied to the footing	> 1.0	N/A	3	GS	4	1	1	1	1	1	4.0	1.0	0.8	0.4	0.8	0.2	4.0	12.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**12.0**
GS Score	12.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-29 Shop Building A

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Wall panels are not tied to the footing	N/A	> 1.0	3	GS	4	1	1	1	1	1	4.0	1.0	0.8	0.4	0.8	0.2	4.0	12.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**12.0**
GS Score	12.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-30 Shop Building B and Building 3

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Wall panels are not tied to the footings	> 1.0	N/A	3	GS	4	1	1	1	1	1	4.0	1.0	0.8	0.4	0.8	0.2	4.0	12.0
5	Wall anchorage of the roof at the south wall of Bldg 3	1.6	N/A	5	GS	4	1	1	1	1	1	4.0	1.0	0.8	0.4	0.8	0.2	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	20.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-30 Shop Building B and Building 3

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
1	Wall panels are not tied to the footings	N/A	> 1.0	3	GS	4	1	1	1	1	1	4.0	1.0	0.8	0.4	0.8	0.2	4.0	12.0
5	Wall anchorage of the roof at the south wall of Bldg 3	N/A	2.4	5	GS	4	1	1	1	1	1	4.0	1.0	0.8	0.4	0.8	0.2	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	20.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-31 Buildings 5 and 6

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Wall panels are not tied to the footings	> 1.0	N/A	3	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	15.0
4	Wall anchorage of the 2nd floor	1.2	N/A	2	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	10.0
6	Bending failure of beams over chevron braced frames	3.5	N/A	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	25.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**25.0**
GS Score	25.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-31 Buildings 5 and 6

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Wall panels are not tied to the footings	N/A	> 1.0	3	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	15.0
4	Wall anchorage of the 2nd floor	N/A	1.8	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	25.0
6	Bending failure of beams over chevron braced frames	N/A	3.5	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.2	5.0	25.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**25.0**
GS Score	25.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-32 Auto Shop

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Wall panels are not tied to the footings	> 1.0	N/A	3	GS	4	1	1	1	1	1	4.0	1.0	0.8	0.4	0.8	0.2	4.0	12.0
4	Wall anchorage of the low roof at the north and south side	1.1	N/A	1	GS	4	1	1	1	1	1	4.0	1.0	0.8	0.4	0.8	0.2	4.0	4.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**12.0**
GS Score	12.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-32 Auto Shop

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Wall panels are not tied to the footings	N/A	> 1.0	3	GS	4	1	1	1	1	1	4.0	1.0	0.8	0.4	0.8	0.2	4.0	12.0
4	Wall anchorage of the low roof at the north and south side	N/A	1.7	5	GS	4	1	1	1	1	1	4.0	1.0	0.8	0.4	0.8	0.2	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	20.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-33 PEDB2

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
	No PFM Found	< 1.0	< 1.0	0	GS	1	5	5	5	1	1	1.0	5.0	4.0	1.9	0.8	0.2	5.0	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-33 PEDB2

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
2	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.2	N/A	2	DS	2	5	1	5	1	1	2.0	5.0	0.8	1.9	0.8	0.2	5.0	10.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	0.0
DS Score	10.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-34 Central Laboratory

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%		
1	Braced frame column axial stress due to overturning forces	2.9	4.3	5	GS	5	1	1	1	2	1	5.0	1.0	0.8	0.4	1.6	0.2	5.0	25.0
2	2nd floor diaphragm seismic load transfer to braced frames	2.9	4.4	5	GS	5	1	1	1	2	1	5.0	1.0	0.8	0.4	1.6	0.2	5.0	25.0
3	Out-of-plane bracing of braced frame beams	< 1.0	> 1.0	3	GS	5	1	1	1	2	1	5.0	1.0	0.8	0.4	1.6	0.2	5.0	15.0
4	Braces for braced frames are non-compact	> 1.0	> 1.0	3	GS	5	1	1	1	2	1	5.0	1.0	0.8	0.4	1.6	0.2	5.0	15.0
5	Bending failure of beams over chevron-braced frames	6.5	6.5	5	GS	5	1	1	1	2	1	5.0	1.0	0.8	0.4	1.6	0.2	5.0	25.0
6	Connection strength at braces	1.9	2.8	5	GS	5	1	1	1	2	1	5.0	1.0	0.8	0.4	1.6	0.2	5.0	25.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**25.0**
GS Score	25.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 1-34 Central Laboratory

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 16.5%	CoSF Score	RoSF Score
1	Braced frame column axial stress due to overturning forces	4.3	N/A	5	GS	5	1	1	1	2	1	5.0	1.0	0.8	0.4	1.6	0.2	5.0	25.0
4	Braces for braced frames are non-compact	> 1.0	N/A	3	GS	5	1	1	1	2	1	5.0	1.0	0.8	0.4	1.6	0.2	5.0	15.0
5	Bending failure of beams over chevron-braced frames	6.5	N/A	5	GS	5	1	1	1	2	1	5.0	1.0	0.8	0.4	1.6	0.2	5.0	25.0
6	Connection strength at braces	2.8	N/A	5	GS	5	1	1	1	2	1	5.0	1.0	0.8	0.4	1.6	0.2	5.0	25.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**25.0**
GS Score	25.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-1 DAFT A-C Gallery

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
6	Structure response to differential settlement due to liquefaction	> 1.0	> 1.0	3	DS	3	1	2	1	1	1	3.0	1.0	1.6	0.4	0.8	0.0	3.0	9.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**9.0**
GS Score	0.0
DS Score	9.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-1 DAFT A-C Gallery

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
6	Structure response to differential settlement due to liquefaction	> 1.0	N/A	3	DS	3	1	2	1	1	1	3.0	1.0	1.6	0.4	0.8	0.0	3.0	9.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**9.0**
GS Score	0.0
DS Score	9.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-2 DAFT D Gallery & WSSPS

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Lateral spread towards the Talbert Marsh due to liquefaction	> 1.0	> 1.0	3	LS	2	1	2	1	1	1	2.0	1.0	1.6	0.4	0.8	0.0	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	0.0
DS Score	0.0
LS Score	6.0

Risk Ranking Analysis

Structure 2-2 DAFT D Gallery & WSSPS

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Lateral spread towards the Talbert Marsh due to liquefaction	> 1.0	N/A	3	LS	2	1	2	1	1	1	2.0	1.0	1.6	0.4	0.8	0.0	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	0.0
DS Score	0.0
LS Score	6.0

Risk Ranking Analysis

Structure	**2-3 RAS PS East**
Seismic Hazard Level	**BSE 1E**

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	**Description**	**DCR/m (LS)**	**DCR/m (IO)**	**LoSF Score[3]**	**PFM Type[1]**	**Life Safety**	**Primary Treatment**	**Regulatory**	**Stakeholder**	**Financial**	**Public Impacts**	**Life Safety 100.0%**	**Primary Trtmnt 100.0%**	**Regulatory 80.0%**	**Stakeholder 37.5%**	**Financial 80.0%**	**Public Impacts 0.0%**	**CoSF Score**	**RoSF Score**
1	Vertical irregularities in building shear walls	> 1.0	> 1.0	3	GS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	7.2
4	Structural response to differential settlement due to liquefaction	> 1.0	> 1.0	3	DS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	7.2
8	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.3	1.3	3	DS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	7.2

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**7.2**
GS Score	7.2
DS Score	7.2
LS Score	0.0

Risk Ranking Analysis

Structure 2-3 RAS PS East

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%		
1	Vertical irregularities in building shear walls	> 1.0	N/A	3	GS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	7.2
4	Structural response to differential settlement due to liquefaction	> 1.0	N/A	3	DS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	7.2
8	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.4	N/A	4	DS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	9.6

Overall Score	**9.6**
GS Score	7.2
DS Score	9.6
LS Score	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Risk Ranking Analysis

Structure 2-4 RAS PS West

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%		
1	Vertical irregularities in building shear walls	> 1.0	> 1.0	3	GS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	7.2
4	Structure response to differential settlement due to liquefaction	> 1.0	> 1.0	3	DS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	7.2
8	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.3	1.3	3	DS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	7.2

Overall Score	**7.2**
GS Score	7.2
DS Score	7.2
LS Score	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Risk Ranking Analysis

Structure 2-4 RAS PS West

Seismic Hazard Level BSE 2E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%		
1	Vertical irregularities in building shear walls	> 1.0	N/A	3	GS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	7.2
4	Structure response to differential settlement due to liquefaction	> 1.0	N/A	3	DS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	7.2
8	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.4	N/A	4	DS	2	1	3	1	3	1	2.0	1.0	2.4	0.4	2.4	0.0	2.4	9.6

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**9.6**
GS Score	7.2
DS Score	9.6
LS Score	0.0

Risk Ranking Analysis

Structure 2-5 PEPS & MAC

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Flexure in bottom mat due to differential settlement due to liquefaction	2.1	2.9	5	DS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	20.0
5	Flexure in walls due to differential settlement	1.2	1.7	5	DS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	20.0
6	Tension stress in structure slabs due to differential settlement	1.4	2.0	5	DS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	20.0
7	Tension stress in structure walls due to differential settlement	2.2	2.8	5	DS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	20.0
8	Lateral spread towards the Santa Ana River due to liquefaction	> 1.0	> 1.0	4	LS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	16.0
11	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.4	1.4	4	LS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	16.0

Facility Notes:

1 to 9 See General Notes and Legend

Loss of PEPS effluent conduit will result in loss of secondary treatment and result in violation of secondary treatment regulations

Overall Score	**20.0**
GS Score	0.0
DS Score	20.0
LS Score	16.0

Risk Ranking Analysis

Structure 2-5 PEPS & MAC

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Flexure in bottom mat due to differential settlement due to liquefaction	2.1	N/A	5	DS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	20.0
5	Flexure in walls due to differential settlement	1.2	N/A	2	DS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	8.0
6	Tension stress in structure slabs due to differential settlement	1.4	N/A	4	DS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	16.0
7	Tension stress in structure walls due to differential settlement	2.2	N/A	5	DS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	20.0
8	Lateral spread towards the Santa Ana River due to liquefaction	> 1.0	N/A	4	LS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	16.0
11	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.5	N/A	5	LS	2	1	5	1	4	1	2.0	1.0	4.0	0.4	3.2	0.0	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Loss of PEPS effluent conduit will result in loss of secondary treatment and result in violation of secondary treatment regulations

Overall Score	**20.0**
GS Score	0.0
DS Score	20.0
LS Score	20.0

Risk Ranking Analysis

Structure 2-6 Operations Control Center

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Wall anchorage at east and west walls (original building)	4.3	6.5	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
3	Wall anchorage at east and west walls (addition)	4.3	6.5	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
5	Incomplete load path at the south entrance canopy addition of resisting seismic loads	> 1.0	> 1.0	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
6	In-plane shear at shear walls	1.1	1.7	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
7	Drag connection at roof to east and west shear walls	1.7	2.6	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
8	Precast wall panel connection to foundation walls	3.1	4.7	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
9	Structure response to differential settlement due to liquefaction	> 1.0	> 1.0	3	DS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	12.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	20.0
DS Score	12.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-6 Operations Control Center

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Wall anchorage at east and west walls (original building)	6.5	N/A	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
3	Wall anchorage at east and west walls (addition)	6.5	N/A	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
5	Incomplete load path at the south entrance canopy addition of resisting seismic loads	> 1.0	N/A	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
6	In-plane shear at shear walls	1.7	N/A	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
7	Drag connection at roof to east and west shear walls	2.6	N/A	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
8	Precast wall panel connection to foundation walls	4.7	N/A	5	GS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	20.0
9	Structure response to differential settlement due to liquefaction	> 1.0	N/A	3	DS	4	2	2	1	2	1	4.0	2.0	1.6	0.4	1.6	0.0	4.0	12.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	20.0
DS Score	12.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-7 12kV Service Center

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Wall anchorage to roof at north and south walls	> 1.0	> 1.0	5	GS	2	4	4	3	3	1	2.0	4.0	3.2	1.1	2.4	0.0	4.0	20.0
3	Wall anchorage forces at the north and south walls have no sub-diaphragm or ties	> 1.0	> 1.0	5	GS	2	4	4	3	3	1	2.0	4.0	3.2	1.1	2.4	0.0	4.0	20.0
4	Roof diaphragm shear	1.4	2.2	5	GS	2	4	4	3	3	1	2.0	4.0	3.2	1.1	2.4	0.0	4.0	20.0
5	Shear at frame columns	> 1.0	> 1.0	5	GS	2	4	4	3	3	1	2.0	4.0	3.2	1.1	2.4	0.0	4.0	20.0
7	Structure response to differential settlement due to liquefaction	> 1.0	> 1.0	3	DS	2	4	4	3	3	1	2.0	4.0	3.2	1.1	2.4	0.0	4.0	12.0

Facility Notes:		Overall Score	**20.0**
1 to 9	See General Notes and Legend	GS Score	20.0
	Loss of 12kv Service Center will result in power loss to primary treatment and secondary treatment which can be partially mitigated with standby power (Note: CenGen will likely be out of service, see Structure 2-17)	DS Score	12.0
		LS Score	0.0

Risk Ranking Analysis

Structure	**2-7 12kV Service Center**
Seismic Hazard Level	**BSE 2E**

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%		
1	Wall anchorage to roof at north and south walls	> 1.0	N/A	5	GS	2	4	4	3	3	1	2.0	4.0	3.2	1.1	2.4	0.0	4.0	20.0
3	Wall anchorage forces at the north and south walls have no sub-diaphragm or ties	> 1.0	N/A	5	GS	2	4	4	3	3	1	2.0	4.0	3.2	1.1	2.4	0.0	4.0	20.0
4	Roof diaphragm shear	2.3	N/A	5	GS	2	4	4	3	3	1	2.0	4.0	3.2	1.1	2.4	0.0	4.0	20.0
5	Shear at frame columns	> 1.0	N/A	5	GS	2	4	4	3	3	1	2.0	4.0	3.2	1.1	2.4	0.0	4.0	20.0
7	Structure response to differential settlement due to liquefaction	> 1.0	N/A	3	DS	2	4	4	3	3	1	2.0	4.0	3.2	1.1	2.4	0.0	4.0	12.0

Facility Notes:

1 to 9 See General Notes and Legend

Loss of 12kv Service Center will result in power loss to primary treatment and secondary treatment which can be partially mitigated with standby power (Note: CenGen will likely be out of service, see Structure 2-17)

Overall Score	**20.0**
GS Score	20.0
DS Score	12.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-8 Power Building B

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Roof diaphragm shear	1.0	1.5	5	GS	2	4	4	1	1	1	2.0	4.0	3.2	0.4	0.8	0.0	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	20.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure	2-8 Power Building B
Seismic Hazard Level	BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Roof diaphragm shear	1.6	N/A	5	GS	2	4	4	1	1	1	2.0	4.0	3.2	0.4	0.8	0.0	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	20.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-9 Power Building C

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Incomplete lateral load resisting system in the east-west direction	> 1.0	> 1.0	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0
6	In-plane wall shear at shear walls	1.0	1.5	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0
7	Insufficient separation from adjacent digesters	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
8	Footings move independent of the wall	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
9	Tension failure in the CMU walls due to differential settlement	> 1.0	> 1.0	3	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
10	Lateral spread due to liquefaction	> 1.0	> 1.0	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	6.0
LS Score	6.0

Risk Ranking Analysis

Structure 2-9 Power Building C

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Incomplete lateral load resisting system in the east-west direction	> 1.0	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0
6	In-plane wall shear at shear walls	1.5	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0
7	Insufficient separation from adjacent digesters	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
8	Footings move independent of the wall	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
9	Tension failure in the CMU walls due to differential settlement	> 1.0	N/A	3	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
10	Lateral spread due to liquefaction	> 1.0	N/A	3	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0

	Overall Score	**10.0**
	GS Score	10.0
	DS Score	6.0
	LS Score	6.0

Facility Notes:

1 to 9 See General Notes and Legend

Risk Ranking Analysis

Structure 2-10 Power Building D

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Incomplete load path at the south side of the high roof diaphragm	> 1.0	> 1.0	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0
5	Out-of-plane horizontal bending	> 1.0	> 1.0	2	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	4.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-10 Power Building D

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Incomplete load path at the south side of the high roof diaphragm	> 1.0	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0
5	Out-of-plane horizontal bending	> 1.0	N/A	2	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	4.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-11 City Water Pump Station

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Wall anchorage at north and south walls	0.7	1.1	1	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	2.0
5	Out-of-plane horizontal bending	> 1.0	> 1.0	2	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	4.0
6	Differential settlement due to liquefaction	> 1.0	> 1.0	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**8.0**
GS Score	4.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-11 City Water Pump Station

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Wall anchorage at north and south walls	1.1	N/A	1	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	2.0
5	Out-of-plane horizontal bending	> 1.0	N/A	2	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	4.0
6	Differential settlement due to liquefaction	> 1.0	N/A	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**8.0**
GS Score	4.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-12 12kV Distribution Center B

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
2	Structure response to differential settlement due to liquefaction	> 1.0	> 1.0	3	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
6	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.1	1.1	1	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	2.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	0.0
DS Score	6.0
LS Score	2.0

Risk Ranking Analysis

Structure 2-12 12kV Distribution Center B

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
2	Structure response to differential settlement due to liquefaction	> 1.0	N/A	3	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
6	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.2	N/A	2	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	4.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**6.0**
GS Score	0.0
DS Score	6.0
LS Score	4.0

Risk Ranking Analysis

Structure 2-13 12kV Distribution Center D

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Differential settlement due to liquefaction	> 1.0	> 1.0	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**8.0**
GS Score	0.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-13 12kV Distribution Center D

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Differential settlement due to liquefaction	> 1.0	N/A	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**8.0**
GS Score	0.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-14 Headworks Power Building A

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
3	Building separation allows pounding	25.6	38.4	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0
5	Building response to differential settlement due to liquefaction	> 1.0	> 1.0	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-14 Headworks Power Building A

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
3	Building separation allows pounding	38.4	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0
5	Building response to differential settlement due to liquefaction	> 1.0	N/A	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-15 Headworks Power Building B

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
3	Building separation allows pounding	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
5	Building response to differential settlement due to liquefaction	> 1.0	> 1.0	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**8.0**
GS Score	6.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-15 Headworks Power Building B

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
3	Building separation allows pounding	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
5	Building response to differential settlement due to liquefaction	> 1.0	N/A	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**8.0**
GS Score	6.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-16 Headworks Standby Power Building

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]							
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
3	Building separation allows pounding	> 1.0	> 1.0	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
5	Building response to differential settlement due to liquefaction	> 1.0	> 1.0	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**8.0**
GS Score	6.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-16 Headworks Standby Power Building

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
3	Building separation allows pounding	> 1.0	N/A	3	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
5	Building response to differential settlement due to liquefaction	> 1.0	N/A	4	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	8.0

Facility Notes:

1 to 9 (Not used)

Overall Score	**8.0**
GS Score	6.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-17 Central Power Generation Building

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Discontinuous shear walls along grid line B (mezzanine)	> 1.0	> 1.0	3	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	12.0
2	Wall anchorage at the north and south walls	9.7	14.5	5	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	20.0
4	Steel mezzanine at EL 21 lacks bracing	> 1.0	> 1.0	2	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	8.0
5	In-plane shear in shear walls at shear walls in the east-west direction	0.8	1.2	2	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	8.0
6	Roof diaphragm shear transfer	1.7	1.7	5	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	20.0
7	Roof diaphragm shear	2.3	3.7	5	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	20.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-17 Central Power Generation Building

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Discontinuous shear walls along grid line B (mezzanine)	> 1.0	N/A	3	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	12.0
2	Wall anchorage at the north and south walls	14.5	N/A	5	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	20.0
4	Mezzanine at EL 21 lacks bracing	> 1.0	N/A	2	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	8.0
5	In-plane shear in shear walls at shear walls in the east-west direction	1.2	N/A	2	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	8.0
6	Roof diaphragm shear transfer	2.8	N/A	5	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	20.0
7	Roof diaphragm shear	3.8	N/A	5	GS	3	1	1	1	5	1	3.0	1.0	0.8	0.4	4.0	0.0	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**20.0**
GS Score	20.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-18 Aeration Basins A-H

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Top slab flexure due to response to differential settlement	0.9	1.2	2	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	8.0
5	Wall flexure due to response to differential settlement at the interior basin dividing walls and the north and south perimeter walls	1.1	1.4	4	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	16.0
6	Out-of-plane shear response to differential settlement	2.7	2.7	5	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	20.0
7	Tension in top slab rebar due to differential settlement	1.4	2.0	5	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	20.0
8	Tension in interior basin-dividing walls due to differential settlement	1.4	1.8	5	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Loss of Aeration Basins could result in loss of secondary treatment capacity and failure to meet regulatory requirements for more than 6 months.

Overall Score	**20.0**
GS Score	0.0
DS Score	20.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-18 Aeration Basins A-H

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
5	Wall flexure due to response to differential settlement at the interior basin dividing walls and the north and south perimeter walls	1.1	N/A	1	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	4.0
6	Out-of-plane shear response to differential settlement	2.7	N/A	5	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	20.0
7	Tension in top slab rebar due to differential settlement	1.4	N/A	4	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	16.0
8	Tension in interior basin-dividing walls due to differential settlement	1.4	N/A	4	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	16.0

Facility Notes:

1 to 9 See General Notes and Legend

Loss of Aeration Basins could result in loss of secondary treatment capacity and failure to meet regulatory requirements for more than 6 months.

Overall Score	**20.0**
GS Score	0.0
DS Score	20.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-19 Gas Holder

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
6	Tank shell overstress due to liquefaction-induced lateral spread and settlements	1.1	1.1	1	DS	2	1	3	1	1	1	2.0	1.0	2.4	0.4	0.8	0.0	2.4	2.4
7	Anchor failure overstress due to liquefaction-induced lateral spread and settlements	1.2	1.2	1	DS	2	1	3	1	1	1	2.0	1.0	2.4	0.4	0.8	0.0	2.4	2.4

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**2.4**
GS Score	0.0
DS Score	2.4
LS Score	0.0

Risk Ranking Analysis

Structure 2-19 Gas Holder

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
6	Tank shell overstress due to liquefaction-induced lateral spread and settlements	1.0	N/A	0	DS	1	1	3	1	1	1	1.0	1.0	2.4	0.4	0.8	0.0	2.4	0.0
7	Anchor failure overstress due to liquefaction-induced lateral spread and settlements	1.0	N/A	0	DS	1	1	3	1	1	1	1.0	1.0	2.4	0.4	0.8	0.0	2.4	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Potential Leakage of digester gas from broken piping can be fixed within 1 month, resulting in regulatory rating of 3

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-20 Secondary Clarifiers A-L

Seismic Hazard Level BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%		
11	Separation across expansion joints due to differential settlements	>1.0	>1.0	3	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	12.0

Facility Notes:

1 to 9 See General Notes and Legend

Loss of Secondary Clarifiers could result in loss of secondary treatment capacity and failure to meet regulatory requirements for more than 6 months.

Overall Score	**12.0**
GS Score	0.0
DS Score	12.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-20 Secondary Clarifiers A-L

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
11	Separation across expansion joints due to differential settlements	>1.0	N/A	2	DS	3	1	5	1	5	1	3.0	1.0	4.0	0.4	4.0	0.0	4.0	8.0

Facility Notes:

1 to 9 See General Notes and Legend

Loss of Secondary Clarifiers could result in loss of secondary treatment capacity and failure to meet regulatory requirements for more than 6 months.

Overall Score	**8.0**
GS Score	0.0
DS Score	8.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-21 DAFT A-C

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
3	Structure response to differential settlement due to liquefaction	> 1.0	> 1.0	5	DS	3	1	3	1	2	1	3.0	1.0	2.4	0.4	1.6	0.0	3.0	15.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**15.0**
GS Score	0.0
DS Score	15.0
LS Score	0.0

Risk Ranking Analysis

Structure	**2-21 DAFT A-C**
Seismic Hazard Level	**BSE 2E**

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	**Description**	**DCR/m (LS)**	**DCR/m (IO)**	**LoSF Score[3]**	**PFM Type[1]**	**Life Safety**	**Primary Treatment**	**Regulatory**	**Stakeholder**	**Financial**	**Public Impacts**	**Life Safety 100.0%**	**Primary Trtmnt 100.0%**	**Regulatory 80.0%**	**Stakeholder 37.5%**	**Financial 80.0%**	**Public Impacts 0.0%**	**CoSF Score**	**RoSF Score**
3	Structure response to differential settlement due to liquefaction	> 1.0	N/A	5	DS	3	1	3	1	2	1	3.0	1.0	2.4	0.4	1.6	0.0	3.0	15.0

Overall Score	**15.0**
GS Score	0.0
DS Score	15.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-22 DAFT D

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
3	Dome-to-wall connection	1.1	1.7	5	GS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.0	3.0	15.0
5	Bottom mat flexure due to response to differential settlement	1.7	2.3	5	DS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.0	3.0	15.0
6	Bottom mat out-of-plane shear due to differential settlement	1.5	2.2	5	DS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.0	3.0	15.0
7	Hoop tension in wall and slab due to differential settlement	2.9	3.8	5	DS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.0	3.0	15.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**15.0**
GS Score	15.0
DS Score	15.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-22 DAFT D

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
3	Dome-to-wall connection	2.3	N/A	5	GS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.0	3.0	15.0
5	Bottom mat flexure due to response to differential settlement	1.7	N/A	5	DS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.0	3.0	15.0
6	Bottom mat out-of-plane shear due to differential settlement	2.2	N/A	5	DS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.0	3.0	15.0
7	Hoop tension in wall and slab due to differential settlement	2.9	N/A	5	DS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.0	3.0	15.0
9	Chord/ring tension in the dome thrust ring	1.8	N/A	5	GS	3	1	3	1	1	1	3.0	1.0	2.4	0.4	0.8	0.0	3.0	15.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**15.0**
GS Score	15.0
DS Score	15.0
LS Score	0.0

Risk Ranking Analysis

Structure	**2-23 Surge Tower #1**
Seismic Hazard Level	**BSE 1E**

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	**Description**	**DCR/m (LS)**	**DCR/m (IO)**	**LoSF Score[3]**	**PFM Type[1]**	**Life Safety**	**Primary Treatment**	**Regulatory**	**Stakeholder**	**Financial**	**Public Impacts**	**Life Safety 100.0%**	**Primary Trtmnt 100.0%**	**Regulatory 80.0%**	**Stakeholder 37.5%**	**Financial 80.0%**	**Public Impacts 0.0%**	**CoSF Score**	**RoSF Score**
9	Permanent displacements due to liquefaction-induced lateral spread and settlements	>1.0	>1.0	3	LS	2	5	5	1	2	1	2.0	5.0	4.0	0.4	1.6	0.0	5.0	15.0
10	Bending/shear failure of piles due to lateral spread (surface PGD = 64-inches)	>1.0	>1.0	5	LS	2	5	5	1	2	1	2.0	5.0	4.0	0.4	1.6	0.0	5.0	25.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**25.0**
GS Score	0.0
DS Score	0.0
LS Score	25.0

Risk Ranking Analysis

Structure	**2-23 Surge Tower #1**
Seismic Hazard Level	**BSE 2E**

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	**Description**	**DCR/m (LS)**	**DCR/m (IO)**	**LoSF Score[3]**	**PFM Type[1]**	**Life Safety**	**Primary Treatment**	**Regulatory**	**Stakeholder**	**Financial**	**Public Impacts**	**Life Safety 100.0%**	**Primary Trtmnt 100.0%**	**Regulatory 80.0%**	**Stakeholder 37.5%**	**Financial 80.0%**	**Public Impacts 0.0%**	**CoSF Score**	**RoSF Score**
10	Bending/shear failure of piles due to lateral spread (surface PGD = 64-inches)	>1.0	N/A	5	LS	2	5	5	1	2	1	2.0	5.0	4.0	0.4	1.6	0.0	5.0	25.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**25.0**
GS Score	0.0
DS Score	0.0
LS Score	25.0

Risk Ranking Analysis

Structure 2-24 Surge Tower #2

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
9	Permanent displacements due to liquefaction-induced lateral spread and settlements	>1.0	>1.0	3	LS	2	5	5	1	2	1	2.0	5.0	4.0	0.4	1.6	0.0	5.0	15.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**15.0**
GS Score	0.0
DS Score	0.0
LS Score	15.0

Risk Ranking Analysis

Structure 2-24 Surge Tower #2

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
	No PFM Found	<1.0	N/A	0	GS	1	5	5	1	2	1	1.0	5.0	4.0	0.4	1.6	0.0	5.0	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-26 Truck Loading

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
	No PFM Found	< 1.0	N/A	0	GS	1	1	1	1	3	1	1.0	1.0	0.8	0.4	2.4	0.0	2.4	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-26 Truck Loading

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
	No PFM Found	N/A	< 1.0	0	GS	1	1	1	1	3	1	1.0	1.0	0.8	0.4	2.4	0.0	2.4	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**0.0**
GS Score	0.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-27 Maintenance Building

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
2	Flexural/axial stress in moment frame columns	4.0	N/A	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.0	5.0	25.0
3	Flexural/axial stress in moment frame beams	6.2	N/A	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.0	5.0	25.0
4	Precast wall cladding interferes with moment frames	> 1.0	N/A	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.0	5.0	25.0
5	Moment frame beam-column connection	2.2	N/A	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.0	5.0	25.0
9	Differential settlement due to liquefaction causes failure of precast concrete wall panels	>1.0	N/A	4	DS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.0	5.0	20.0

Overall Score	**25.0**
GS Score	25.0
DS Score	20.0
LS Score	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Risk Ranking Analysis

Structure 2-27 Maintenance Building

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
2	Flexural/axial stress in moment frame columns	N/A	4.2	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.0	5.0	25.0
3	Flexural/axial stress in moment frame beams	N/A	10.2	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.0	5.0	25.0
4	Precast wall cladding interferes with moment frames	N/A	> 1.0	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.0	5.0	25.0
5	Moment frame beam-column connection	N/A	3.6	5	GS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.0	5.0	25.0
9	Differential settlement due to liquefaction causes failure of precast concrete wall panels	N/A	> 1.0	4	DS	5	1	1	1	1	1	5.0	1.0	0.8	0.4	0.8	0.0	5.0	20.0

Overall Score	**25.0**
GS Score	25.0
DS Score	20.0
LS Score	0.0

Facility Notes:

1 to 9 See General Notes and Legend

Risk Ranking Analysis

Structure 2-28 Boiler Building

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Roof diaphragm shear	1.5	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure 2-28 Boiler Building

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (CP)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
4	Roof diaphragm shear	N/A	1.6	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	0.0
LS Score	0.0

Risk Ranking Analysis

Structure: 2-29 Ocean Outfall Booster Pump Station

Seismic Hazard Level: BSE 1E

PFM	Description	LoSF				CoSF[4-9]						Weighted CoSF[2]						CoSF Score	RoSF Score
		DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%		
1	Wall anchorage at the roof level at the north and south walls	4.8	7.2	5	GS	2	5	5	1	5	1	2.0	5.0	4.0	0.4	4.0	0.0	5.0	25.0
2	Wall anchorage at the roof level at the east, west, and interior wall (grid line G)	10.5	15.8	5	GS	2	5	5	1	5	1	2.0	5.0	4.0	0.4	4.0	0.0	5.0	25.0
5	Roof diaphragm shear	2.2	2.2	5	GS	2	5	5	1	5	1	2.0	5.0	4.0	0.4	4.0	0.0	5.0	25.0
8	Uneven buoyant uplift	> 1.0	> 1.0	4	LS	2	5	5	1	5	1	2.0	5.0	4.0	0.4	4.0	0.0	5.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**25.0**
GS Score	25.0
DS Score	0.0
LS Score	20.0

Risk Ranking Analysis

Structure: 2-29 Ocean Outfall Booster Pump Station

Seismic Hazard Level: BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Wall anchorage at the roof level at the north and south walls	7.2	N/A	5	GS	2	5	5	1	5	1	2.0	5.0	4.0	0.4	4.0	0.0	5.0	25.0
2	Wall anchorage at the roof level at the east, west, and interior wall (grid line G)	15.8	N/A	5	GS	2	5	5	1	5	1	2.0	5.0	4.0	0.4	4.0	0.0	5.0	25.0
5	Roof diaphragm shear	3.6	N/A	5	GS	2	5	5	1	5	1	2.0	5.0	4.0	0.4	4.0	0.0	5.0	25.0
8	Uneven buoyant uplift	> 1.0	N/A	4	LS	2	5	5	1	5	1	2.0	5.0	4.0	0.4	4.0	0.0	5.0	20.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**25.0**
GS Score	25.0
DS Score	0.0
LS Score	20.0

Risk Ranking Analysis

Structure 2-30 12kV Distribution Center A

Seismic Hazard Level BSE 1E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Wall anchorage to roof at north and south walls	0.8	1.2	2	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	4.0
3	Torsional response due to E-W seismic	> 1.0	> 1.0	2	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	4.0
4	Shear at frame columns	1.6	2.4	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0
5	Structure response to differential settlement due to liquefaction	> 1.0	> 1.0	3	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
9	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.1	1.1	1	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	2.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	6.0
LS Score	2.0

Risk Ranking Analysis

Structure 2-30 12kV Distribution Center A

Seismic Hazard Level BSE 2E

		LoSF				CoSF[4-9]						Weighted CoSF[2]							
PFM	Description	DCR/m (LS)	DCR/m (IO)	LoSF Score[3]	PFM Type[1]	Life Safety	Primary Treatment	Regulatory	Stakeholder	Financial	Public Impacts	Life Safety 100.0%	Primary Trtmnt 100.0%	Regulatory 80.0%	Stakeholder 37.5%	Financial 80.0%	Public Impacts 0.0%	CoSF Score	RoSF Score
1	Wall anchorage to roof at north and south walls	1.2	N/A	2	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	4.0
3	Torsional response due to E-W seismic	> 1.0	N/A	2	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	4.0
4	Shear at frame columns	2.4	N/A	5	GS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	10.0
5	Structure response to differential settlement due to liquefaction	> 1.0	N/A	3	DS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	6.0
9	Out-of-plane shear on the buried walls due to liquefied soil conditions	1.2	N/A	2	LS	2	1	1	1	1	1	2.0	1.0	0.8	0.4	0.8	0.0	2.0	4.0

Facility Notes:

1 to 9 See General Notes and Legend

Overall Score	**10.0**
GS Score	10.0
DS Score	6.0
LS Score	4.0